

Capital Projects & Infrastructure Practice

Decoding digital transformation in construction

Few engineering and construction companies have captured the full benefit of digital. Five practices can help E&C companies move beyond isolated pilots and unlock digital's value across their enterprises.

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After spending five years and countless sums on trialing new software platforms and ways of working, the executive team at a large contractor was nearly ready to call an end to its digital-transformation program. Dozens of attempts to streamline projects with digital solutions, such as 5D BIM, had failed to deliver. A few had succeeded in the pilot phase, but the company had struggled to apply those solutions at scale. Site and office workers grumbled about having to adopt yet more new technologies—before abandoning them and returning to their old ways of working. Overall, projects hit delays and ran over budget as frequently as before, and productivity had barely budged upward.

Scenarios such as this remain all too common in the engineering and construction (E&C) sector, which is one of the world's least digitized.¹ The difficulties are understandable. The typical construction project involves a multitude of independent subcontractors and suppliers, which have little incentive to embrace new methods during the brief periods when they are on the job. Projects vary greatly, so E&C companies often struggle to develop tools and methods they can apply repeatedly. Limited R&D budgets prevent E&C businesses from spending as much on digital as companies in other sectors do. And construction work often takes place in remote, harsh environments that are not well suited to hardware and software developed for the office. It is no wonder, then, that many E&C businesses end up with little to show for their technology investments.

Yet we are also seeing an increasing number of E&C companies overcome these challenges to transform projects or even business divisions digitally. When we assessed construction companies that successfully implemented digital technologies and ways of working, we found that, despite differing conditions, their transformations had five practices in common, from which other E&C companies embarking on similar transformations may learn:

- Focus on fixing pain points, not installing IT solutions.
- Implement digital use cases that promote collaboration.
- Reskill and restructure engineering teams.
- Adjust project baselines to capture value.
- Connect projects to unlock impact across the enterprise.

For a digital transformation to be successful, executives and managers must start with a clear definition of how digital will create value for the business (see sidebar, “Defining digital transformation in engineering and construction”). During the transformation, they must spend as much time, if not more, on operational change as they spend on technology. Those that do stand to realize a significant productivity payoff. Research by the McKinsey Global Institute indicates that digital transformation can result in productivity gains of 14 to 15 percent and cost reductions of 4 to 6 percent.² In this article, we offer a closer look at how E&C companies can realize benefits like these.

Why construction is stuck in the analog era

Outside individual major projects, few construction companies have fully digitized their operations. They aren't alone. Companies in all industries report that digital transformations often fall short of expectations. In one McKinsey survey, just 16 percent of respondents said their organizations' digital transformations had delivered sustainable performance improvements. Common challenges include unclear definitions of what digital means, an indistinct idea about what the transformation should accomplish, and poor integration of digital tools with business processes.³

¹ “Reinventing construction through a productivity revolution,” McKinsey Global Institute, February 2017, McKinsey.com.

² Ibid.

³ For more on cross-industry challenges, see Jacques Bughin, Tanguy Catlin, Martin Hirt, and Paul Willmott, “Why digital strategies fail,” January 2018; “Unlocking success in digital transformations,” October 2018; “How the implementation of organizational change is evolving,” February 2018; and “Can IT rise to the digital challenge?,” October 2018; on McKinsey.com.

Defining digital transformation in engineering and construction

Digital transformation can mean different things to different stakeholders, so starting with a shared definition can help executives and managers to agree on a transformation's goals. Broadly, a digital transformation involves two types of change: business-model innovation, whereby companies introduce digitally enabled products

and services, and operational improvement, whereby companies apply advanced technologies and ways of working to enhance the development and delivery of projects.

This article focuses on the latter type of change. In effecting such changes, engineering and construction executives

must recognize that digital transformation is about more than adopting tech solutions. The success of a transformation will depend greatly on how well a company institutes the new ways of working that technologies enable. To ensure sustained success, companies must also prioritize efforts to define new products and services as well as digitize their operating models.

But these factors don't explain entirely why digital transformation in the E&C industry is so hard. The following characteristics of the construction industry make digital transformation particularly challenging:

- **Fragmentation.** Construction projects are typically fragmented along the value chain, with specialists generally operating in one or a small number of disciplines. And each step in the value chain involves multiple layers of contractors and subcontractors. Implementing digital solutions across a project thus requires coordinating changes among organizations—a task that is especially hard, given the short-term and often adversarial nature of construction contracts.
- **Lack of replication.** Construction projects are nearly always one-of-a-kind endeavors, with unique requirements that necessitate bespoke design and delivery approaches. Since these approaches are seldom repeated, it is harder to introduce changes across numerous projects, as full-scale transformation requires. The exceptions are multiyear major projects, on which companies can establish processes and reinforce them over time.
- **Transience.** Ordinarily, a new construction project will involve a new set of organizations working together. Project teams, too, are rarely consistent. Contractors face similar challenges at the enterprise level, at which workforce turnover is high. Transience at the

project and company levels makes it difficult for E&C companies and their subconsultants and subcontractors to establish new ways of working and build capabilities that carry over from one project to the next.

