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Winning with connected construction
Digital opportunities in engineering and construction

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Executive summary

Every day, around the world, more than 200,000 people are moving into cities. To support this influx, cities need to build. Yet, only 25 percent of the infrastructure we'll need in 2050 exists today.¹ As a result, the engineering and construction (E&C) industry is projected to grow at a rapid pace—around 3 percent per year through 2021.² However, profitability and margins in the industry continue to be low.³ Earnings before interest and tax (EBIT) from construction activities is on an average just 5 percent of sales.⁴ This is primarily because global trends such as increased competition, urbanization, and limited natural resources, as well as pervasive challenges such as talent access and engagement, tend to make E&C projects complex to manage and execute. To meet demand and improve the bottom line for construction projects, E&C firms should consider industrializing construction. What does this mean? It means digital transformation at a level that can allow builders to seamlessly connect construction, assets, suppliers, and contractors; automate processes; and synchronize equipment, labor, and supply chains.

Digital technologies have the potential to transform this industry and help imagine, create, and build the spaces, structures, and cities of tomorrow. Specifically, connected construction technology could enhance how E&C companies deliver construction and infrastructure projects, drive down costs, and improve overall project execution and timeliness. Using connected construction tools, such as active and passive asset tracking, connected time clocks, computer vision, AR/VR, real-time data analytics, predictive maintenance, and automation, E&C companies are expected to be able to create smart, connected job sites of the future. Connected construction could make assets work smarter, reduce downtime through proactive asset monitoring, optimize asset utilization and efficiency, gain visibility and predictive actionable insights, and trigger automated business processes.

