Deloitte.

The State of Digital Adoption in Construction Report 2023

Autodesk

March 2023

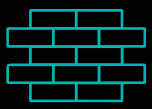
Deloitte Access Economics

Contents

Digital Adoption in Construction at a Glance

Businesses vary in their adoption of select technologies

40%
Use Building Information Modelling



34%
Use prefabrication and modular construction

39%
Use cloud software

33%
Use data analytics

33%
Use mobile apps

Expanding the use of technologies is key to realising the benefits of future growth

Businesses using more digital technologies are:

30% more likely to be optimistic about the future and...

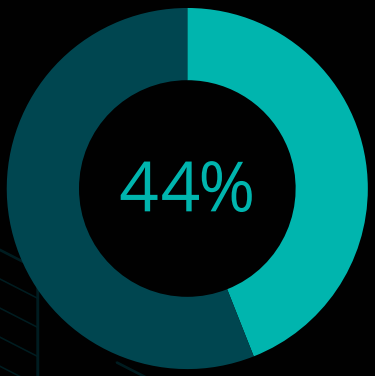
2x as likely to have international operations.

And the use of each additional technology is associated with a

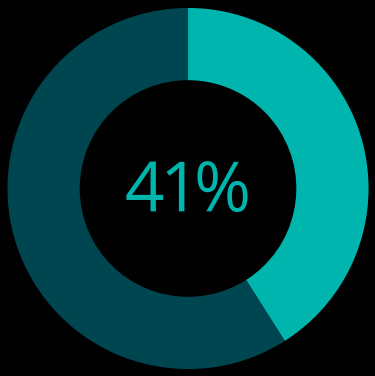
0.58 point

percentage point increase in expected revenue each year for the average business

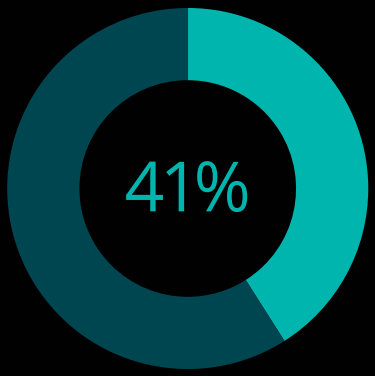
Increasing technology adoption in the industry will require addressing three common barriers to adoption



Have a lack of digital skills among staff



Are uncertain about the required skills



Have a lack of budget allocated

Digital skills training and an organisation-wide strategy can help overcome these barriers

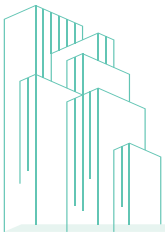
57%

Of businesses with useful digital training have a high impact of digitisation

2x

The amount of investment in new technologies when businesses offer digital training compared to no training provided

Businesses with an organisation-wide strategy are twice as likely to have introduced three or more innovations



Executive summary

The construction and engineering industry is responsible for designing, building and maintaining landmarks around the world. The industry also plays a critical role in the functioning of modern economies by delivering buildings for health care, education, other sectors and other critical infrastructure.

Given the importance of the construction and engineering industry for the functioning of other industries in an economy, Autodesk has commissioned this research to analyse the trends impacting the industry and the level of digital adoption across Australia, Japan and Singapore.

The construction and engineering industry has faced significant challenges over the past three years. This includes widespread COVID lockdowns that shut down worksites and halted investment. Worksites are now open, but businesses have had to deal with supply shortages and rapid rises in material costs, along with significant labour shortages. **The higher costs have resulted in reduced profitability for many businesses in the construction and engineering industry, which could potentially translate to increased business exits.**

While supply challenges persist in many parts of the construction and engineering industry, 2023 adds further challenges with rapidly rising interest rates (to combat global inflation), reducing the pipeline of future work for the construction and engineering industry, at least in the short term.

How do construction and engineering businesses best navigate these challenges of shortages and uncertain demand? By being the best in what they do and being agile to take advantage of opportunities as they arise. But the construction and engineering industry does not have the best track record of driving productivity growth through technology adoption. Annual productivity growth in the global construction industry has only grown at only around 1% per annum over the past two decades. One estimate in Australia has found that low productivity growth has cost the industry and the economy $47 billion over the past 30 years.

Despite the numerous challenges and changing conditions, construction and engineering businesses across Australia, Japan and Singapore have strong confidence in their businesses going forward as supply chain bottlenecks ease. Our survey of 229 construction and engineering businesses across Australia, Japan and Singapore found that while average revenue growth for all businesses surveyed during FY2022 was only 3.8% and expected to be a modest 4% in FY2023, this is expected to increase to 9.9% per year over the next five years.

How can construction and engineering businesses navigate the numerous challenges facing the industry and turn this expectation of high revenue growth into a reality?

One crucial enabling factor will be adopting and successfully implementing technology in business operations. Using new technology to deliver client work was cited by 61% of businesses as a main source of revenue growth after winning more complex and higher value work (66%) and winning work of similar complexity and value to that being done currently (63%). In addition, nearly half (48%) of businesses see new technologies improving internal business processes as a source of growth.

There is a wide variety of technologies that can help businesses deliver work more efficiently, with higher quality and more safety. Cloud construction management software allows employees to simultaneously access and share key documents and design specifications even on the construction site.

Construction wearables, including exoskeletons, are being used to improve employee safety while lifting heavy objects or undertaking repetitive tasks. Data analytics help to present project managers and clients with comprehensive overviews on the progress of a project.

When businesses were asked about the use of 16 different construction technologies, their responses showed varying rates of adoption across the industry. Business Information Modelling (BIM) is being used by 40% of businesses, mainly large and more long-established businesses, while cloud management software is being used by 39% of businesses. These technologies are expected to become more widespread with an additional quarter of businesses looking to adopt these important tools during 2023.

More generally, businesses use an average of five of the 16 technologies. **Only about 10% of businesses surveyed are currently using more than ten different technologies,** suggesting there could be significant opportunities to increase the use of technologies for the majority of construction and engineering businesses.

There are clear benefits for those businesses that are using more technology in their day-to-day operations. The most commonly cited business benefits from introducing technologies were increased productivity (34%), improved customer experience (33%) and increased staff safety (33%). These results suggest that effectively adopting technologies could address some of the biggest issues faced by the construction and engineering industry.

These benefits can lead to improved business performance. Modelling for this report shows that each additional technology adopted by a business within the construction and engineering industry can lead to an average increase of 0.58 percentage points in expected revenue growth per year over five years. For a business with USD $100 million in revenue, the adoption of an additional technology could be worth an additional USD $580,000 per year in additional revenue.

In addition to the increased revenue, there are also substantial cost savings from using technologies, such as cloud management software, in the construction and engineering industry.

As identified in two case studies developed for this report, the use of cloud technology can result in time savings of between 21% and 60% for administrative tasks throughout the project life cycle.

Construction and engineering businesses are recognising the need to increase their use of technology. These intentions are backed by significant investment as well. Nearly nine in ten (89%) of businesses reported investments or purchases of new technology during FY2022. On average, this investment represented 17% of a company's total expenditure, highlighting the importance the industry places on preparing for a more technologically advanced industry.

Realising the benefits requires not only adopting more technology but making sure it is implemented effectively within business processes and operations. In order to do this, businesses must overcome a number of barriers to adoption and implementation. **The most common barrier to adopting digital technology was a lack of digital skills in the workforce** (cited by 44% of businesses), followed by uncertainty about skills and capabilities (41%) and a lack of budget allocated (41%).

In order to address these common barriers and others, this report recommends businesses to focus on progressing these five key priority areas:

Develop an organisation-wide strategy and track progress.
A strategy can be used to set goals for a business to progressively build digital capabilities within specified timelines alongside allocated funding. Businesses with an organisation-wide strategy are twice as likely to have introduced some form of new innovation in their business like a new product or service or changing an internal process in the past twelve months.

Build the motivation for change, backed by a robust change management plan.
Making the most of digital tools requires active acceptance and use by team members. Considering the perspectives of users when assessing potential technologies and articulating the benefits of transformation for all levels are critical to building enthusiasm for introducing new technologies.

Importantly, businesses need to back this up with a solid change management strategy and plan. A well-developed change management plan should include skill development, transition support, clear communications of defined milestones and consistent tracking of success measures.

Develop in-house digital skills.
Attracting and retaining team members with digital skills will be key to unlocking the potential of technology in the construction and engineering industry. Businesses, where staff believe the training is effective are almost three times more likely to report a 'high' or 'very high' impact from digitisation of their business.

Partner with trusted advisers.
Businesses should consider partnering with expert technology providers who play the role of trusted advisers that can support their digital transformation journey. Partnering can assist time-strapped businesses to understand the latest technology trends in a rapidly evolving field. These partners may also provide a broader perspective to digital technology adoption approaches that can address potential business risks and avoid interoperability challenges down the track.

Focus on business outcomes of digital adoption strategies and investments.
Businesses should identify key business outcomes and objectives first and then evaluate how different technology investments can help their organisation attain the desired goals. Identifying these goals - such as improving efficiency, quality and safety - and how they relate to investments will help businesses avoid fixating on bigger and flashier 'toys' or technology. For example, taking advantage of cloud construction management software could deliver tangible benefits in ecosystem relationships, financial health and regulatory compliance of projects. Harnessing analytics and insights in a Common Data Environment not only drives scheduling efficiencies, reduces costly rework but also supports the organisation in meeting sustainability goals.

Taking action efficiently and progressing these priority areas will mean businesses have the potential to realise the numerous benefits that come from more technologically advanced operations. The current macroeconomic challenges provide a strong incentive to move to more efficient processes across the construction and engineering industry, driven by technology adoption.

1. Economic outlook of construction and engineering industry

The construction and engineering industry generates significant economic activity and employment. In 2020, it was estimated that construction-related spending across the world accounts for 13% of global Gross Domestic Product (GDP) and the industry employs 7% of the world's population.[1]

In addition to the significant economic activity generated directly by the construction and engineering industry, most other industries and citizens rely on the buildings, structures and infrastructure designed and created by the construction and engineering industry to operate and live their everyday lives.

