



**How are engineering  
and construction  
companies adapting  
digital to their  
businesses?**



Digital is undoubtedly a hot topic capturing the attention of all stakeholders of engineering and construction (E&C) companies around the world – from the front lines at physical locations, to the C-suite, the board, the suppliers and the customers interacting with the space. In Q4 2017, EY took on two significant initiatives to assess and benchmark how leading C&E companies see the impact of technology in C&E. One was a series of in-person interviews and workshops with more than 80 top players in the industry, which is detailed in the complimentary six-part series that can be found [here](#); the interviews focused on those companies that are well-established in their digital strategy and understanding how they are putting innovation into action. The second initiative, running parallel to the series, was EY Global Construction & Engineering Survey, which helps to study where the industry stands today and also to gauge how the majority views the potential impact of technology in the future. We felt it was important to take a two-pronged approach, to go beyond the usual surveys and allow for free-flowing conversation and ideation. Here, we present the survey findings and relevant market trends.

## About the survey

We surveyed numerous companies along the E&C value chain – general contractors (GCs), infrastructure, building materials, EPC/EPCI (engineering, procurement, construction and installation), designers, homebuilders and developers. Some demographics:

- ▶ Combined revenues total more than US\$500 billion, with varying company sizes represented:
  - ▶ 23% – less than US\$500 million
  - ▶ 23% – US\$500 million to US\$1 billion
  - ▶ 30% – US\$2 billion to US\$5 billion
  - ▶ 12% – US\$6 billion to US\$10 billion
  - ▶ 12% – more than US\$10 billion
- ▶ Headquartered mostly in Europe, North America and Asia-Pacific
  - ▶ 45% operate in more than six countries
  - ▶ 23% in three to six countries
  - ▶ 32% in less than three

*Digital is specific to the objectives of each company.*

The survey focused on the following key areas: **digital strategy and readiness; digital transformation; innovation; digital tools and systems; and cybersecurity.**

With only 25% of respondents reporting a clear strategy and agenda in place and less than 10% confident in how far along they are on the digital readiness spectrum, the findings highlight a clear need in the industry for an immediate call to action. Like any company strategy, digital is specific to the objectives of each company. Unsurprisingly, the survey results reflect the variations in perceptions of what digital means to the future of the industry as a whole, as well as to the companies themselves. While many things are rapidly changing, what industry players promise to clients will likely remain the same – they must deliver projects on time, on budget, safely and at agreed-upon quality.

We asked respondents what issues are keeping them up at night. The top five look similar to what they always have been and tie directly to deliverables:



Source: EY

While technology isn't keeping them up at night, it certainly provides opportunities to manage these issues efficiently and effectively when implemented as part of an overall digital strategy. In this publication, we will further explore how companies believe digitalization could assist them in achieving their strategic objectives.

We would like to thank the hundreds of executives who took the time to complete the survey, to sit through interviews, and to help push the boundaries of what's possible in workshops. Many of your comments and ideas have helped challenge my own views and push me to think of our industry through a different lens. Your willingness to share your strategies (or lack thereof), thoughts and ideas have helped us better understand what's important to you and also how we can help others regardless of where they fall along the digital readiness spectrum. In return, we share the results from your peers and thoughts from academic collaborators, as well as some research on cutting-edge trends and new entrants in the market.

In the words of Leo Quinn, CEO of Balfour Beatty, construction is "the best industry on the planet because it's an industry that bends skylines and empowers communities." I couldn't agree more.

Sincerely,

**Ad Buisman**

*EY Global Construction Leader Partner,  
Real Estate, Hospitality & Construction,  
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# Digital survey results

## Digital strategy and readiness

While technology can certainly assist you in hitting your targets by helping organize processes, integrate systems, allow for better communication, identify efficiencies, boost productivity, cut costs and more, it's not as simple as adopting a basket of one-off technologies and then the problem is solved. To go from current state to totally transformed (no one is there yet), many factors will come into play but, without question, you cannot get there without a well-planned strategy. Of the companies surveyed, 28% of respondents have a digital strategy and agenda in place, while 56% are in the process of designing their strategy and 16% don't believe a strategy is necessary at all.

For those with a plan in place, here are the top five elements clearly enacted in their strategy:

- 1 Organizational structure, tools and processes for collaboration, communication between employees, company culture and workspace design
- 2 A clear vision that brings the company to the next performance level
- 3 A strong purpose that is open for digital innovation and change
- 4 Capabilities enabling the company with adequate technical skills and assets, and the appropriate development model
- 5 New digital product, service and solution innovation

Source: EY

The efficacy of these elements is directly tied to a strong transformational leader who is tasked with all of the above and, most importantly, with creating a strong culture of change.