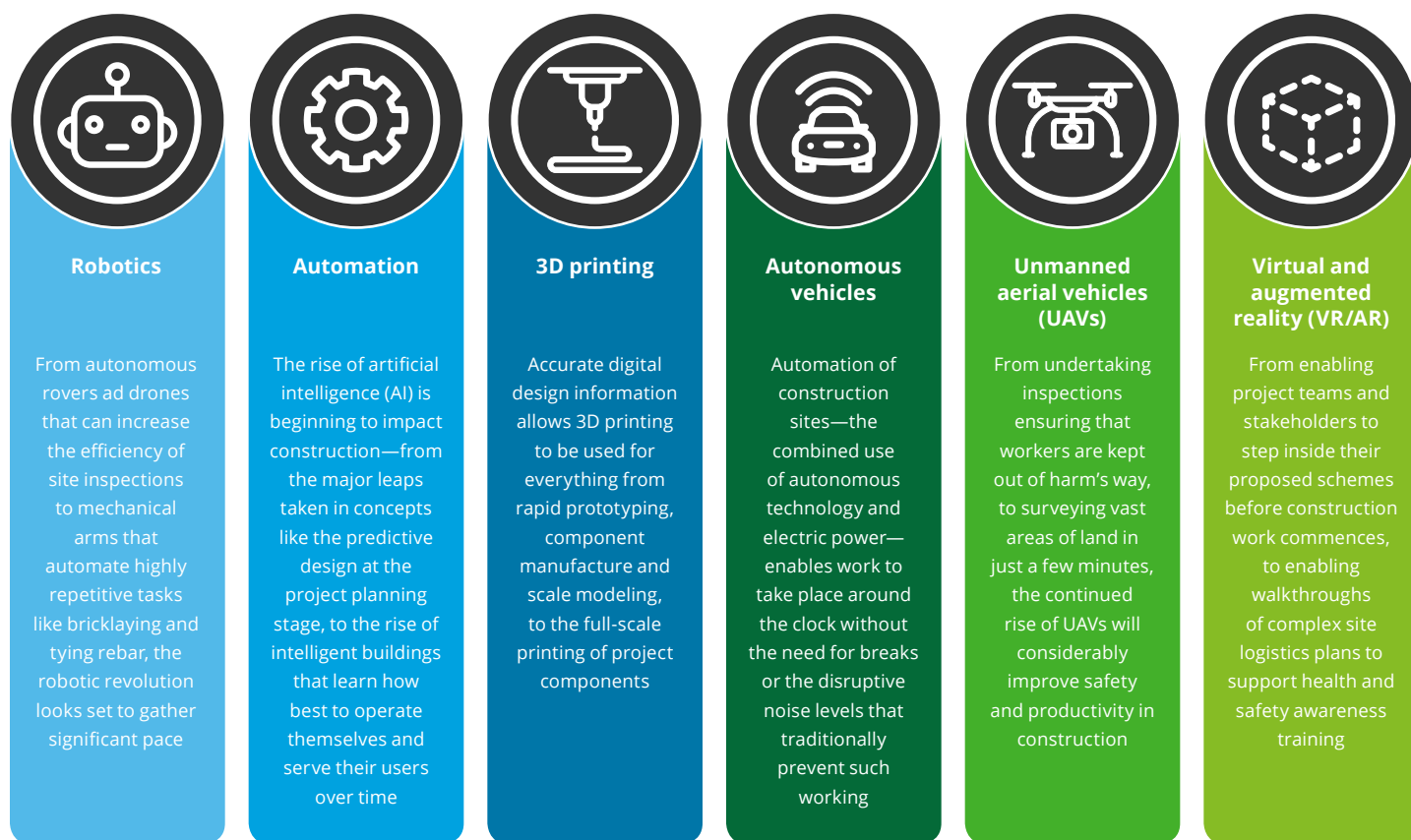


The construction industry lags other industries in digital strategy and maturity

Digital and advanced technologies are impacting the E&C industry like never before (see figure 1). From cloud-based collaboration and the development

of digital twins to robots, wearable technology, and artificial intelligence, an incredible array of developments is helping to improve this industry. Below is a sneak peek of the major technologies the E&C industry should keep its eyes on.

Figure 1. Construction reinvented – Technologies that could shape the world we live in