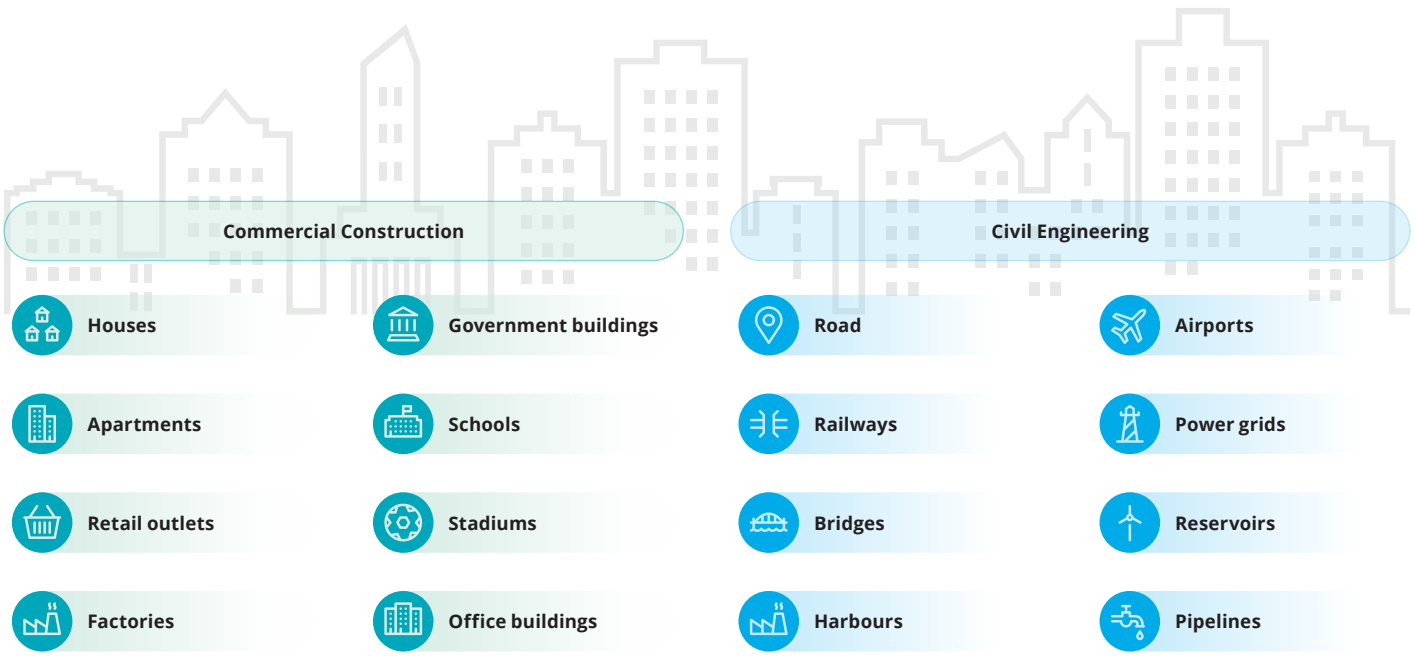
Health care systems could not function without well-constructed and designed hospitals and it is hard to imagine a functioning education system without schools, vocational education and university facilities. In addition, much of the physical infrastructure leading to productivity improvements such as roads, airports and seaports come from services provided by the construction and engineering industry.

The construction and engineering industry is also responsible for designing and building houses and dwellings for citizens of a nation, which is not only a source of shelter but also usually an individual's largest financial asset.

The industry is associated with a wide range of activities. Often the construction and engineering industry is associated with the design, building, restoration, demolition, renovation and maintenance of buildings, infrastructure and other land features.

The industry can be divided into two further sub-industries based on the purpose and the scale of the building or infrastructure as shown in Figure 1.1.

Figure 1.1: The sub-industries of the construction and engineering industry



Source: Deloitte Access Economics (2022)

Given the importance of the construction and engineering industry to a country's prosperity, Autodesk has commissioned this research to analyse the trends impacting businesses within the industry and the level of digital adoption across Australia, Japan and Singapore.

To inform this analysis, Deloitte Access Economics fielded and analysed a survey of 229 businesses within the construction and engineering industry to understand trends and levels of digital adoption, developed three case studies of businesses to understand their digital adoption journey and conducted extensive desktop research on the industry in each of the three markets.

Further details about the methodology and characteristics of survey respondents are available in Appendix A.

1.1. The construction and engineering industry in Australia, Japan and Singapore

The construction industry is well developed in Australia, Japan and Singapore with 855,000 businesses across all three countries and employed more than 5.3 million people in 2021 (see Table 1.1).

At the country level, Japan's construction industry is the third largest globally and the country is home to 15 out of the 100 largest construction companies in the world.[2] Construction is the fourth largest industry (out of 18) in Australia as measured by GVA.[3] As a result of its small island geography, the construction industry in Singapore is much smaller in absolute size compared with Australia and Japan, but does have a higher share of the workforce involved in construction. Despite the smaller size, the infrastructure quality in Singapore is considered to be a global leader, demonstrating the quality of the industry.[4]

While similarly specific information is not available on the number of employees and businesses for architects and engineers in all three countries, there is evidence to suggest these professions are an important component of the industry. In addition to the 1.2 million people employed in construction in Australia, there are 586,000 architects and engineers employed and 75,000 architecture or engineering businesses operating in FY2022.[5]

Considering the economic significance of the construction and engineering industry in these markets, understanding the trends impacting businesses within the industry could have a significant impact on the economic performance of these economies and future prosperity.

1.2. Outlook for the construction and engineering industry

The construction and engineering industry, like many other parts of the economy, experienced significant disruption during COVID-19. Physical restrictions meant that many construction sites were closed or had limited operating capacity. As the construction industry is highly capital intensive, the pipeline of work for the construction and engineering industry is sensitive to economic downturns, resulting in significant disruption for the industry.

During 2019-20 with the arrival of the pandemic, over 1,400 construction businesses registered for insolvency in Australia. This was the second highest number of insolvencies by industry in the financial year after businesses classified within Other Services. Construction businesses made up one-in-five of all business insolvencies during 2019-20. Even now, the Australian construction industry industry is over represented in insolvency figures with the latest data available indicating that construction businesses account for 28% of all insolvencies. The same pattern was observed in Singapore. At the height of the pandemic in 2019, around 2,300 construction businesses ceased operations in Singapore, 6.3% higher than in 2018 and 2.3% higher than in 2017. The construction industry's share of nominal gross domestic product also dropped to 2.7% in 2020 from 3.7% in 2019. In Japan, 607 cases of COVID-19 related bankruptcies have been recorded in the construction industry as of January 2023, the second highest out of all the industries.[6]

The repercussions of COVID-19 on the industry are still being felt by businesses. For instance, over half of businesses cite economic uncertainty as one of the key challenges they are currently facing. The **cost of raw materials, lack of workers with suitable skills and higher labour costs were the other three most common challenges cited by businesses.** In fact, 61% of businesses reported that rising material and labour costs were having a significant impact on the financial viability of their business. The majority of these challenges stem from supply chain disruptions causing higher raw material costs as well as restrictions on the physical movement of people, exacerbating skills shortages.[7] In Australia, the input prices for the housing construction industry rose by 14.2% between December 2021 and December 2022.[8] Meanwhile, in Japan during the same period, the price of metal products increased by 12.8% respectively.[9] In Singapore, the price of iron and steel has increased by 19%, while the price of cork and wood has increased by 18.7% between 2021 and 2022.[10]

Yet some issues facing the industry have been long-standing. The construction industry has been identified as a laggard in terms of long-term productivity growth. For example, the Australian annual labour productivity growth for construction businesses between 1989 and 2021 averaged only 0.5%, while the equivalent rate for

the entire economy was 1.8%. Globally, productivity growth in construction has only averaged 1% per year.[11]

This low productivity growth has a substantial cost to the construction and engineering industry and the broader economy. The Australian Constructors Association has estimated that this lower productivity growth has resulted in a $47 billion (AUD) cost in the past 30 years to 2021.[12]

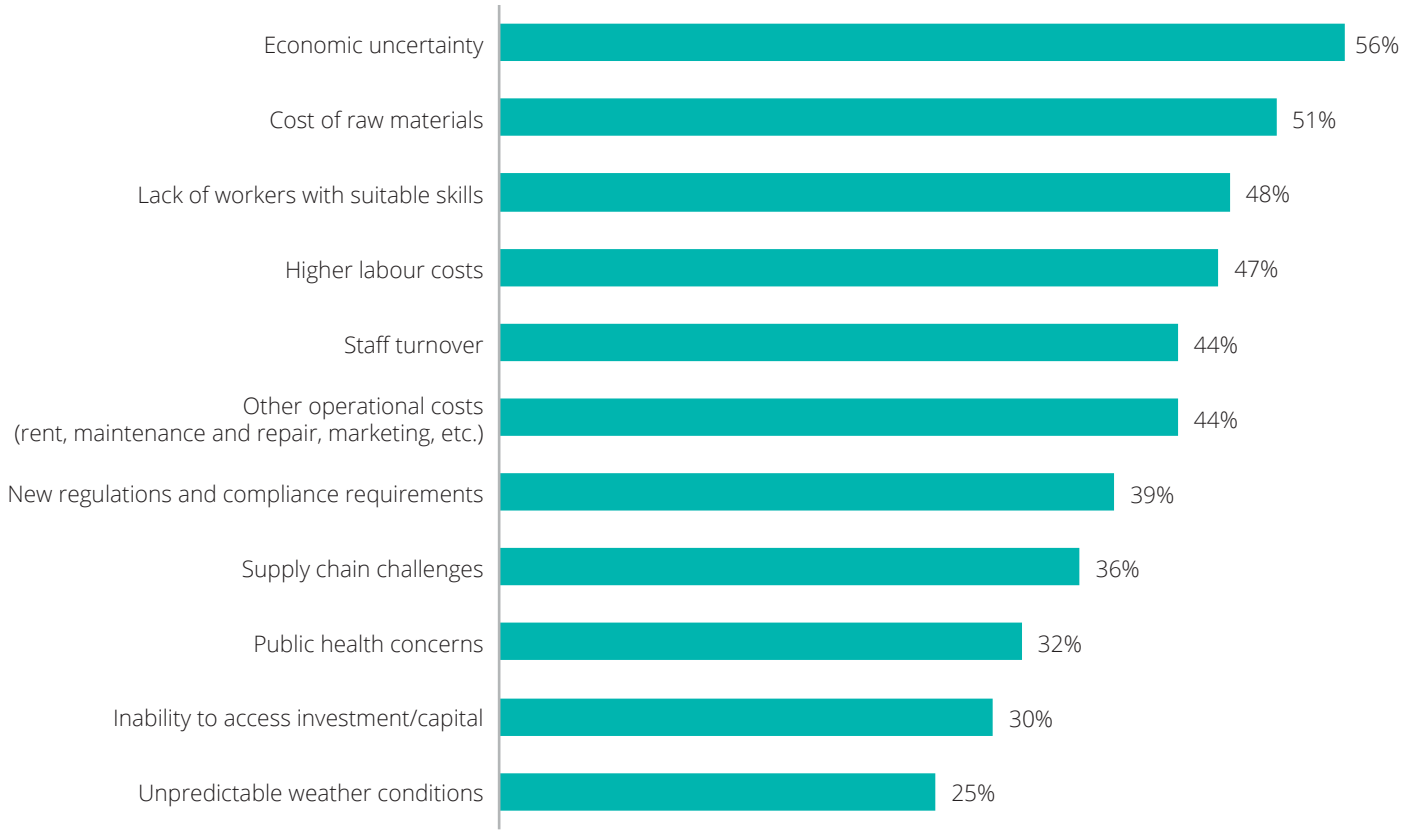
At the same time, businesses are navigating numerous trends changing the face of the industry. The most impactful trends reported by businesses are changing customer demands, cited by 62% of businesses (see Chart 1.2). For example, sustainable building designs and materials have been driven primarily by client and market demand.[13]