Although approximately 25% of respondents have a digital strategy and agenda in place, only 9% felt that they fall on the high end of the digital readiness scale, with 63% in the middle and 28% on the lower end. This shows that even for those with a strategy and agenda in place, there is still work to do before they feel truly equipped for a digital future. In reality, there is no end to learning and preparation; all digital strategies must have flexibility incorporated into the design to help ensure their ability to adapt to a rapidly changing future. Essentially there is no "there" to get to – the target continues to move.

While there are differences in opinion as to whether a strategy is necessary, 98% of respondents agree that digital solutions will be critical to the future viability of their company, with 40% feeling that they are somewhat critical and 58% stating that digital solutions are absolutely necessary (only 2% seeing no significant need).

While the vast majority see digital solutions as a necessary part of their overall strategic plans, with some form of a strategy and plan in place, their focus was more on the direct impact transformation will have within their own company and less on the threat posed by competition: 11% felt that competitors further along the digital readiness spectrum posed no additional threat to their business, while 63% felt there would be some impact and only 26% felt the need to take action immediately to combat a potentially significant impact to their business.

**Why is a strategy so important?** To gain a competitive advantage, companies need to build digital into all aspects of their strategic approach. Key questions are: "Is your purpose fit for the digital age?"; "Where to play?"; and "How to win?" Strategic initiatives are prototyped as an engine for your digital transformation. Without having a plan in place, how can you excel and become the disrupter rather than the one who gets disrupted?

*Ninety-eight percent of respondents agree that digital solutions will be critical to the future viability of their company.*

## The power in data

A lot of money and time can be wasted on technology, especially in the form of improper use or underutilization of the tools themselves. An argument can be made that digital tools are just that – tools – and tools don't need strategies. But what often makes them so powerful is the data that they produce and transmit back. Whether from a drone surveying a site, wearables to help monitor safety, RFID chips on equipment or back-office software, you need to understand how to collect, tag, store and use this data or it means very little in the long run. The power in data is the ability to analyze each stream in a meaningful way in relation to all the other available data streams, in order to come to actionable conclusions.

## Digital transformation

The heart of transformation is the biggest challenge for most people – change. As a leader, change and transformation must first take place within. We had a unique opportunity to sit with Jim Lawless, author of *Taming Tigers*, who has defied many odds on his own transformational journey. His thoughts:

“It’s not even transforming to lead by example. It is the level of personal transformation required to do new stuff in order to lead. That is where it goes wrong. E.g., we all have full diaries. Yet to lead transformation requires tasks to be done. These must go into the schedule. But the schedule is full with ‘real’ stuff that keeps the boss happy and (we think) ‘pays the bills.’ Judiciously removing ‘real’ stuff is a massive personal transformation. It is very scary – as we believe it is keeping our position and mortgage safe. However, avoiding this task means that we will not progress.

This is not done to “lead by example” (although it does). It is done to make time to lead, which is a time-intensive activity.

If we want a different result, we need different actions driven by different decisions. That includes the leader.

Digital transformation poses an even greater perceived threat for a few reasons:

1. Technology is always changing – knowing where to start is not obvious, and the learning process never ends.
2. For most people, implementing/using technology requires learning a new set of skills, and the learning curve can be steep.
3. Embracing and implementing technology does not guarantee future success; in fact, most tech professionals and innovators will recommend the “fail fast” model – fail fast, learn, move on.
4. There are no right answers – just educated bets based on calculated risk and perceived rewards.

Once a transformational leader succeeds at creating a culture of change, the next step is to train or hire the right talent to execute the strategy. In an industry that has seen very little change over the past century – many are still paper-driven organizations – it is no wonder that identifying key hires to drive digital transformation can be challenging. We are seeing more leaders from outside of the sector – technology – being brought in to tackle the nuances of digital transformation.

*The heart of transformation is the biggest challenge for most people – change.*

Of the top five general challenges identified, talent and resistance to change (internal and customer buy-in) take four spots:

- 1 Lack of integration between systems
- 2 Lack of trained staff to review, implement and operate digital technologies
- 3 Difficulties obtaining buy in and adoption around technologies
- 4 Mentality of technology not being effective in construction environment
- 5 Clients unwillingness to pay for system implementation or pay associated costs

Source: EY

While talent is one of the greatest challenges, respondents are still putting people in place to tackle the issues that digital and disruption pose to the industry – 58% have someone designated in the role of digital transformation officer to focus at least a portion of their time on digital solutions. And 44% of respondents have gone beyond designating one person and have expanded resources, allocating additional time, money and talent focused exclusively on digital.