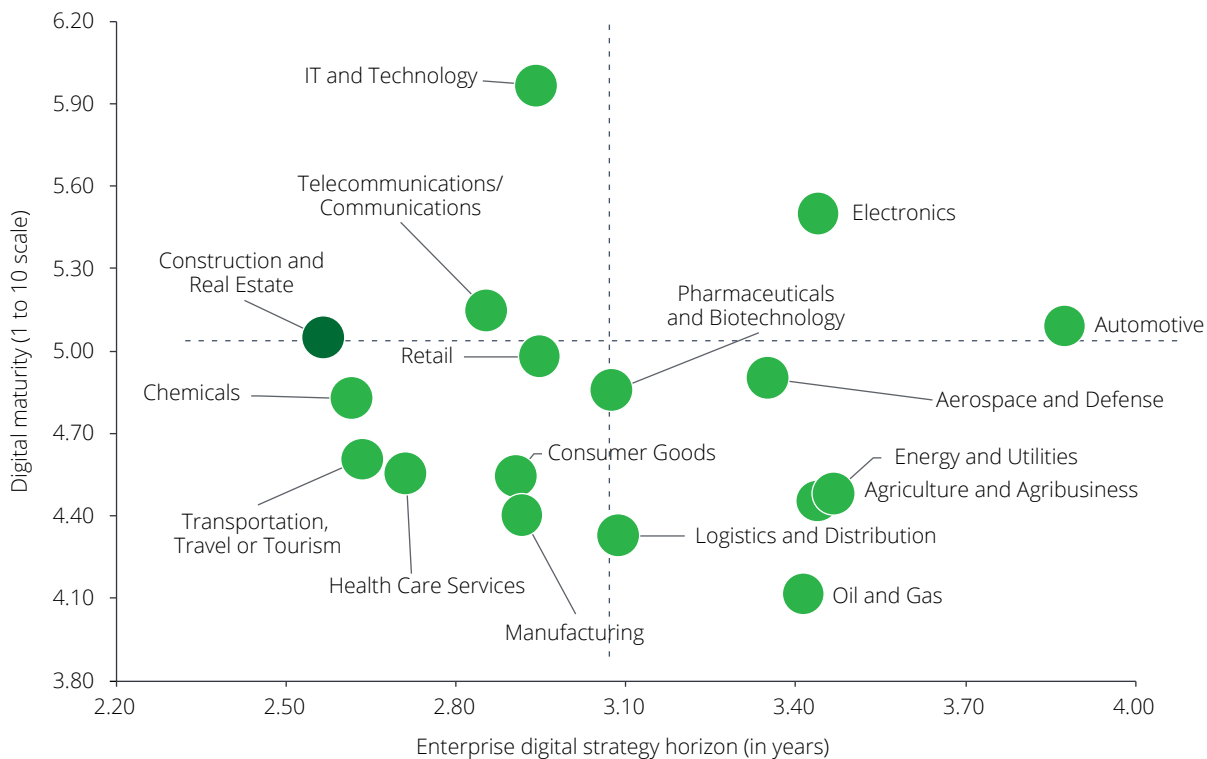


Source: Deloitte analysis.

However, only a few E&C companies seem to be using digital as a tool to create new business and improve margins (see figure 2). Focusing on the long term, the E&C

industry should consider adopting digital technologies and investing in transformational innovation to generate cost-effectiveness and sustained revenue growth.

Figure 2. Digital maturity and strategy horizon by industry



Source: Deloitte analysis of MIT Sloan Management Review and Deloitte University Press, *Achieving digital maturity: Adapting your company to a changing world*, July 13, 2017, <https://www2.deloitte.com/insights/us/en/focus/digital-maturity/digital-mindset-mit-smr-report.html>.

Typically, when an E&C company receives a request for information (RFI) for a new project, it should:

- 1) Come up with an engineering design
- 2) A plan of the requirements, including finding an engineering team and coordinating materials
- 3) Develop a full-scale project management plan

However, this is complex and demanding, as no single company seems to have been able to solve this challenge holistically, resulting in cost and schedule overruns,⁵ especially for fixed price contracts, thereby