Table 1.1: Summary of construction industries in Australia, Japan and Singapore

	Australia	Japan	Singapore
Total employees	1,167,000	3,765,000	408,200
Share of total employed persons	8.9%	6.1%	11.2%
No. of businesses	411,801	483,653	33,461

Source: Deloitte Access Economics based on Australian Bureau of Statistics,[14] Statistics Bureau of Japan,[15] Singapore Department of Statistics[16] and Dun and Bradstreet.[17]

Chart 1.1: Main challenges for businesses



Source: Deloitte Access Economics based on construction and engineering business survey (2022)

Sample: 229

Chart 1.2: Trends impacting businesses

Source: Deloitte Access Economics based on construction and engineering business survey (2022). Blue bars indicate the options directly related to adoption of digital technologies.

Sample: 229

Technology and digital trends feature strongly among the most impactful trends for the construction and engineering industry. About 54% and 48% of businesses respectively agreed that changing technologies and software interoperability are impactful to their business operations. Changing technologies is a more relevant trend to Singaporean and Australian businesses, with 68% and 58% of businesses respectively citing this as a major trend affecting their operations, compared to 37% of Japanese businesses.

Despite challenges and changes within the industry, our survey found the construction and engineering industry is optimistic about future growth. Net optimism, as measured by removing those reporting to be pessimistic from those reporting optimistic, for all businesses stands at 26%.

The majority of Singaporean construction and engineering businesses express confidence about their business conditions over the next 12 months, with 69% feeling optimistic or highly optimistic. In Australia, a similar degree of optimism is felt in the construction and engineering space, where more than half (51%) of businesses reported feeling optimistic or highly optimistic about their future prospects. Japanese construction and engineering businesses, however, felt much less secure about their prospects over the next 12 months, with only 22% feeling optimistic or highly optimistic.

This variation in outlook may be a result of Japan relaxing COVID restrictions later than Singapore and Australia, resulting in delays for the pipeline of work to recover, combined with a depreciating Japanese Yen that exacerbated rising material costs.

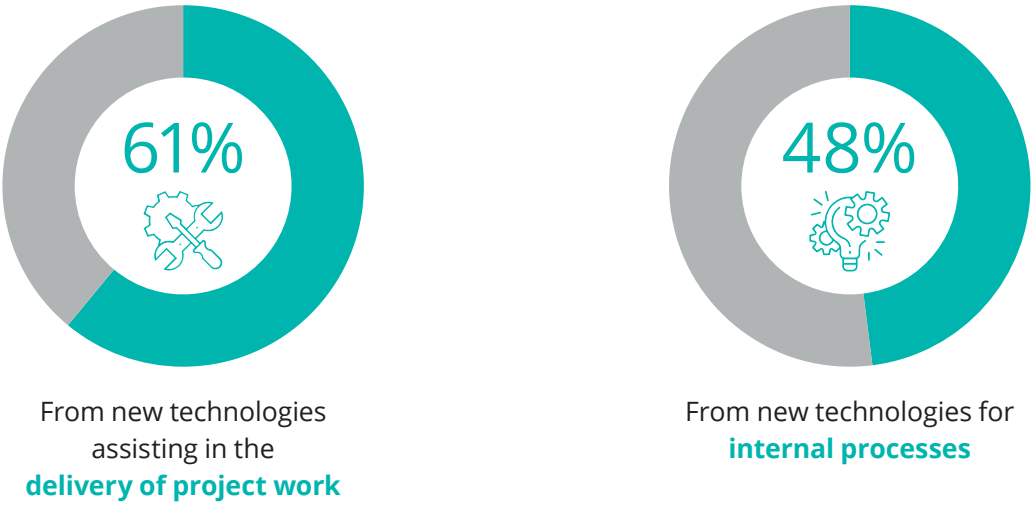
This optimism has translated into expectation of revenue growth among many construction and engineering businesses. While revenue increased by 3.8% for average surveyed businesses between FY2021 and FY2022, this is expected to increase to 4.0% over the next financial year (FY2023). In fact, 60% of businesses expected positive revenue growth over the current financial year.

This recovery is expected to gather pace as the average surveyed business anticipated revenue growth of 9.9% per year over the next five years out to FY2027.

Achieving this scale of growth would be no small feat. According to the International Monetary Fund (IMF), the outlook for economic growth is expected to range between 1.9% and 2.3% for Australia, 0.5% and 1.6% for Japan and 2.3% and 2.7% for Singapore, over the next five years.[18] In Australia and Singapore, the construction industry's growth lagged the overall economy from 2009-2019, with the industry growing at 2.0% annually in Australia and 3.3% in Singapore, compared to overall growth of 2.6% and 4.9% respectively.[19,20] There is some cause for optimism in Japan, with construction growing more quickly than the overall economy between 2010 and 2019.[21] This suggests that achieving the anticipated revenue growth will require significant action by businesses to realise their expectations.

The effective adoption and use of new digital technology will play a crucial role in realising this revenue growth, and for business survival. Using new technologies to assist with project delivery is the third common source of growth as selected by 61% of businesses. In addition, almost half (48%) of surveyed businesses realised the potential of using new technologies for internal processes (such as e-invoicing) to support growth in the business. This suggests that adopting and maximising value from investments in digital technology will be important to support growth in construction and engineering businesses.

Figure 1.2: New technology as a source of business growth



Source: Deloitte Access Economics based on construction and engineering business survey (2022).
Sample: 132

2. Accelerating technology use in the construction and engineering industry

New disruptive technologies are impacting every industry of the economy, changing how businesses plan, organise and deliver their work. The construction and engineering industry is no different, with an array of technologies being recently introduced to the industry.

For example, Luyten, an Australian-based construction business has produced the first building code compliant 3D printed home in the southern hemisphere, with printing completed in two days and assembly in one day.[22]

The Singapore Housing and Development Board (HDB) are using precast technology, which comprises 70% of all structural concrete used during construction.[23] The use of precast materials not only improves the quality and safety of public housing provided by HDB, but also reduces waste and noise at worksites.

Adopting these technologies does not simply mean purchasing the device or having the software installed. Effectively adopting technology often requires changes to the way a business is organised. Using a combination of technologies can lead to rethinking how design and construction takes place. The use of cloud technology along with digital twins has meant that engineering knowledge and requirement can be incorporated into the twin from the start rather than after an architect has designed the building. Large, data-intensive designs can be edited and reviewed by multiple team members at the same time rather than sequentially.

Historically, construction businesses have at times been seen as lagging behind in the adoption of digital technology compared to other industries.[24] Previous research by Deloitte found the construction industry had one of the lowest use of technology, despite the tasks undertaken by the industry having the highest likelihood of automation.[25] While this same observation is not usually made for engineering and architectural businesses, there does seem to be opportunity for increasing use of technology more broadly in these businesses.

Our survey shows significant differences in current use of technology by businesses. When asked about current use of 16 different construction-related technologies, the most used technology was Building Information Modelling (BIM) (being used by 40% of businesses), followed by Construction management cloud software (39%) and drones (37%). Table 2.1 shows current use of the 16 selected technologies by construction and engineering businesses.

Both BIM and the use of construction management cloud software can be seen as important enabling technologies that can unlock the use of other more advanced digital technologies, contributing to their relatively higher use. For example, businesses that used BIM were more than twice as likely to use artificial intelligence and machine learning and augmented and virtual reality, and 80% more likely to use 3D printing and undertaking prefabrication of certain building elements. Other research has confirmed that the adoption of cloud technology is a significant enabler of artificial intelligence and machine learning.[26]

Table 2.1: Technology use by construction and engineering businesses

Technology	Share of businesses currently using
1. Building Information Modelling (BIM)	40%
2. Construction Management Cloud Software	39%
3. Drones	37%
4. Construction Wearables	34%
5. Prefabrication and Modular Construction	34%
6. Data Analytics	33%
7. Mobile Apps	33%
8. Non-Destructive Concrete Testing	32%
9. Sustainable Building Materials	29%
10. Internet of Things and Smart Sensors	28%
11. Digital Twin	28%
12. 3D Printing	27%
13. Robotics and Automated Systems	26%
14. AI and ML	26%
15. Augmented and Virtual Reality	23%
16. Blockchain	21%

Source: Deloitte Access Economics based on construction and engineering business survey (2022).
Sample: 229

More advanced technologies, and those with more specific use cases, were less likely to be in use, with artificial intelligence and machine learning (26%) augmented and virtual reality (23%) and blockchain (21%) seeing half as much use as the most common technologies.