*The biggest hurdles hindering their specific transformation effort are all still tied to either buy-in or talent.*

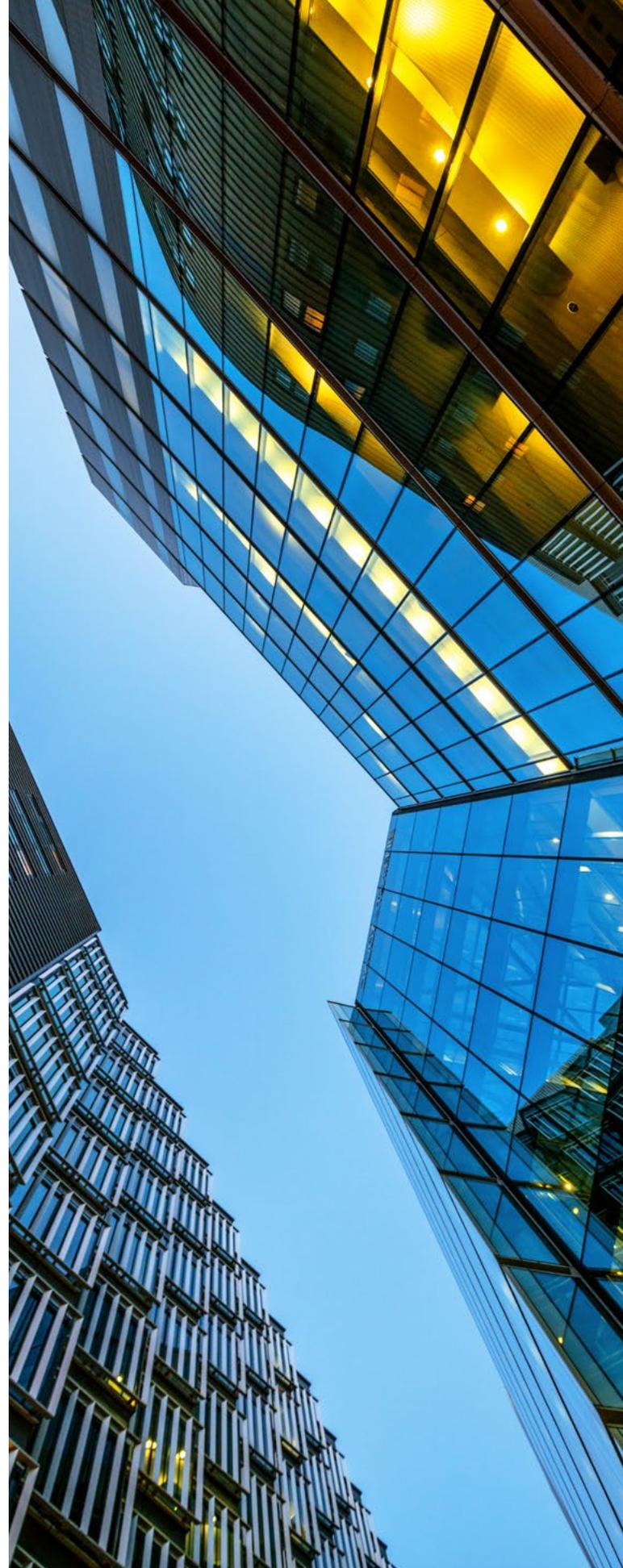
Regardless of investment, the biggest hurdles hindering their specific transformation effort are all still tied to either buy-in or talent:

- 1 Appropriate skills/capabilities
- 2 Resources
- 3 Commitment and sponsorship
- 4 Funding
- 5 Attractiveness of the industry to attract right talent

Source: EY

There are a few ways to fill the gap in talent – buy, build or collaborate. All three can be beneficial strategies to consider when mapping out your digital capabilities and filling gaps where you have need. Our respondents were virtually split down the middle between growing the necessary skills through in-house methods (46%) and acquiring or partnering (54%). Each approach has clear benefits and challenges. Acquiring or partnering allows for rapid uptake of key technologies without having to tackle a steep learning curve; building within allows you to know the work style, ethic and values of key players driving your strategy. Notably, key challenges are that in-house growth can take too much time and there is no guarantee that the necessary skills will be obtained; partnering or acquiring can be challenging because of differing company cultures, values and work styles – often, mergers and acquisitions fail because of culture shock.

**Why is a full transformation recommended?** A full digital transformation is not right for every company. As many of our clients experience, the success of a planned transformation is dynamic and has many moving parts. With a well-planned strategy and an honest assessment of your digital readiness, the areas of critical importance should become apparent. Often, in the beginning stages, the resources needed are nominal, and assessment of critical flaws along value-chain activities can be identified using a small team. As you begin to build the business case for transformation, map out the necessary framework for technology adoption and continue to build out your team, implementing technology becomes more resource-intensive. The benefits of investment can be realized as you move toward a full transformation – where systems are connected seamlessly, necessary information is available to all of your stakeholders, and time is freed up to make decisions critical to future success.