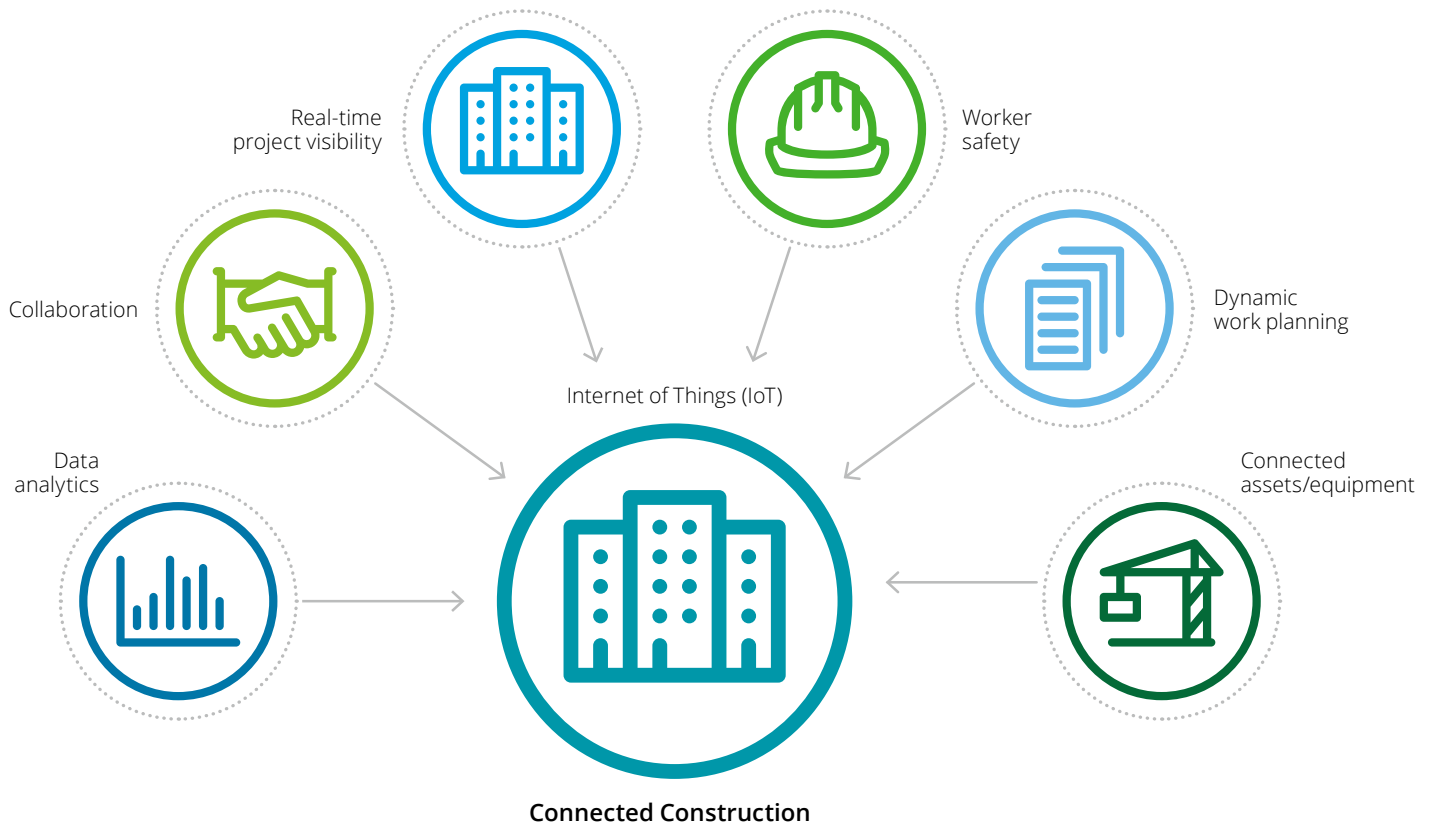
resulting in low margins. Moreover, E&C firms generally experience prolonged cash-conversion cycles and financial constraints, including longer average-day sales outstanding of 82 days—more than all other industries.⁶ Nonetheless, these operational challenges could be addressed through connected construction technologies. Using an efficient, connected platform to bring together all the data, the industry could solve dependencies among various processes and applications, help different teams and functions to coordinate, and provide visibility into the entire project management process.

Connected construction: An ecosystem of connected job sites, machines, and workers that enhances operational effectiveness and safety

A core component of connected construction involves equipping the job sites, machines, and workers with sensors and tags to create visibility from the field,

interact with machines and job sites, collaborate with other work packages, create dashboards/reports to monitor progress and maintenance, and perform analytics on process, resource performance, and environmental conditions (workers' safety). Figure 3 represents some of the key enabling capabilities that are part of connected construction.

Figure 3. Connected construction is a dynamic, "always on" network providing a continuous flow of information and analytics



Source: Deloitte analysis.

Connected assets: With sensors getting smaller, smarter, connected, and mobile, they can be put everywhere across the construction value chain. Using this technology, companies can understand soil conditions, temperature, humidity, and water levels at the construction site. This can help in preventing major events like fire or water damage, etc.

Dynamic work planning: Connected construction helps in tracking material and resources effectively because the construction sites are equipped with sensors. This can help in executing the work packages/modules to plan construction activity.

Worker safety: Since construction sites need to keep a high level of focus on the health and safety of workers, connected construction technology could be leveraged to reduce work hazards. A connected data environment can help construction managers, schedulers, and operators to gain insights through real-time visuals to plan work, identify potential risks, and comply with safety requirements.

Real-time project visibility: 3D data is becoming easier to generate and collect as well as more flexible in using to make decisions. Using 3D data, designers and engineers could now generate building profiles and building parts/components in real time and help enable a connected construction environment virtually. These advances in technologies can help in identifying how structures are progressing during the construction phases. Since all data is aggregated into a digital dashboard, project managers and project teams can have real-time status updates.