On average, businesses use five of the 16 technologies. Only about 10% of businesses surveyed are currently using more than ten different technologies, suggesting there could be opportunities to increase the use of technologies for the majority of construction and engineering businesses.

When considering businesses with more than 100 employees, Australian and Singaporean businesses used the most technologies at more than six each (6.3 and 6.4, respectively), while Japanese businesses reported an average of 3.6 technologies.[27] However, the relatively small sample size, particularly from Japan and Singapore, means these results should only be seen as indicative as respondents may not be representative of the industry generally within the selected countries. However, this finding does align with existing research suggesting that Japanese businesses have relatively lower levels of digital adoption compared to Australia and Singapore. For example, Japan has fallen to the 28th in the IMD Digital competitiveness ranking in 2021, well behind Singapore (4th) and Australia (14th).[28] This suggests a substantial opportunity for Japanese businesses to increase their use of technologies in construction and engineering.[29]

Larger businesses in the survey used significantly more technologies on average, with businesses that have more than 500 employees using an average of seven different technologies, compared with four technologies for those with fewer than 500 employees.

While there is a large difference in how much technology construction and engineering businesses are currently using, there is widespread intention to adopt more technologies. Mobile apps (39%) were the most commonly planned-for technology, with the internet of things (35%) and data analytics (33%) also commonly identified to be implemented in the future. There is also expected to be higher take-up among commonly used technologies with 26% and 31% of businesses planning to implement BIM and construction management cloud software respectively in the future.

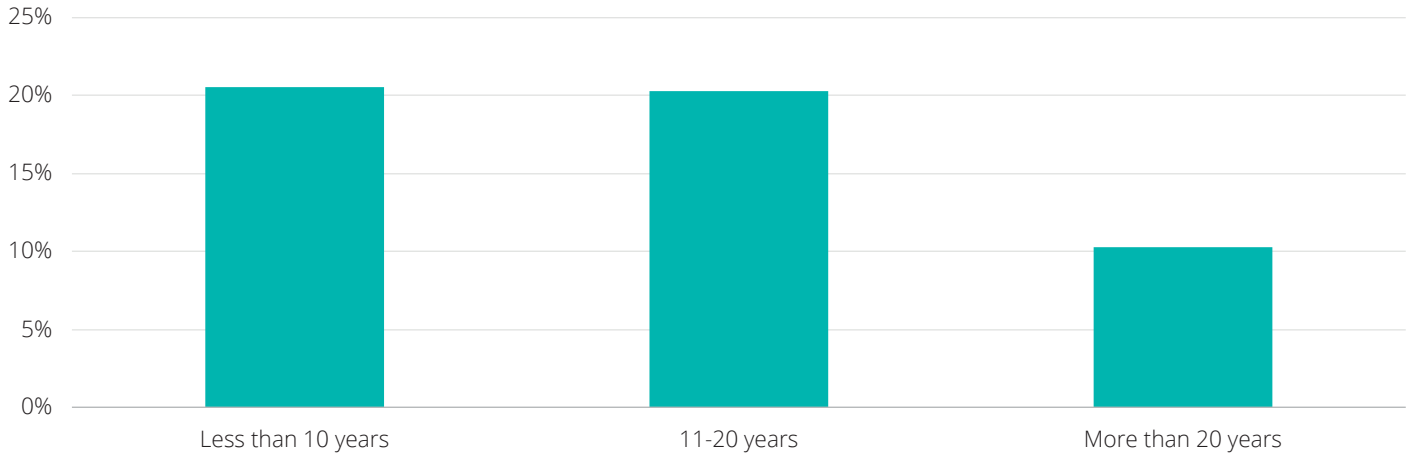
There is also an indication that businesses will introduce more advanced technologies as well. Despite being the third-least currently used technology, 35% of businesses are planning to implement artificial intelligence and machine learning in the future.

These intentions are backed by significant investment. Nearly nine in ten (89%) of businesses reported investments or purchases of new technology during FY2022. On average, this represented 17% of business total expenditure, highlighting the importance the industry places on preparing for a more technologically advanced industry.

Newer businesses are more likely to be investing in new technologies, with businesses less than 10 years old investing 80% more than those in operation for 20 years or more (Chart 2.1). This may reflect the need to invest in more capital equipment as the business grows its operations. The variation in investment could also indicate that more recent start-ups are more innovative.[30] While these businesses may invest more in new technologies, research suggests the financial returns from such investments are polarised - with either very commercially successful impacts or delivering little return, while investment in new technologies undertaken by more established businesses brings more predictable returns.[31]

It is likely that COVID-19 has significantly contributed to this prioritisation of technology, with a survey by McKinsey revealing that over 50% of construction companies have increased investments in digital transformation to meet demands in new business conditions following the onset of the pandemic.[32]

Chart 2.1: Share of expenditure on investments and purchases of new technology, by business age.



Source: Deloitte Access Economics based on construction and engineering business survey (2022).
Sample: 229

Identifying the next digital opportunity at Boustead Projects

Boustead Projects is a leading real estate solutions provider and has constructed and developed more than 3 million square metres of industrial real estate across Singapore, China, Malaysia and Vietnam.

Muhammad Khalil Bin Shaiful Bahari, Deputy Director of the Technology Office at Boustead Projects, recognises that digital technologies have been critical in delivering large scale projects efficiently and sustainably.

Boustead Projects has prioritised embracing digital technology to support their operations for quite some time, while some recent factors such as COVID-19 and supply chain disruptions have fast tracked adoption at Boustead Projects. To ensure their digital adoption is strategic, Boustead Projects has developed a Digital Roadmap for 2022-2023. Muhammad explains that the financial year has been broken down to identify what the types of technologies are being invested and adopted within Boustead Projects, saying that:

For the first half of the year, we are investing in digital twin capabilities, data analytics, consolidated BIM standards and Internet of Things (IoT) devices. In the second half of the year, we are looking to explore clean energy sources and blockchain technology.

The development of a digital roadmap often involves making the decision to invest in one technology over another. When these types of choices are made at Boustead Projects, the cost and making sure the technology is user friendly are key criteria. For example, Boustead Projects is currently focusing on building data analytics platforms that can be used to inform decision making while other technologies and their applications such as Augmented Reality and HoloLens are still being explored. Muhammad notes:

We want to avoid the shiny new toy syndrome, and instead focus on what can have tangible impact for our team and our clients.

One example of technology having an impact has been the use of cloud construction applications. For instance, the use of 360 degree Camera Site Progress Update provides a live platform for tracking and updating construction site progress, replacing more manual updates. Muhammad emphasised the importance of having a unifying platform where data is gathered and processed for the convenience of all stakeholders, explaining that:

Using the cloud means we collaborate and coordinate better with our team and clients onsite or offsite in real time.

The use of the cloud can provide significant benefits in terms of time savings. The use of cloud management software in one project saw nearly a 62% increase in efficiency being realised for administrative tasks being undertaken throughout the project – including design review, document management, submittals, site construction and reports. In total, this equated to a total project saving of $995,000 from using this software.

62%

Efficiency realised

$995,000 **(SGD)**

Total project savings

Listening to current staff members when implementing technology is another crucial element to the successful adoption of digital technology at Boustead Projects. Muhammad explains that being user centric means listening to staff and understanding what problems in the business can be solved with new technology solutions. This is necessary to make sure investments are designed and can be fit for purpose. It also means that the team more quickly adopts and uses any new technology. Boustead Projects also has several incentives for staff to learn more about digital technologies and the skills required for some of the new technology solutions.

Technology transformation is also crucial for talent attraction and retention at Boustead Projects. Labour shortages in Singapore have meant that businesses need to compete for top talent. Muhammad recognises that many young Singaporeans consider construction a physical and repetitive industry. Boustead is looking to reframe how construction is viewed with ongoing digital transformation and data analytics to attract younger employees.

3. Business value from greater technology adoption

Construction and engineering businesses that are successfully adopting and implementing technology are realising the benefits on their business performance. There is significant research suggesting that the use of new technologies is a significant factor in improving business outcomes such as productivity growth.[33,34] The construction and engineering industry is recognising the importance of technology with 60% of businesses agreeing that introducing new technology will be required to remain competitive.

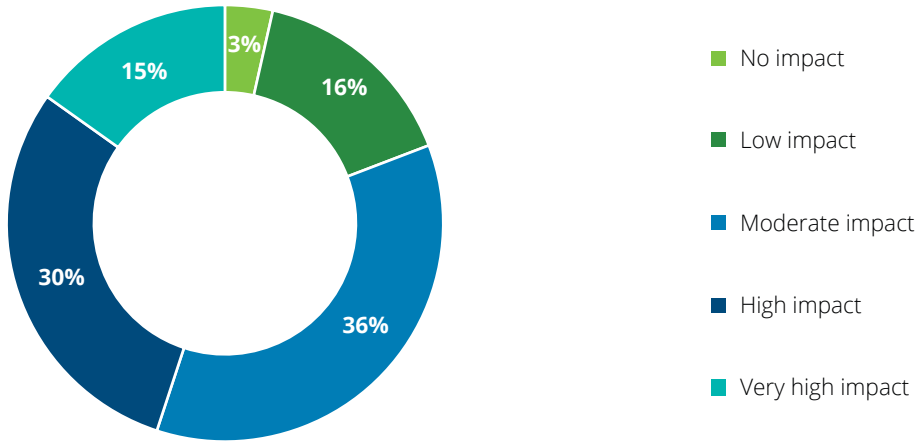
One example is the use of digital twins and drones by Komatsu, a Japanese construction manufacturer, to conduct site surveys. Topographic data of the site is collected with a drone and built into a three-dimensional digital twin. The use of these technologies reduced the time for surveying work which previously took four days to complete, to just 20 minutes.[35]

Another example of on-site technology contributing to improved productivity is the use of 360-degree camera site progress updating, which provides a live platform for tracking and updating construction site progress. This has allowed Boustead Projects, a major property developer, to automate previously manual updates to clients and key stakeholders. This use of digital technology is explored in more detail in the case study on the previous pages.