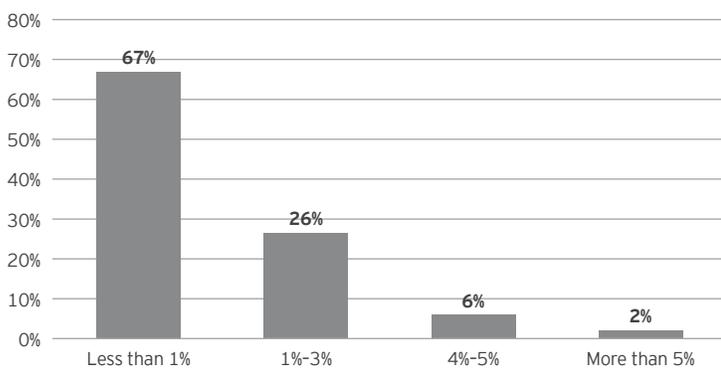


## Innovation

Engineering and construction companies hardly come to mind when you talk about innovation, and, at first glance, our survey results corroborate that story line. While the majority (63%) of survey respondents feel that digital innovation is very likely to be transformative to their business, 67% of respondents are spending less than 1% on research and development in digital as a percentage of turnover. To put this into perspective, of the 2,500 leading companies worldwide, the average investment spend on R&D is 3.8%; the top 10 sectors spend about 6% on R&D.

That is, however, not the full story – many R&D efforts are project-driven and not accounted for as such. Also, while there may not be much investment within the sector, what’s happening behind the scenes from outside the sector is worth looking into a bit deeper. A construction startup recently secured US\$865 million in funding and, while not common, it speaks to how the market views the industry – ripe for disruption. The investment fund backing this startup is also responsible for other remarkable investments around the globe in the mobility space, as well as real estate – in office coworking space – and many other tech-driven business models. Like it or not, digital is the future of all industries, including C&E.

### How much do you spend on R&D in digital as a percentage of turnover?

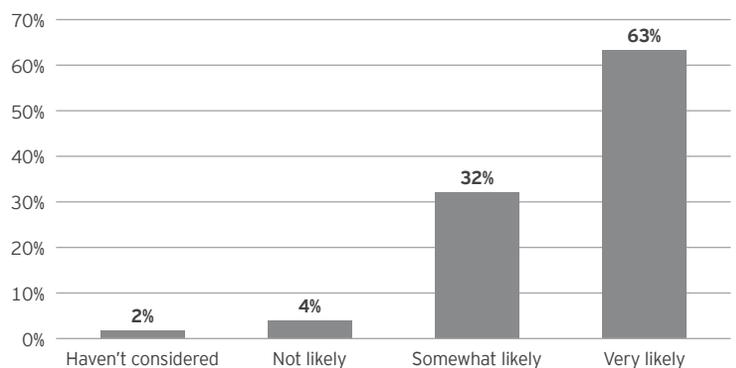


Source: EY

It’s possible that innovation is slow within the sector, given the current feeling around technology and competitive advantage. Only 9% of survey respondents felt that the winners in this industry in the digital age would be the innovators – those first companies to adopt an innovation – while 60% felt that it would be the early adopters that would find the optimal competitive advantage.

While the C&E industry watches and waits, the tech industry will continue to make power moves. Notable tech companies watching and investing in businesses sure to impact C&E are Amazon, Google, Facebook and Elon Musk’s The Boring Company, among others. For example, take Sidewalk Labs, a subsidiary of Google, which is working on a complete urban development project in Toronto. Along with other technologies, it is looking to modular and prefab to offer efficient and cost-effective options for its smart neighborhood concept and is reportedly in talks with a number of companies to build 10,000 units. While modular and prefab methods have been around for decades, recently we are seeing a renewed interest in them for both cost-efficiency and sustainability. For more on modular construction and what leaders in C&E are doing today, see our series “Transformation in C&E: *Modular Construction*.”

### How likely is it that digital innovation will be transformative to your business?



Source: EY

**Sixty-seven percent of respondents are spending less than 1% on R&D in digital as a percentage of turnover.**

## Why should you be focusing on innovation?

While technology often has a shorter life cycle than traditional businesses, recent data from Dr. Andrea Chegut of MIT's Real Estate Innovation Lab (see figure below) shows the innovation life cycle of technology is about 25 years – not exactly too short to be worth it. Looking further at the impact of innovation on companies from all sectors, those willing to invest and be first to market often find themselves with a competitive advantage that is hard for others to replicate. What do most successful innovators do well? They don't stop innovating and are always looking at ways to disrupt themselves.