Collaboration: Connected job sites can use cloud technology to make information about almost every aspect of a construction operation available to all the relevant parties, regardless of whether those parties are on site or elsewhere, improving collaboration.

Data analytics: From putting design information streamed from a single point of truth into the palms of operatives, to information by geolocation, to remote site monitoring, personnel location tracking, live markups, and the seamless transfer of as-built information, connected job sites can help deliver powerful analytics that improve project execution.





Let's take a moment to understand how this could be implemented in a typical workday at a construction company.

A

Digital forms connected to the back office automate tasks

B

Predictive analytics help minimize downtime by tracking operating hours and analyzing usage of equipment

C

Equipment and employees are linked wirelessly

D

Managed Wi-Fi sends and receives large data files, such as engineering diagrams

E

Geofencing helps to check in automatically

F

Connected time-clocks automate the log-in process

G

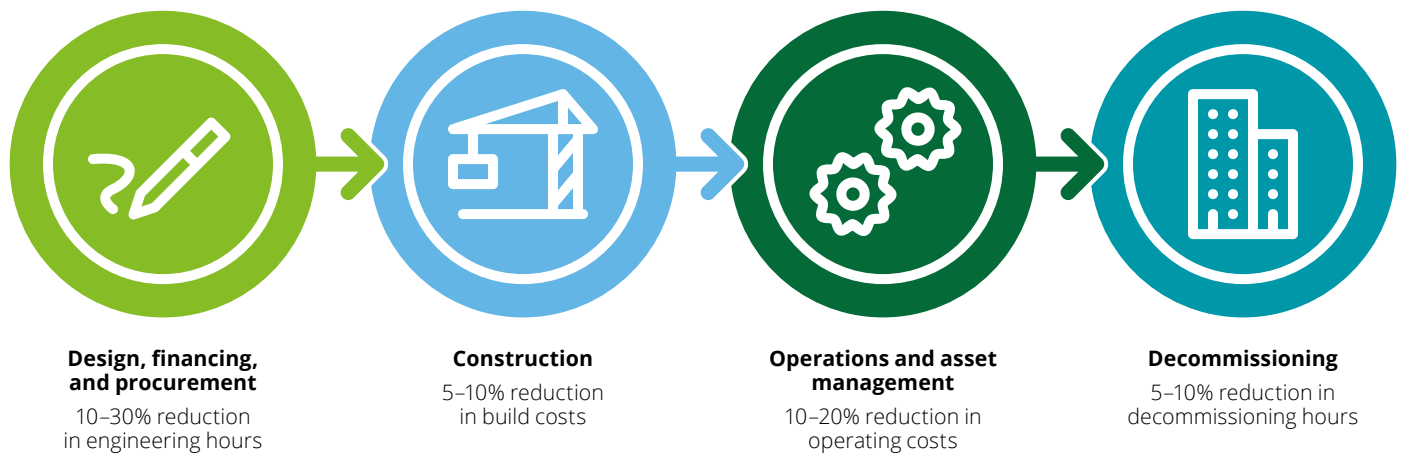
Project manager has data related to the location of employees and heavy equipment at all times, which helps ensure safety of workers and preventing the loss of valuable assets

Connected construction could transform the E&C industry by delivering a true 360-degree view of in-process projects

Figure 4 identifies potential value realization through various aspects of a construction project. By delivering a true 360-degree view of in-process projects, a connected construction company is expected to be

able to improve operational processes by optimizing time and resources; enhance construction project performance with near-real-time visibility into progress; manage construction assets including equipment health and maintenance more effectively; and streamline the design change process with more efficient procurement and faster access to resources.

Figure 4. Investing in digital (and connected) technologies that are built around data, E&C firms could realize value throughout the entire project life cycle



Source: Deloitte, *Digital capital projects: The capital project of the future*, 2019, <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/consultancy/deloitte-uk-the-capital-project-of-the-futurev4.pdf>.