From a public sector perspective, the Singapore Building and Construction Authority has committed to transforming the construction project life cycle through Integrated Digital Delivery (IDD), which incorporates digital technologies across design, fabrication, and on-site assembly. Businesses applying for Government Land Sales sites and certain funding must provide digital submissions and inspections and collaborative planning tools, enabled by cloud software, BIM, and other technologies. The process has been largely beneficial, with one study indicating participating businesses reported improvements in project costs, quality, and schedule performance of about 5% on average.[36]

Digital technology can contribute at all stages of a project's lifecycle. BIM technology was used for the detailed design of eight stations on Sydney's Metro Northwest project, contributing to winning the ENR Global Best Rail Project in 2020.[37] Members of the project team stated that: "We're resolving issues in minutes that would have been easy to miss in a 2D process. It's going to deliver both cost and time savings during construction, along with maintenance advantages over the life of the asset."[38]

Chart 3.1: Impact from digitisation on business performance

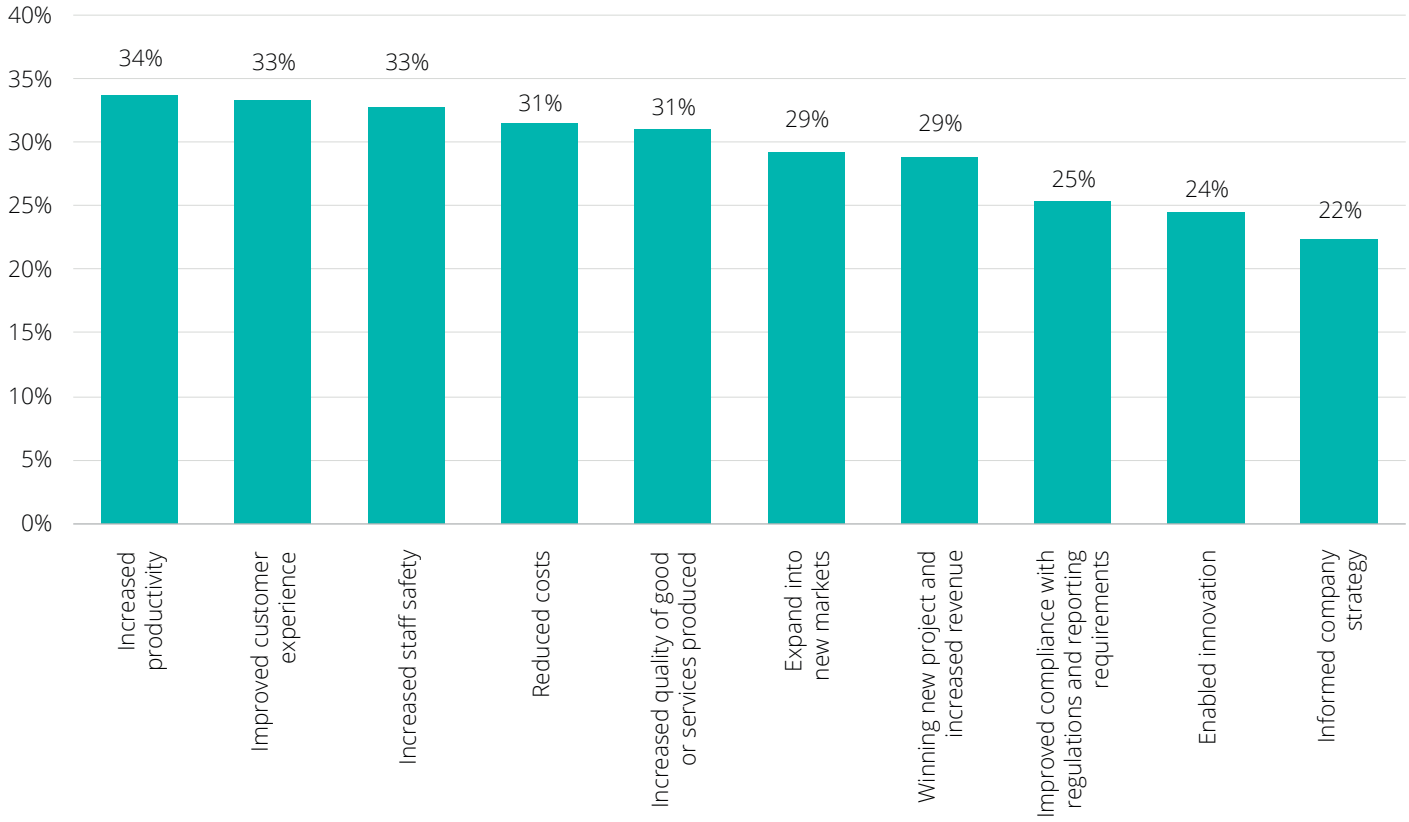


Source: Deloitte Access Economics based on construction and engineering business survey (2022).
Sample: 229

More generally, construction and engineering businesses are recognising the importance of digitisation of business processes. Nearly all businesses (96%) reported digitisation had improved their business performance, with 45% rating the impact as 'high' or 'very high'. Australian and Singaporean businesses in the survey were particularly impacted by digitisation, while Japanese businesses were less impacted, with 12% rating the impact as 'high' and only 2% rating the impact as 'very high'.

Improved productivity was the most commonly cited benefit from introducing new technologies, followed by customer experience, staff safety and cost savings also common benefits experienced by businesses (Chart 3.2). These benefits align closely with the challenges faced by the industry, suggesting that digital technologies are already a key solution to the issues facing the industry. More productive firms with satisfied customers will be better placed to ride out economic uncertainty and handle skills and cost challenges.

Chart 3.2: Types of business benefits realised from introducing technologies



Source: Deloitte Access Economics based on construction and engineering business survey (2022).
Sample: 229

When it comes to increasing staff safety, the use of technology can have a tangible effect. Developments in wearable devices used in construction have offered significant benefits in reducing hazards and behaviours associated with work-related injuries. In Australia, a trial in the use of construction wearables in the form of exoskeletons was found to reduce hazardous movements according to a Deloitte Access Economics report.[39] This can substantially reduce the risk of work-related musculoskeletal disorders, which construction workers are at particular risk of due to repetitive movements and sustained postures in ordinary work activities. These technologies also have the capability of changing attitudes in the workplace which can reduce risky behaviours, with 73% of participants surveyed agreeing they are more aware of safety risks at work after the trial.

Businesses with higher rates of digital adoption are already seeing tangible outcomes for business performance. Businesses in the survey that reported using an above-average number of technologies (six or more) were 30% more likely to be optimistic or highly optimistic (Chart 3.3) about the future. This finding was supported by **economic modelling which found that an additional technology was associated with an average increase of 0.58 percentage points in revenue growth expectations over the next five years.** For a business with USD $100 million in revenue, the adoption of an additional technology could be worth an additional USD $580,000 per year in additional revenue growth.

This result holds after accounting for a business' age, location and size. For example, this model predicts that from the average expected growth rate of 9.9% per year, using an additional technology would increase the growth rate to 10.5% per year over the next five years.

This is supported by other econometric research around the benefits of technology, through the use of data analytics. A survey of over 3,100 organisations across the Asia Pacific, including those in construction, found that businesses with higher data maturity earned 8.7% higher revenue per year.[40]

In addition to the increased revenue, there are also substantial cost savings from using technologies, such as cloud management software, in the construction and engineering industry. As identified in two case studies developed for this report, the use of cloud technology can result in time savings of between 21% and 60% for administrative tasks throughout the project life cycle.

Businesses with an above average level of technology use were also more than twice as likely to have international operations (35% vs 16%), suggesting that the adoption of technologies can improve access to international markets and growth for businesses.

Figure 3.1: Business benefits from using technology

30%

more likely to be optimistic about the future and

2x

as likely to have international operations.

And each additional technology is associated with a

0.58% point

increase in expected revenue growth over 5 years.

Using digital technologies to respond to new opportunities at Beca

Beca is one the largest design and engineering consultancies across Asia Pacific, with 23 offices and over 3,800 team members globally.

Tim Mumford, Business Director of Digital and Innovation and Luke Carvell, Digital and Innovation Leader emphasise the importance of digital technologies to allowing the business to navigate two of the biggest challenges facing the industry: productivity and sustainability.

The construction industry across the globe has been facing declining productivity levels, according to Tim:

We are facing ongoing calls to do more with less. Whether it's less money, less carbon, or less impact. First hand, we've seen digital solutions address these. For instance, maintaining digital data throughout the asset lifecycle has and can lift productivity well beyond the project into operations and maintenance. Our clients have saved money and improved their asset decisions through improved maintenance performance due to the availability of more accurate data generated through delivery. The big challenge for all of us across the industry is to implement these solutions intelligently.

Tim points out that the technology is rarely the bottleneck. Furthermore, it's often the basics behind the technology that elicit the most value. For instance, a Common Data Environment (CDE) is a sharing environment for the project – and a single source of truth. It improves the collection, storage, management and use of data across the project, whether it be project team members, suppliers, clients or others.

Tim recognises the important role that a CDE plays by saying:

A CDE working effectively is equal parts process and technology. Getting both these parts right unlocks a more efficient collaboration between team members, reduces the duplicated effort and potential errors that come from maintaining multiple environments and enables more effective decision making.

Another value-creating focus for Beca in the technology space is interoperability. Similar to CDE, implementation of suitable software, processes, approaches and enterprise systems that improve the 'linkage' between people and their knowledge provides consistency and certainty which enables scalable, integrated project delivery. Luke emphasised value created across Beca by federating information from design environments to create new solutions for our clients.

Luke goes on to say:

We can now, in near real time, link our design choices to potential trade-offs in schedule, capital costs, ongoing costs, carbon, or functionality. Technology and processes underpin the growing complexity of major projects.

Sustainability is another trend transforming the construction industry. Luke explains that:

We produce a capital budget for every project, but we are already being asked to produce a carbon budget for our projects. In 10 years' time, I would expect that most projects will be driven by carbon cost, rather than our capital cost. So we need to be adopting workflows and capable tools as part of our business as usual, to effectively produce this service now.

To deliver on this expectation, Beca is looking at options to develop digital technology for project designs that compiles data on construction and building materials to estimate carbon in real time. Tim believes this will allow customers to understand the changes in carbon footprint that come from certain design features in various designs, empowering them to make informed choices before construction even starts.