*What do most successful innovators do well? They don't stop innovating and are always looking at ways to disrupt themselves.*

### A case study on innovation cycles

#### Technology, stages and life cycle of technology

Technologies	Average duration	Life cycle
<b>186</b> new technologies	Innovation trigger <b>3</b> years	<b>25</b> year cycle
4 min      20 max	Peak of inflated expectations <b>2</b> years	<b>10-20</b> new per year
<b>10-20</b> new per year	Trough of disillusionment <b>3</b> years	
	Innovation trigger <b>2</b> years	
	Innovation trigger <b>5</b> years	

Source: The Real Estate Innovation Lab

There are two significant ways that not focusing on innovation can leave you at a competitive disadvantage.

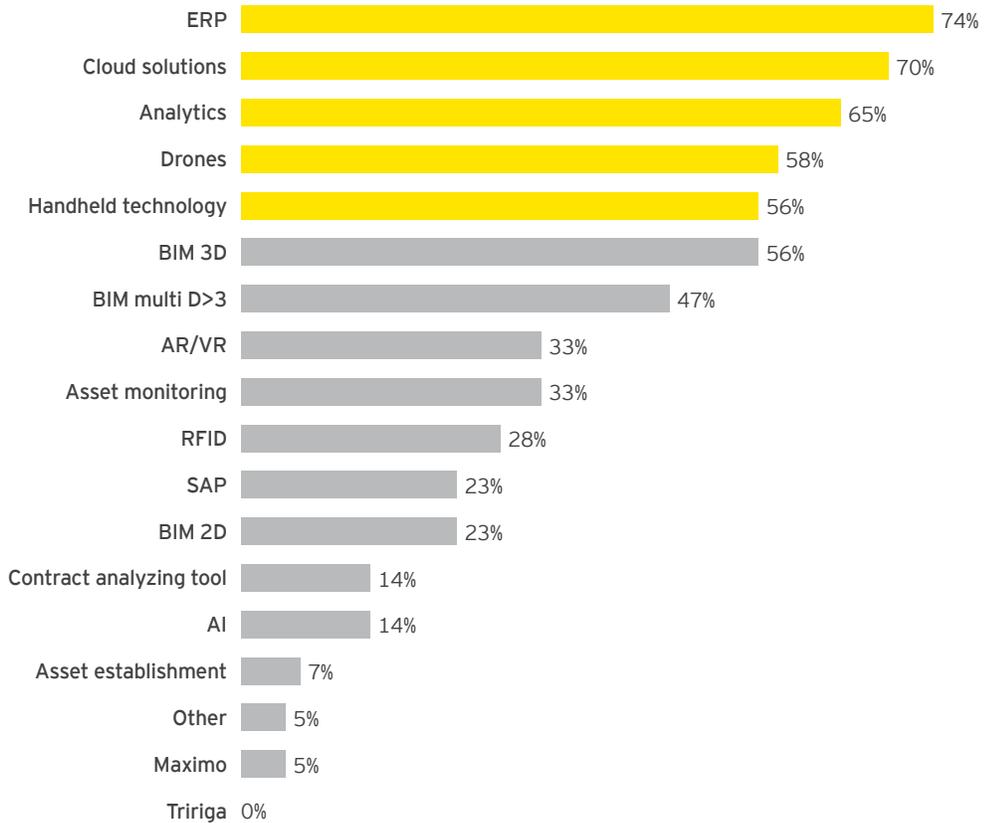
1. You will not see the competition coming until it's too late, leaving you to play catch-up in investment in human capital and also specific technologies just to stay relevant.
2. You miss the unique opportunities available in the C&E sector that still exist today given the slower uptake of technology. While you still are focusing on business models of the past, your competition will be taking advantage of new business models coming available that may render yours obsolete.





## Digital tools and systems

Our survey revealed the following:

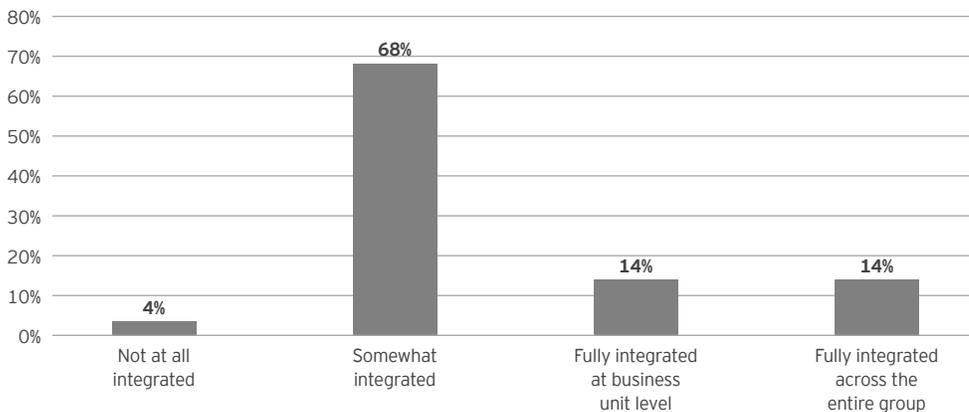


Source: EY

ERP systems (74%) and building information modeling (BIM) 3D and BIM 2D (jointly 79%) are at the top of the league table. This perhaps is not surprising for an industry that has always been said to have a lack of quality data. The industry has a complex process that it has to go through to build a building. It needs access to either 2D or 3D data or both, financial data, corporate data, documents, schedule elements, weather – all this has to be linked, but it seldom is.