Improve operational processes: Connected construction technology can enable E&C firms to optimize worker productivity and enhance the use of materials and resources. In particular, tools, such as Bluetooth beacons, managed Wi-Fi, on-ground sensors that track temperature and soil conditions, onboard sensors that track equipment maintenance/performance, can all improve the operations and productivity of the E&C firms. And over time, the data collected can facilitate AI-based optimization on the best possible crew build, inventory consumption patterns that require replenishments, and unfavorable environmental conditions that impede work packages, thus repositioning crew to other work packages.

Enhance project performance: With connected construction, a project manager could visualize all aspects of a project in real-time. Through the construction site tile, for example, the project manager can visualize project maintenance using 3D visual analytics to match photos from drones or fixed cameras with 3D renderings. Also, project managers can see if a project appears to be on schedule and on budget. This can help in having an up-to-date status of a project and forecasting in near real time.

Manage connected assets: Using a connected construction dashboard, site and operations managers can track the overall health of their on-site assets, including stationary assets like cranes, and mobile assets such as trucks and drones. If an asset needs repair or maintenance, the asset intelligence network can provide step-by-step visual instructions to perform a repair and minimize downtime. Furthermore, asset intelligence can track overall asset performance by project or site, identifying opportunities to alter or improve fleet decisions for future projects.

Enable more effective design changes: Connected construction can also facilitate proposed design changes in real time. 3D modeling enables projection of what a change would look like before decisions are made, along with the ability to evaluate several scenarios. Connecting out to suppliers and contractors often provides a faster way to obtain cost estimates on proposed changes.

With connected construction solutions, an E&C firm's project teams have the visibility and control needed to manage all aspects of the construction project more effectively, making it easier to deliver on time and on budget. And the as-built information from the construction phase can seamlessly transition to the operations modules to significantly accelerate the commissioning times.

The McAvoy Group, one of the UK & Ireland's off-site construction specialists, created a virtual reality model of South Gates, a passenger boarding facility at Dublin Airport, to demonstrate the building design and offer a fully immersive virtual reality experience. Using 3D drawings and models for both the steel structure and architectural modeling, a common data environment was created. Application of these technologies enabled the company to construct the new boarding zone in time to enable earlier occupation and meet the rising demand for flights from the airport.

<https://www.cita.ie/wp-content/uploads/2019/03/McAvoy-Case-Study.pdf>



Bouygues Construction, a construction company with operations in more than 60 countries, is leveraging digital transformation in an effort to industrialize operations and improve collaboration with its suppliers. Using a digital project management platform, the company is providing its employees and the complete supply chain with a collaborative management tool. This platform is allowing the company to have the project data simultaneously used by all players throughout the life cycle of the building or structure, bringing in efficiencies.

<https://www.bouygues-construction.com/en/shared-innovation/innovative>



Connected construction begins with the digitization of work processes

With business leaders being increasingly interested in transforming their projects digitally to convert new construction projects and retrofitting existing structures to IoT-enabled smart projects and

structures, E&C companies have a significant opportunity in connected construction.⁷ However, successful connected construction adoption generally requires industry leaders to define their vision, map a comprehensive digital blueprint, and work toward realigning their business models to reflect the opportunities that this technology brings.

Figure 5. Understanding the strategic priorities and future vision are typically foundational to the success of a connected construction digital transformation effort



Think big

Develop vision for the **"connected construction journey"** of the organization based on long-term strategic priorities



Start small

Develop solutions and **demonstrate value** on a smaller set of the overall scope



Scale fast

Deploy and **scale validated** solutions across overall scope, and monitor closely for benefit realization

Source: Deloitte analysis.



1. Think big: E&C companies should be deliberate in their digital strategy and therefore should focus on the long-term benefits of digital transformation. They then should align their investments, initiatives, and skills behind that enduring vision. Industry executives should have a clear financial roadmap—strong performance and measurement systems to measure the return on investment (ROI) from connected construction. This can help executives to better plan how the technology is going to drive tangible benefits.