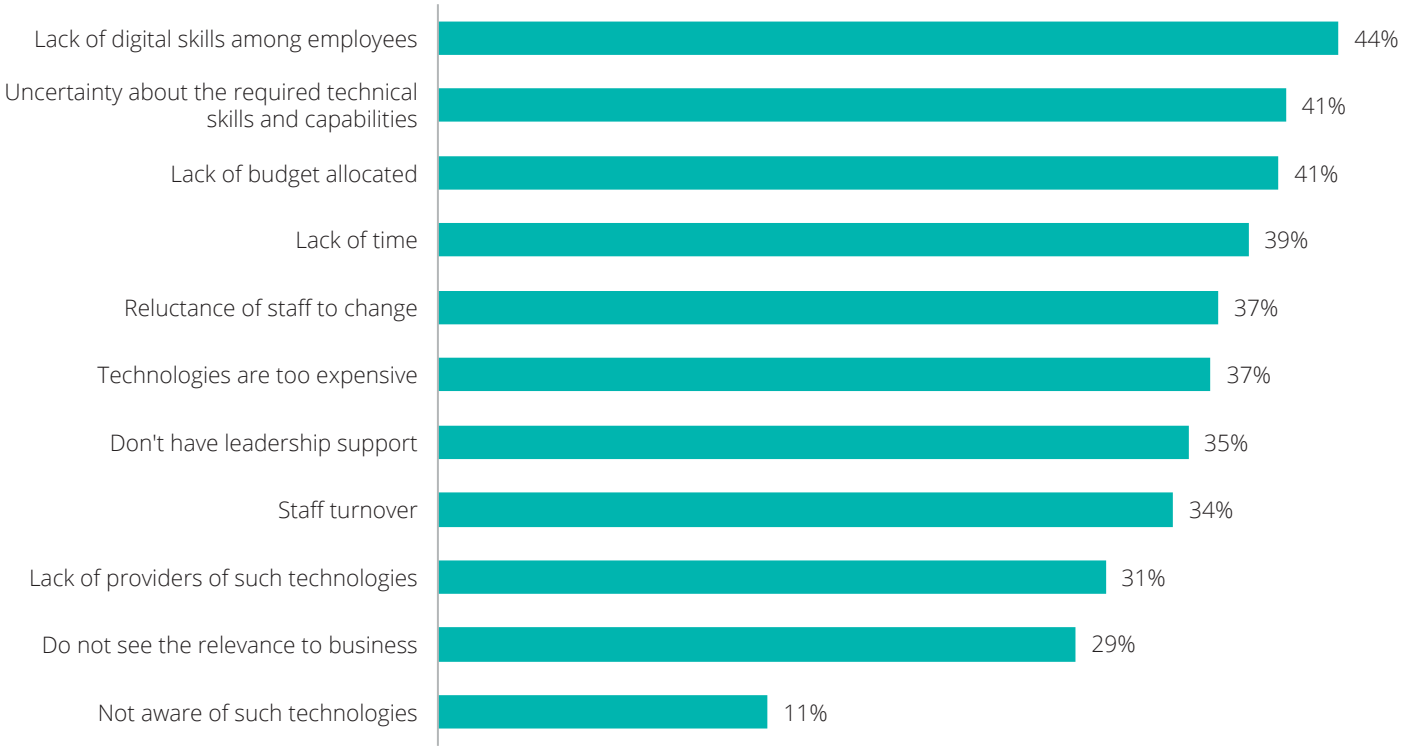

NOK
RBM

4. Key success factors in digital adoption

Realising the potential of technologies in the construction and engineering industry will require overcoming a number of barriers to adoption and successful implementation of the technology. Businesses face several barriers to adopting digital technology, with 95% of businesses reporting at least one barrier to adopting digital technology, and 8 in 10 reporting three or more.

Chart 4.1 indicates **the most common barrier to adopting digital technology was a lack of digital skills in the workforce (cited by 44% of businesses).** This concern is greatest for Singapore, where 55% of businesses reported the skills gap, followed by 43% for Australia.

Chart 4.1: Barriers to digital technology adoption



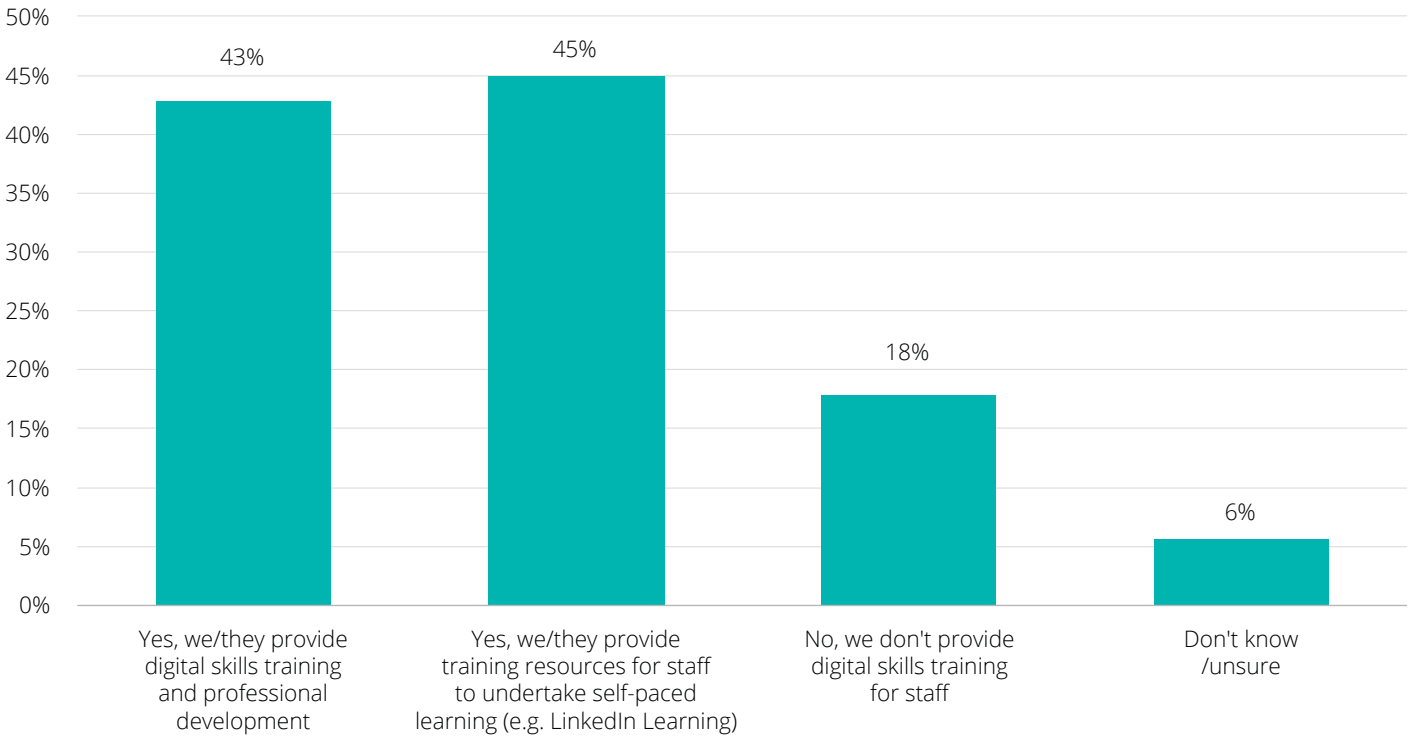
Source: Deloitte Access Economics based on construction and engineering business survey (2022)
Sample: 229

The prevalence of digital skills gaps across both countries and industries has been well documented. The APEC Digital Skills Gap survey found that 75% of businesses identified a significant digital skills gap in their country.[41] This poses a significant challenge for businesses within the construction and engineering industry, as the business must compete with other industries for in-demand digital skills that remain undersupplied.

To address this need for digital skills, construction and engineering businesses can undertake a variety of potential solutions. Some businesses may look to train or reskill existing staff, hire new talent, outsource tasks, or partner with other organisations. Many businesses will undertake a mixture of these approaches. Deloitte's research on business data and analytics capabilities in countries across the Asia-Pacific region found that nearly a quarter of businesses (24%) are looking to outsource digital capabilities to other organisations and the same proportion are looking to buy skills through hiring new talent.[42] While hiring new talent offers an alternative to training, global labour shortages in digital skills may limit the extent to which construction and engineering businesses effectively use this strategy to address skills gaps.

Providing training for existing staff can increase their capabilities to meet the specific digital needs of the business. Our survey found that 90% of businesses already offer digital skills training, most of which provide the training at least once a year. Two of the more common delivery methods for digital training are providing self-paced learning resources (45%) and providing digital skills training directly (43%).

Chart 4.2: Digital training offering



Source: Deloitte Access Economics based on construction and engineering business survey (2022)
Sample: 229

Providing effective training to staff increases the likelihood that digitisation will have a notable impact on business performance. Over half (57%) of businesses with staff that perceive their training as useful also experienced a high or very high impact of digitisation, compared to only 21% of businesses with staff who did not perceive their training as useful.

Training is linked to other positive effects surrounding technology adoption. Businesses that offer training invest much more in new technology, with businesses offering direct training investing 21% of revenue on average in new technology, and businesses offering self-paced training investing 16%, compared to 11% investment by businesses not offering training.