Systems integration is therefore key to optimizing available data and setting proper analytics. Having a number of disparate systems often leads to inefficiency through multiple factors – duplication, decision-making based on fragmented and stale information, reduced ability to see the big picture, confusion and chaos due to weak communication channels, and more. Conversely, connectivity and interoperability of systems allow for streamlined processes, often flowing through one communication channel and back to multiple stakeholders to allow for real-time information sharing and producing actionable information for decision-making. Unfortunately, many in C&E are not there yet – only 14% of respondents say that their back-end systems are fully integrated, with 68% of respondents working toward full integration but being only somewhat integrated today. In terms of all areas where C&E companies struggle – time, budget, safety and productivity – the picture becomes clearer as to why; most C&E companies are highly inefficient today.

#### How integrated are your back-end systems?



Source: EY

**Systems integration is key to optimizing available data and setting proper analytics.**

While most are not optimized when it comes to systems integration, those working toward getting there are finding some efficiencies in available tools in the market – whether it be more seasoned technology like BIM, which has been around for

decades, or newer tools like augmented reality (AR) and virtual reality (VR). Cloud solutions, BIM, drones, analytics and handheld technology were the top five most common digital or digitally enhanced technologies and products respondents are using that they feel may add the most value to their growth and profitability strategy. Interestingly, BIM models have the ability to take in data from many new technologies to offer the best picture of a project, but few are optimizing their usage of BIM and realizing the power of combining BIM with synergistic technologies. For more information on the power of BIM and how industry leaders are using this technology to lead in the market, see *Transforming Engineering and Construction: BIM*.

## Why should you start integrating your systems immediately?

Many in the industry are investing in tools and systems to optimize their business and reap the benefits of technology. C&E is a historically low-margin business, and there are material financial and nonfinancial implications to delivering projects late, workers getting injured, errors in materials ordering, clerical errors, wastage and more, but this is not a necessary part of doing business. In fact, according to metrics from an approach being developed and deployed by Ernst & Young LLP partner Mark Gibson, through systems integration and using robotic process automation, in the area of payment processing we are seeing facilities and construction-related invoice processing accuracy jumping from industry lows of around 30% to up to 99.5% and reducing processing time from an average of 60 days to 7. Is it possible to see the day when C&E is a remarkably higher-margin business? Our research says yes, but it takes work and investment to get there.