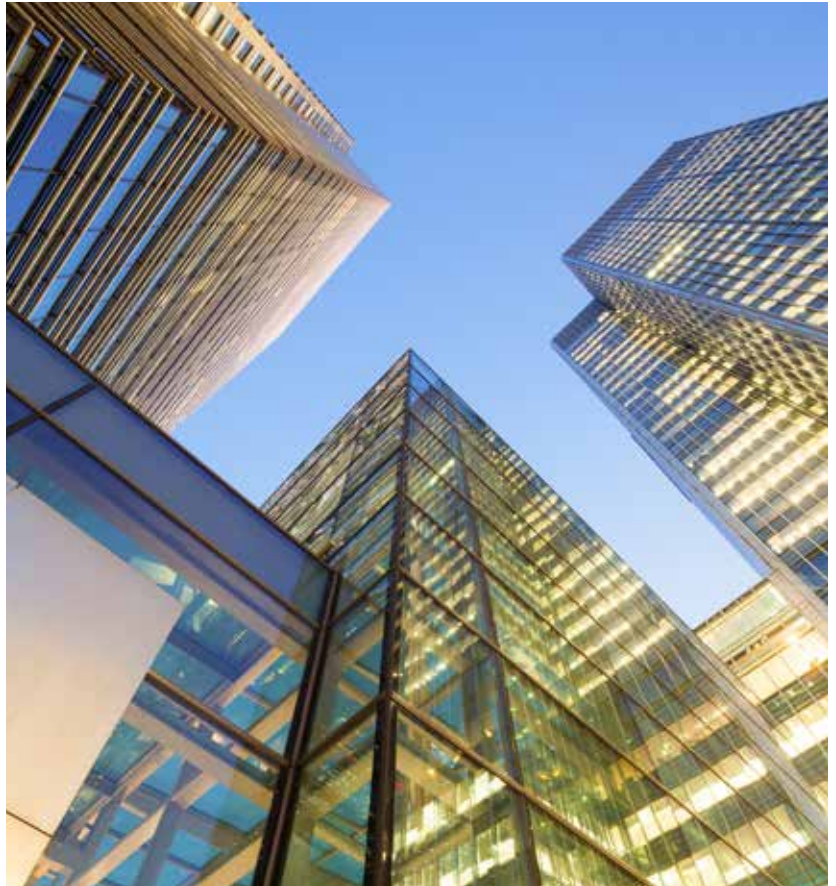
2. Start small: They then should navigate by understanding which solution they should focus on currently to take the benefits and which solution they should focus on in the future. In addition, they should incubate new ideas by finding use cases because many solutions may not have a business case as they are not ready or scalable. This can help companies anticipate the next wave of solutions perhaps not ready for large-scale adoption today but that could be disruptive in the future. A pilot or proof of value (PoV) program with minimal investment delivered in an Agile Method could be key.



3. Scale fast: Industry executives should think of connected construction as an investment into driving growth, innovation, productivity, and efficiency, rather than just as an overhead cost, and scale it throughout the entire business. Since the benefits brought by connected technologies could be much more sustainable and robust over business cycles, executives should align top leadership, workforce, and investments around it. Specifically, industry players should prepare the workforce—they should consider how they can reskill existing employees due to the adoption of connected construction technologies.

Conclusion: Cracking the code to enhanced execution and improved profitability

Engineering and construction firms shape the world and build structures that enable other businesses and service sectors to operate. In that context, ensuring that the built-environment is operating as effectively as possible is of critical importance to the long-term success of the industry. Companies that want to win more work, deliver projects more efficiently, and design better buildings need powerful solutions. And connected construction is a solution that has the potential to help improve project planning and execution efficiencies as well as margins. By harnessing the data from the digitally enabled built assets, homes, offices, and, in turn, cities can all be operated in a smarter, more efficient, and useful way. Furthermore, the data arising can be used to assess trends and to inform the design of future buildings, infrastructure projects, and even large-scale citywide master plans. E&C companies should invest in and leverage connected construction technology to provide innovative solutions and real-time insights to formulate and achieve the desired project outcomes—increased productivity, reduced costs, and ensuring safeguards against hazards.



Endnotes

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