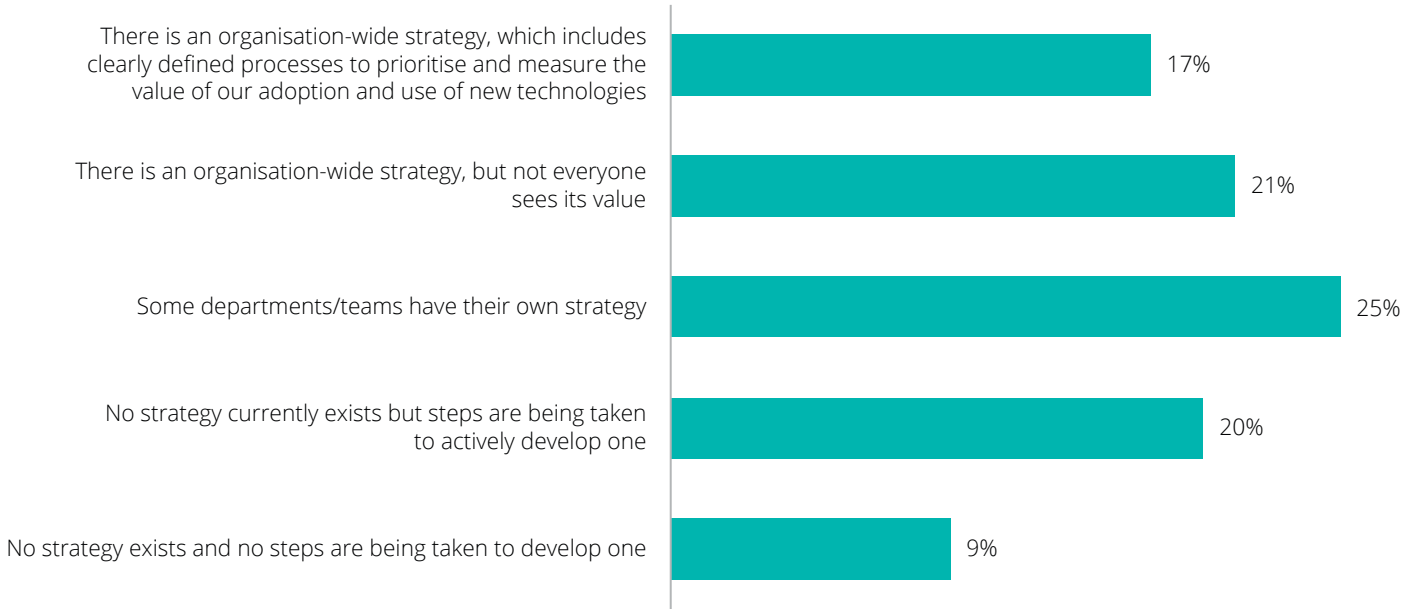
The second most common barrier to digital adoption is uncertainty about the skills and capabilities required for the technology (cited by 41%). This barrier suggests that businesses may not have enough information about various technologies to understand and build their skills and capabilities. While the previous barrier is an issue around the workforce, this is an issue for businesses. In fact, almost 40% of businesses are unaware of at least one of the 16 digital technologies presented in the survey, with 1 in 10 businesses unaware of BIM and construction wearables, and 2 in 10 unaware of digital twin technology.

Businesses can reduce this barrier by developing an awareness of existing technologies and digital trends in other construction and engineering businesses in order to expand digital activity. This may be difficult for smaller businesses that have fewer resources to undertake research into the latest developments in the industry. Gaining an understanding from technical specialists and seeing if support is available from the government could provide assistance to these businesses.

A lack of budget is another barrier holding back construction and engineering businesses from adopting and using technology. In fact, our survey indicatively suggests that for Singapore, the lack of budget (63%) may be the most common barrier to growing digital technology.

A well-developed strategy can help provide direction and readdress budget constraints. The strategy can be used to identify and prioritise investments in technology to achieve the benefits outlined in Chapter 3. A well-developed strategy will also identify and prioritise the required funding for investment in these new technologies. While 63% of businesses have some form of digital strategy, less than 20% have an organisation-wide strategy they find value in, as shown in Chart 4.3 below.

Chart 4.3: Business strategy for adopting new technology for projects



Source: Deloitte Access Economics based on construction and engineering business survey (2022)
Sample: 229

Improving the remit and value of the digital strategy can aid businesses in accessing the benefits of technology. In fact, businesses with a valuable organisation-wide strategy are more likely to perceive a high to very high impact than businesses with a department-level strategy (64% compared to 43%). This may be a result of inefficiencies created by differing departments pursuing and investing in digital technologies that are not interoperable.

An organisation-wide strategy is also linked to a higher likelihood that the business would have introduced some innovation in the last twelve months, such as changing an internal digital process (58%) or introducing a new digital product, service or solution to offer customers (51%). These businesses were twice as likely to have introduced at least three types of innovations to their business than businesses with no strategy.

Finally, investment in new technologies is significantly more likely in businesses with organisation-wide strategies. Almost all businesses with a valuable organisation-wide strategy are currently investing in new technologies (98%), compared to less than half of businesses with no strategy in place (48%).

Addressing these barriers will be important to lifting the adoption of technology within construction and engineering businesses and realising the recovery anticipated by many businesses within the sector. Every day that businesses hesitate is a lost opportunity, and those that do will find it difficult to continue operating in the new normal.

A proactive approach to building technology capacity at Obayashi

Obayashi Corporation is a leading construction and engineering company specialising in infrastructure, high-rise buildings, renewable energy, and other construction-related works. Obayashi operates offices in 16 countries and employs over 15,000 people globally.

Winston Chiew, a Project Manager at Obayashi Singapore, recognises that technology has played a crucial role in navigating the challenging business environment for the firm and unlocking productivity potential within the firm.

Like all businesses within the industry, Obayashi is facing multiple hurdles to overcome. Increasing workplace safety requirements mean that businesses are spending more time are spending more time reviewing safety procedures and documentation. In addition, the rising cost of building materials due to inflation and supply chain instability and rising labour costs are significantly impacting business margins. Winston shares that:

On average, building costs are rising 30% while steel has increased by 60%. The only way for us to survive and stay ahead of the competition is by increasing productivity, and technology has a tremendous role to play in that.

The use of different types of technology has certainly improved productivity at Obayashi. Drones capturing topographic data of a 22-hectare construction site at Mandai in real-time compared to surveyors taking over a week to produce a report, in which time, the topography has already changed. Another example of technology improving business efficiency is through the use of DocuSign – a document signing software to collect approvals online. Winston shares that:

The implementation of cloud technology has saved so much time for our team. Normally, it might take days or even weeks to collect physical approval signatures for certain business decisions such as appointing a subcontractor or supplier. Now this process can be done within minutes.

The use of cloud technology has resulted in significant efficiency gains. During the construction of Keppel Tower, the use of cloud technology saw an overall increase in efficiency in administrative tasks of 21% which equates to $235,400 in total project savings.

21%

Efficiency realised

$235,400 (SGD)

Total project savings

Obayashi Singapore is also looking for the next disruptive technology, exploring technologies that help to measure equipment and machinery productivity in real time. These technologies can be used to track project progress against plans to allow project managers to take action to prevent delays in a project. In a world-first, autonomous tower cranes are also being trialled by Obayashi over the past 2 years with promising signs that these technologies will become a fixture in construction sites of the future.

In order to identify the technologies of the future, Obayashi has taken a proactive approach. Waiting for technology vendors has not worked in such a fast-paced environment. In fact, Winston reveals that:

More than 50% of technologies previously marketed by technology vendors to Obayashi a year ago are now no longer worth implementing. The technologies and our needs change so quickly that we have to be looking at what is around the corner

To get ahead of the curve when it comes to adopting technology, Obayashi operates a number of research facilities across the globe to assist with the development and adoption of technologies for their business, including a facility in Silicon Valley. In addition to ongoing technology research, these centres also form partnerships with local technology start-ups to ensure that Obayashi stays at the forefront of technology.

While being extremely helpful, technology is not seen as the perfect solution at Obayashi. Winston recognises the need to balance the adoption of new technologies with the experience of senior team members. While often more junior staff have the skills to use the technologies, they may not notice the broader requirements or implications of their designs. To address this issue, Winston often organises workshops to give the more digitally capable designers the opportunity to display their works constructed through digital software to senior staff for feedback to take advantage of their expertise and experience. The use of this model also allows senior staff to provide comments and understand the design more quickly, helping to blend the benefits of experience with the efficiency of digital technology.

Priority areas for improving digital adoption

Increasing the digital capabilities of a business may not require significant change to existing operations or extensive funding. Based on our report findings, the below list identifies some priority areas for businesses at different stages of their digital adoption journey.

Develop organisation-wide strategy and track progress
A strategy can be used to set goals for a business to progressively build digital capabilities within specified timelines alongside allocated funding. Collating and prioritising potential use cases in the strategy can make sure investments are made in those technologies or devices with larger returns earlier. The benefits of a strategy come from when it holistically considers the business rather than siloing certain departments which can prevent interoperability of systems and devices and diminish the potential impact.

Build the motivation for change, backed by a robust change management plan.
Making the most of digital tools requires active acceptance and use by team members. Considering the perspectives of users when assessing potential technologies and articulating the benefits of transformation for all levels are critical to building enthusiasm for introducing new technologies. Importantly, businesses need to back this up with a solid change management strategy and plan. A well-developed change management plan should include skills development, transition support, clear communications of defined milestones and consistent tracking of success measures.

Develop in-house digital skills.
Attracting and retaining team members with digital skills will be key to unlocking the potential of technology in the construction and engineering industry. Providing training or resources required to understand and use newly introduced technologies and shorten potential learning curves. Tailoring content to the audience by considering different levels of digital literacy or methods of learning ensures greater understanding from participants.

Partner with trusted advisers.
Businesses should consider partnering with expert technology providers who play the role of trusted advisers that can support their digital transformation journey. Partnering can assist time-strapped businesses to understand the latest technology trends in a rapidly evolving field. These partners may also provide a broader perspective on digital technology adoption approaches that can address potential business risks and avoid interoperability challenges down the track.

Focus on business outcomes of digital adoption strategies and investments.
Businesses should identify key business outcomes and objectives first and then evaluate how different technology investments can help their organisation attain the desired goals. Identifying these goals - such as improving efficiency, quality and safety - and how they relate to investments will help businesses avoid fixating on bigger and flashier 'toys' or technology. For example, taking advantage of cloud construction management software could deliver tangible benefits in ecosystem relationships, financial health and regulatory compliance of projects. Harnessing analytics and insights in a Common Data Environment not only drives scheduling efficiencies, reduces costly rework but also supports the organisation in meeting sustainability goals.

Appendix A: Survey

Data for this project was gathered using an online survey to understand trends affecting the industry, the use of digital technology and barriers and enablers to greater digital technology adoption.

Respondents to the survey were either Chief Executive Officers, Directors, business owners or managers of a construction business with headquarters in Australia, Japan or Singapore.