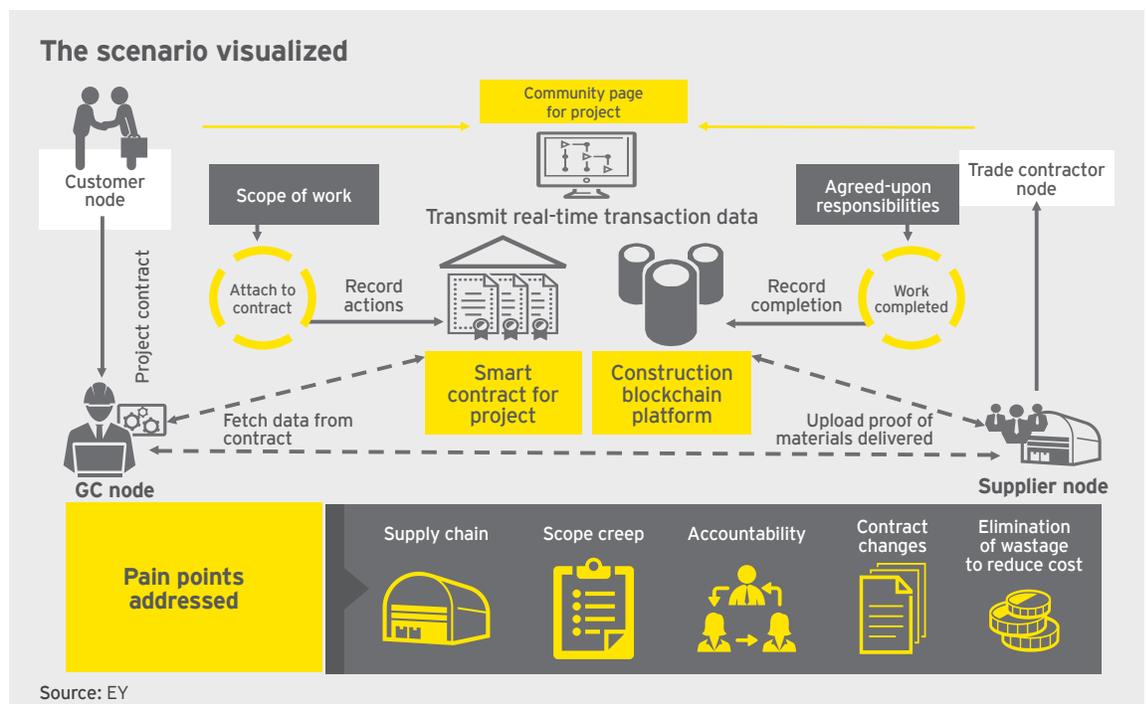


## Blockchain – spotlight on the future

In a very complex industry like the construction industry, integration among the various parties in the chain – often called supply chain management – is a crucial element in achieving efficiency, effectiveness and reliability. Distributed ledger technology, blockchain, could potentially handle all contractual relationships using concepts like smart contracts and electronic verification, authentication, authorization and certification – all features not yet offered by BIM.

*It seems very promising if blockchain and BIM could work in tandem.*

Here, we see a basic diagram of flow between parties:



This is a simplified version – we would need to add multiple contracts, designs, drawings, modeling, architects, engineers, other subcontractors, etc. – but the number of nodes can be expanded to suit the supply chain. Some key advantages of blockchain in construction:

1. Once agreed upon, you cannot go back and amend; rather, you append, and therefore nothing gets lost.
2. A new level of accountability is applied to the project for all parties, including the customer.
3. When working globally, as many large construction companies often do, the buying power of the company is not managed efficiently because of multiple contracts in varying locations. With the blockchain, companies can negotiate from one central place, taking advantage of economies of scale.
4. Changes to scope can be agreed upon by all parties and recorded remotely in one place.
5. The blockchain is hack-resistant in that all parties (nodes) would need to be hacked in order to make a permanent change, and the window of time to hack a node is just minutes.

While we are still exploring and proving use cases, it seems very promising, especially if blockchain and BIM could work in tandem. It is therefore likely that, while blockchain was not mentioned among the top digital solutions companies are considering today, it could be part of basic construction supply chains in the near future.

## Cybersecurity – managing risk you can't see

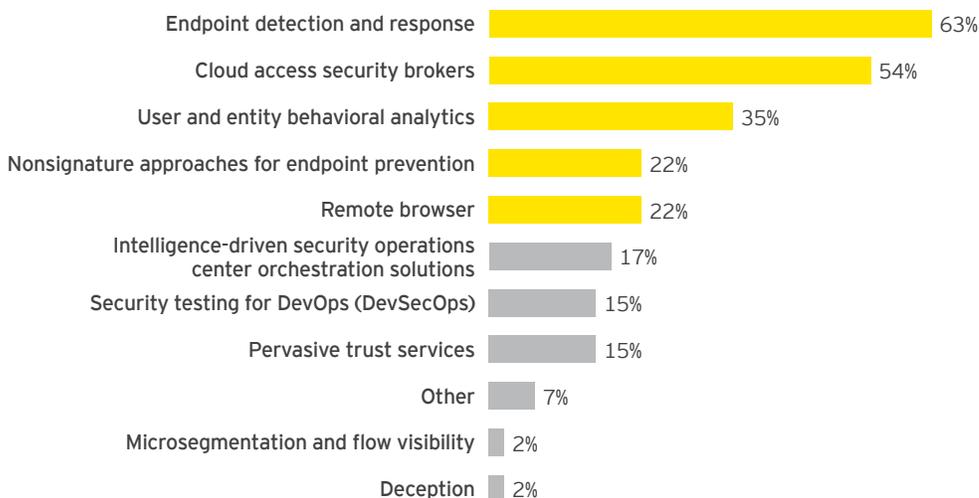
Cybersecurity is a topic that continues to make front-page news, with new threats constantly on the horizon and hackers becoming more brazen and savvy as time goes on. Because of this, cyber is an area that will continue to be important regardless of how advanced or behind you are on the digital readiness spectrum. Some might argue that technology makes you more vulnerable to attacks, but in reality, it is the older systems and software that are the easiest to compromise. According to the 2017 SonicWall annual threat report, ransomware attacks – those that take over a system and do not return it until a ransom is paid – most frequently hit mechanical and industrial engineering (15%) and real estate companies (12%), with mechanical and industrial engineering taking first and real estate taking third out of the three top spots. With ransomware attacks growing from 3.8 million in 2015 to 638 million in 2016, it's clear that you cannot ignore the issue. Today's question is not if you are being hacked, but how and when.