- **Decentralization.** Large E&C companies tend to be highly federated, with business units and divisions following their own processes rather than standardized ones, not least because many have grown by acquiring smaller firms. Individual projects take place at sites that are far from a company office. And few sites are conducive to teaching workers how to work in new ways or use advanced technology.

These characteristics of the E&C industry make it harder for companies to develop digital solutions that they can apply to multiple projects. More commonly, individual teams and business units will develop their own digital solutions, without coordinating with others. The result is a proliferation of subscale, often competing tools within a single company.

Five practices that successful digital transformations have in common

To counter the challenges described above, E&C companies must be thoughtful in the ways they approach their digital transformations. Our experience in the industry suggests that adopting five practices will increase the likelihood of success and enable companies to capture greater value from digital.

Focus on fixing pain points, not installing IT solutions

Around the world, E&C companies are upgrading and replacing legacy back-office systems while also implementing new systems and software to increase engineering and field productivity. However, companies can focus too much on IT, pursuing improvements to systems and software as ends in themselves. We often see E&C companies deploy cutting-edge technology tools before they have figured out whether and how those tools can improve their operations. This tech-first approach can lead to digital “organ rejection,” whereby a solution fails to deliver visible benefits, and the workforce, noticing this, does not adopt it.

E&C companies can increase the likelihood that digital technologies will make a positive difference by first identifying operational changes that will improve performance, then defining digital use cases that will enable those operational changes. This process-centered approach helps focus each use case on a real business need while suppressing the impulse to chase technology trends. Use cases defined in this way deliver greater benefits while building the understanding and conviction of the workforce, from the CEO to managers and frontline workers in various functional groups and decentralized business units. Such use cases are also easier to replicate on multiple projects and to introduce to new workers.

Concentrating on business processes must not stop after the first wave of use cases. The creation of use cases is an ongoing effort, and new opportunities for improvement often emerge once first-wave use cases are in place. For example, one contractor developed an app to allow supervisors to sign completion certificates digitally. After the app was developed, the team defined a new use case to push safety briefings and alerts through the app so supervisors could disseminate them to teams.

A good process-centered use case should specify three things: a process change, the required enablers (data and technology tools, capabilities, changes in mandates and responsibilities, legal and contractual requirements, and others), and the expected benefit. For example, a use case defined as

“reduce losses from unrecoverable rework on steel-concrete connections by 10 percent by visualizing fabrication details with 3-D models” is easier to comprehend and act on than a use case defined as “provide access to 3-D models from all devices.”

Implement digital use cases that promote collaboration

We know many E&C companies that cherry-pick digital use cases that apply to just one activity or trade. One reason they do this is to avoid the complexity of working across multiple organizations in the fragmented value chain. But developing narrowly targeted use cases usually means that E&C companies miss out on a valuable opportunity: stemming the large efficiency losses that can occur because information isn’t transmitted effectively during handoffs between trades and functions.

E&C companies should therefore devote special attention to activities that involve multiple disciplines and groups and design digital use cases that smooth the interactions among them. For example, real-time progress reporting from the construction site can help ensure that subcontractors raise invoices promptly and accurately. Of course, use cases can be more difficult to implement when they involve numerous designers, subcontractors, and specialists. But if E&C companies put compelling incentives in place, then cross-cutting use cases can unlock significant value despite the industry’s fragmentation.

One contractor’s experience showed why it is so important to implement digital solutions that promote and support collaboration among different parties. Historically, site workers hadn’t sent feedback to a supplier on all defects in the elements that the supplier was making. When they did send feedback, it was anecdotal, unstructured, and difficult to act on. Defects persisted, so workers needed either to fix defective products or to wait for replacements. This unplanned rework increased labor costs and caused delays.

The company saw an opportunity to correct the problem by improving the mechanism for passing feedback between the site team and the supplier. The site team used a mobile app to tag defects

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against specific elements in the BIM model and store them in a common data environment (CDE), a single repository for information about the project. The supplier monitored defect reports in the CDE, then ran root-cause analyses with its factory team to diagnose and reduce defects. The resulting improvement, a 12 percent reduction in rework hours at the contractor's job site, demonstrated the benefit of smoothing communication between these previously disconnected organizations.