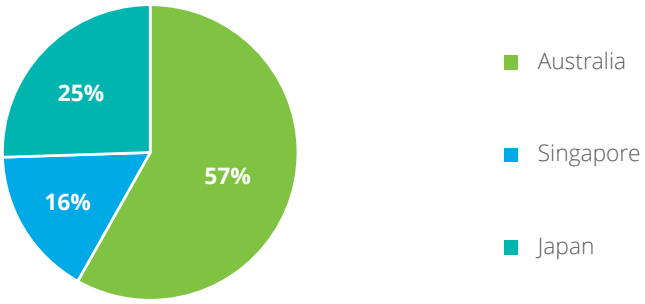
Respondents were provided with a link to the survey through newsletters for construction businesses circulated by Autodesk, through Deloitte's internal network and through Dynata, a survey provider.

A total of 229 businesses were surveyed with some breakdowns of the survey sample available below.

A.1.1. Survey breakdown by location of headquarters

Of the businesses surveyed, 132 had headquarters in Australia (57%), 38 had headquarters in Singapore (16%) and 59 had headquarters in Japan (25%).

Chart A.1.1: Business breakdown by headquarters

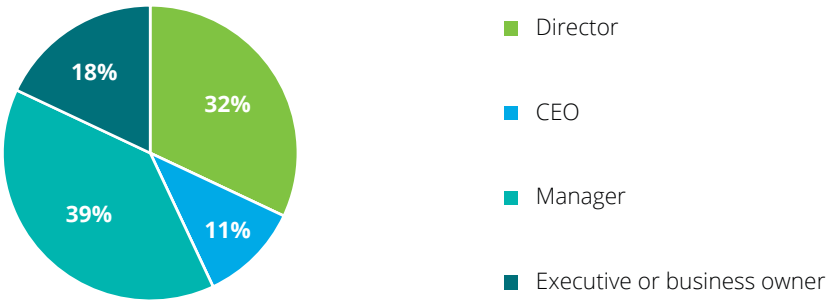


Source: Deloitte Access Economics based on construction and engineering business survey (2022)
Sample: 229

A.1.2. Survey breakdown of occupation

The responders to the survey held the following roles in their businesses: 90 responders were Managers (39%), 73 were Directors (32%), 41 were Executives or Business Owners (18%) and 25 were CEO's (11%).

Chart A.1.2: Business breakdown by headquarters

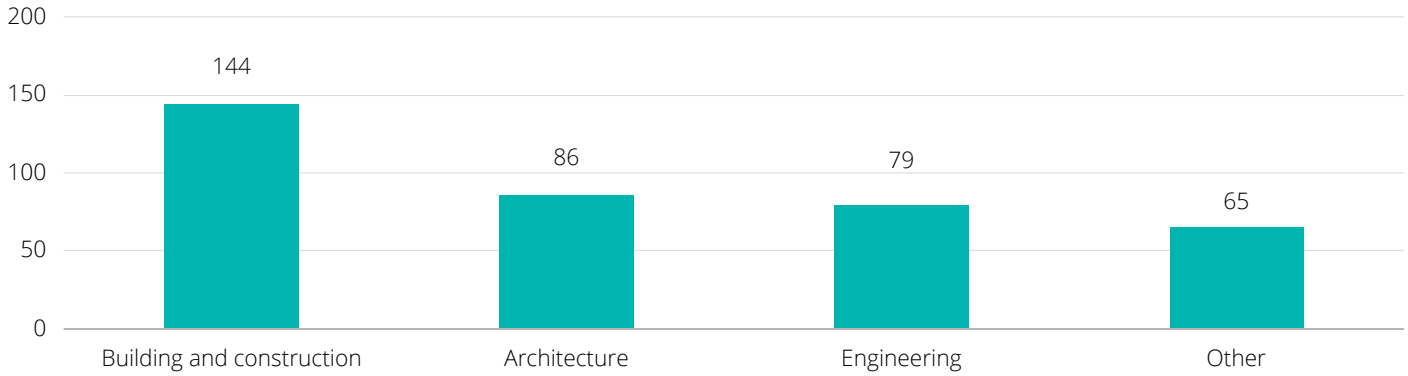


Source: Deloitte Access Economics based on construction and engineering business survey (2022)
Sample: 229

A.1.3. Survey breakdown by construction and engineering services provided

Businesses surveyed provided the following services: 144 businesses provided Building and Construction services (39%), 86 provided Architecture services (23%), 79 provided Engineering services (21%) and 65 provided other services, including Real Estate Development and Specialty Trade (17%). Businesses may provide multiple of these services, with 41% providing at least two services or more.

Chart A.1.3: Business breakdown by construction and engineering services provided



Source: Deloitte Access Economics based on construction and engineering business survey (2022)

Sample: 229

A.1.4. Use of digital technologies

Businesses were asked about the use and intentions to adopt 16 different technologies applicable to the construction and engineering industry. A summary of responses is provided below.

Table A.1.4: Use and intentions of digital technologies responses for all businesses

Digital Technology	Using it already	Not yet, but planning to implement in the future	No and we do not have plans to implement in the future	Not aware of such technology
3D printing	27%	29%	38%	7%
AI and ML	26%	35%	29%	10%
Augmented & Virtual Reality	23%	31%	34%	12%
Blockchain	21%	29%	38%	13%
Building Information Modelling	40%	26%	22%	11%
Concrete non-destructive testing	32%	31%	31%	6%
Construction management cloud software	39%	31%	24%	6%
Construction wearables	34%	30%	25%	11%
Data analytics	33%	33%	26%	7%
Digital twin	28%	26%	28%	18%
Drones	37%	26%	31%	6%
Internet of Things and Smart sensors	28%	35%	27%	9%
Mobile apps	33%	39%	18%	10%
Prefabrication and modular construction	34%	28%	28%	9%
Robotics and Automated systems	26%	30%	36%	8%
Sustainable Building Materials	29%	30%	33%	9%

Source: Deloitte Access Economics based on construction and engineering business survey (2022)

Sample: 229

A.1.5. Barriers, trends, and sources of growth

Businesses were asked about barriers to growing the use of technology, trends impacting their business operation, and main sources of growth for their business. A summary of responses, broken down by location of headquarters is provided below.

Table A.1.5: Barriers, trends and sources of growth responses for all businesses and by country

	All Responses	Australia	Singapore	Japan
Barriers to growing use of technology				
Staff turnover	34%	38%	50%	17%
Reluctance of staff to change	37%	39%	45%	27%
Lack of digital skills among employees	44%	43%	55%	39%
Don't have leadership support	35%	42%	42%	17%
Uncertainty about the required technical skills and capabilities	41%	45%	39%	32%
Do not see the relevance to business	29%	31%	37%	19%
Lack of time	39%	42%	37%	32%
Technologies are too expensive	37%	33%	55%	32%
Lack of budget allocated	41%	43%	63%	20%
Lack of providers of such technologies	31%	37%	37%	12%
Not aware of such technologies	11%	6%	13%	20%
Trends impacting on business operation				
Cyber security	44%	52%	45%	27%
Environmental sustainability	48%	52%	61%	31%
Changing customer demands	62%	67%	79%	41%
Growing competition	60%	56%	76%	58%
Changing technologies	54%	58%	68%	37%
Software interoperability	48%	55%	45%	36%
Flexible work arrangements	46%	50%	61%	27%
Main sources of growth				
Winning more work (similar in size and complexity to the projects currently being won)	63%	62%	52%	74%
Winning more work (that is higher value or more complex than projects currently being won)	66%	68%	84%	53%
New technologies assisting delivery of project work	61%	72%	64%	39%
New technologies for internal processes	48%	52%	60%	34%
Access to new domestic markets	49%	45%	60%	50%
Access to new international markets	30%	29%	52%	18%

Source: Deloitte Access Economics based on construction and engineering business survey (2022)

Sample: 229 for Barriers and Trends, 132 for Sources of Growth

Appendix B: Economic modelling

Methodology

Businesses were asked about their use of 16 digital technologies, and the number of technologies that were indicated in use was counted. The average number of technologies in use was 4.97, with responses covering the whole range from 0 to 16.

An ordinary least squares regression model was used to estimate the association between technology use and expected growth over one- and five-year periods. Results controlled for the business' country, age and size (using the categories for these characteristics from the survey). This ensures that the estimate is not biased by the known correlations between these characteristics and growth expectations. The regression can be summarised by the equation:

$$Growth\ Forecast = \beta_0 + \beta_1 * Number\ of\ Technologies + \alpha * Number\ of\ Employees + \delta * Age\ of\ Business + \gamma * Headquarters\ of\ Business$$

The full regression output is in the table below.

Independent Variable	Dependent Variable					
	1-Year Growth Forecast			5-Year Growth Forecast		
	Estimate	Std. Err	P-Value	Estimate	Std. Err	P-Value
Number of Technologies	0.21	0.22	0.09	0.58	0.24	0.02
Self-employed	-11.81	4.77	0.01	-14.67	5.27	0.01
100-499 employees	-2.84	1.74	0.10	-1.02	1.92	0.59
500-999 employees	-4.16	2.53	0.10	-2.69	2.80	0.34
1,000 employees or more	-1.71	2.71	0.53	-0.39	2.99	0.90
1-3 years of operation	-14.98	11.39	0.19	10.29	12.58	0.41
3-10 years of operation	-13.80	10.84	0.20	11.23	11.97	0.35
10-20 years of operation	-12.59	10.84	0.25	10.21	11.97	0.39
More than 20 years of operation	-10.72	10.84	0.32	9.14	11.97	0.45
Headquarters in Japan	-3.41	2.47	0.17	-0.90	2.72	0.74
Headquarters in Singapore	0.68	2.07	0.74	3.33	2.29	0.15

After controlling for business size, age and location, technology use has a statistically significant, positive relationship with a 5-year growth forecast, but not a 1-year growth forecast. While this should be interpreted with caution and interpreted as a correlation only, otherwise similar businesses that use more technologies forecast a higher level of long-term growth. That this relationship doesn't hold for short-term growth forecast suggests that businesses may see digital technologies as a long-term investment that may not deliver immediate returns. Further, the control variables suggest that it is small (less than 100 employees) and very large businesses that forecast the highest growth.

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