Ransomware is only one of many cyber threats necessary to understand, given that depending on the type of breach, your infected system can in turn infect the systems of your valued clients. While direct monetary damages related to a breach are commonly reported, it is much harder to quantify indirect losses, such as damages to your brand reputation, loss of client confidence, employee confidence and other stakeholder damages.

Engineering and construction companies that also operate and manage infrastructure assets are particularly vulnerable to hacking, as all these assets are connected with the internet.

Our survey respondents had many different ways of approaching the cybersecurity problem, with endpoint detection and response being the first line of defense, followed by cloud access security brokers, and user and entity behavioral analytics. No matter what you choose to protect your business, you must revisit your cybersecurity strategy often and conduct tests regularly – the average time a hacker spends in a system once it is breached is more than 3 months, ranging from 50-plus days on the low end and over a year on the high end. Imagine how much can be learned about your business in even 50 days. And ... accepting that ultimately you will be hacked, a backup and recovery plan is as important as any preventive measure. A solid cybersecurity strategy is a must.

### What cybersecurity technologies do you use to protect yourself against cybercrime?



Source: EY



## Tying it all together

As with any company strategy, cookie-cutter solutions cannot be applied. The unique nature of each company – the ability to interact directly with stakeholders, the size of the operation, global vs. regional, and current digital readiness, among other things – will ultimately drive short-term goals and help shape long-term future planning. Innovators in the sector already have a competitive advantage, having learned how to manage the change associated with our new technology-focused reality and truly becoming agile organizations. While “watch and wait” has been a sector strategy of the recent past, this is no longer possible – disrupt yourself or be disrupted. Create your own story and drive your company into the digital future on your own terms. To begin:

### Is your corporate strategy fit for a digital world?



At EY, we have several tools to help you assess your digital readiness, including our Digital Maturity Check – to get a quick understanding of your organization’s digital maturity – and our more detailed Digital Readiness Assessment – an online, interactive assessment and comparison tool that helps you to benchmark digital maturity across seven focus areas:

- ▶ Strategy, innovation and growth
- ▶ Customer experience
- ▶ Supply chain and operations
- ▶ Technology
- ▶ Risk and cybersecurity
- ▶ Finance, legal and tax
- ▶ People and organization

Rather than finding excuses not to take action, we have highlighted many reasons why you must. Digital can be overwhelming but, to simplify, digital solutions take often-arduous, disconnected, opaque processes and create efficiency and clarity to free up time to focus on value-added activities. This is time to better understand your key stakeholders and deliver excellence.

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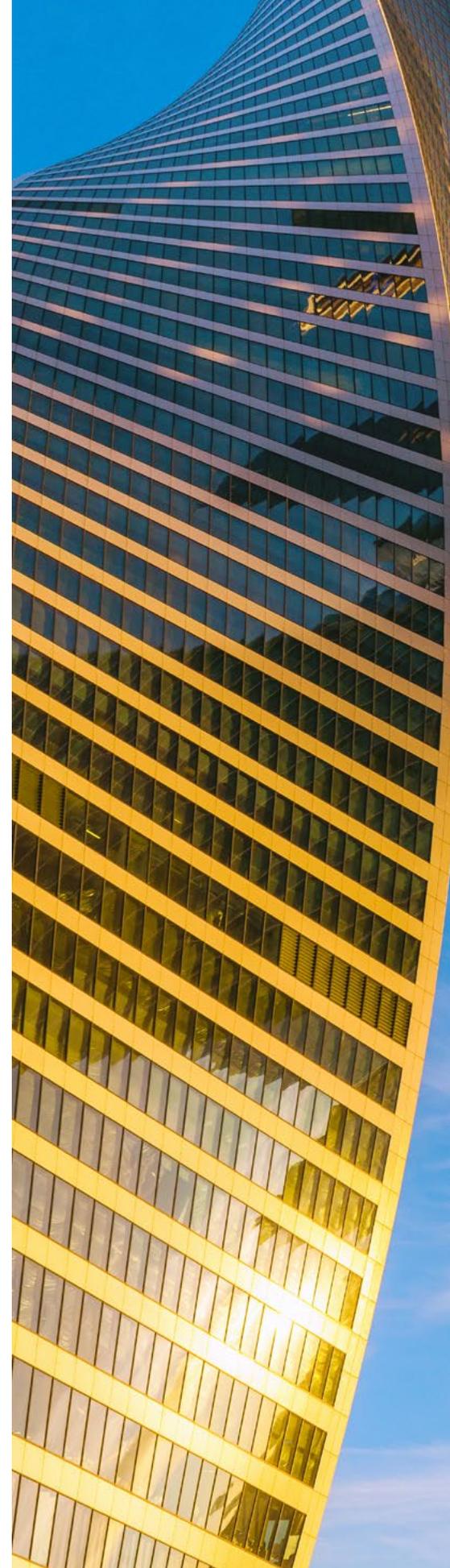
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