Reskill and restructure engineering teams

Digital technologies have introduced profound changes to engineering design. For example, generative design tools, which automatically propose a range of design options in accordance with user-defined specifications, can radically reduce the time it takes to develop designs. The ability to examine and optimize a product of generative design is arguably becoming as important as the ability to conceive an original design. In addition, the uptake of modular construction methods has placed more importance on standardizing design elements and storing them in design libraries so they can be used over and over.

Applying these new techniques requires designers not only to learn technical skills but also to design in new ways. E&C companies with internal design functions should equip themselves with new technical skills—for example, by hiring developers to build standard libraries of design elements and automate certain parts of the design process. They should also start to adopt digital ways of working, shifting from a traditional, linear design process

to a more agile approach that consists of faster iteration in short test-and-refine loops. Such a change requires that designers adopt a new mindset, using their experience to validate model results and to look for opportunities for standardization and repetition. This way of working will create capacity for designers to focus on more intellectually challenging problems, such as reviewing and refining generative designs, for which engineering brainpower is irreplaceable.

Adjust project baselines to capture value

Many of the E&C executives we speak to say their companies have seen some productivity gains from digitization but little impact on the bottom line because the savings from added productivity don't make up for the cost of implementing new software and systems. This can occur when productivity-boosting use cases create float during the execution phase and managers neglect to remove this float from the project baseline. To realize the full bottom-line benefit from digital use cases, managers must adjust baselines to eliminate unproductive time and generate value.

For example, there is little to gain from compressing the time taken to survey a site if excavators are not in place for employees to start earthworks as soon as the survey is complete. Similarly, digital tools can help accelerate construction by reducing defects and thereby reducing rework. But if the labor force isn't streamlined or reassigned to other activities, then workers will end up waiting during the time they would have spent on rework, and the costs will still accrue.

Managers can capture the benefits of increased productivity in several ways: compressing on-site schedules, reducing noncritical resources, and even restricting overtime. This approach requires close collaboration among the organizations working on the project as well as clear communication about the project plan, especially with new workers who are accustomed to a slower pace of execution. Companies can also change contracts and incentives to share benefits and risks appropriately across the value chain.

Teams need not take a leap of faith when adjusting baselines. They should closely monitor the effects of each use case while it's being tested on a pilot project to understand how much they can adjust baselines without jeopardizing subsequent projects. This might involve observing site works and tracking downtime before and after implementing a use case. Knowing how much downtime is created will help inform future adjustments to resource levels and schedules. Adjustments could also involve stopping work one or two hours early each day to constrain the schedule deliberately and show that higher productivity is possible. Whatever the findings are from these efforts, project managers should document them so future projects can replicate effective methods of adjusting baselines.

Connect projects to unlock impact across the enterprise

At a typical decentralized E&C company, it is easy for business-unit leaders to focus on optimizing projects—while overlooking the enterprise-wide use cases that could unlock a whole new wave of

value as the company standardizes its digital tools and platforms across its various business units and shares more data from projects. Common enterprise-wide use cases for E&C companies include the following:

- consolidating cost and schedule data from multiple projects and business units to increase the accuracy of bids for future tenders, thereby increasing the margin
- gaining an enterprise-wide view of resources to optimize resource loading and respond quickly when project demands change
- creating central repositories for designs at the element, package, and project levels so those designs can be repurposed on future projects

A company must pick the right time to start developing enterprise-wide use cases. This will often be after it has scaled the project-level use cases developed in the first pilots and stabilized them across the business.

One E&C company embraced the potential of enterprise-wide use cases by standardizing the specifications for its insulation panels. Previously, the company had sourced similar products from different suppliers. Why? The products were not coded or classified in a standard way, so designers could not determine that the elements were similar, which would have enabled them to use just a few products in place of the many different ones ordered previously. By digitizing and standardizing

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In another example, an E&C company used advanced analytical techniques to analyze past tender data and identify ways of optimizing tender selection and pricing. As a direct result of that effort, the company improved its project margins by 3 to 5 percent.

Most E&C companies have embraced the idea of implementing digital technologies and are determined to see their efforts bear fruit. But

despite good intentions and determined efforts to embed digital technologies in operations, E&C companies rank among some of the least digitized businesses. There are reasons for this, but companies can overcome them. Our experience shows that adopting the five practices described in this article improves the odds that a digital transformation will yield tangible benefits. What is more, E&C companies that scale up their digital transformations before their rivals do stand to reap the most gains: McKinsey research on digital competition shows that companies that are first to make bold moves, or quickly follow the leads of those that do, create advantages that slower-acting companies find it difficult to overcome. For E&C companies that have struggled to do more than experiment with tech solutions, the time to redouble their efforts is now.

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