

The graphic features a dark blue vertical bar on the left containing the FMI logo and issue information. The background is a light blue field filled with various icons representing technology, construction, and business, such as a lightbulb, a bar chart, a magnifying glass, a crane, and currency symbols.**FMI**FMI QUARTERLY
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Simplifying E&C Projects: Technology as an Enabling Solution

By Jay Snyder

By being innovative and fully leveraging technology, E&C firms can effectively address the various levels of complexity within their projects while assuring quality and timely project delivery.

A rigid supply chain, changing business conditions, leadership shifts and myriad of other factors come together to make project complexity a stark reality in the engineering and construction (E&C) world. Add sluggish productivity, a severe labor shortage and project schedule compression to the equation, and the result is a perfect storm of challenges that today's project teams must deal with effectively.

“As the tools available to designers have become ever more sophisticated and the environmental performance standards ever more stringent, there seems to be an inevitable drive toward complexity in the design of buildings,” Mahadev Rahman writes in “Complexity in Building Design.” “Technological advances have also added additional stages to the construction process, and in an industry where time is money, this can produce innumerable challenges for a design team. Yet as we'll see, the new tools are actually optimizing the efficiency of the design process.”¹

In this edition of the “FMI Quarterly,” we'll look closely at the issue of project complexity, identify the contributing factors, and outline an approach to help E&C firms properly leverage technology as part of the solution.

¹ Rahman, Mahadev, [Complexity in building design](#).

Why Are Projects So Complex?

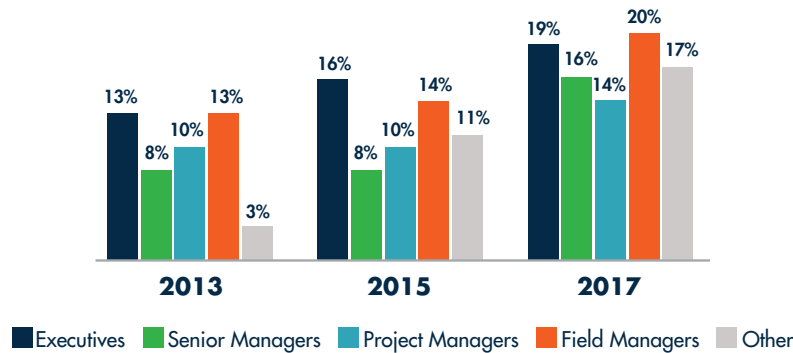
Fundamentally, project complexity refers to the difficulty associated with trying to achieve project objectives. In all cases, the obstacles include maintaining a budget, sticking to a schedule and delivering quality. Here are a few specific examples of how these complexities play out in today's E&C environment:

- **Building automation systems** that control lighting, optimize energy management and manage HVAC systems and energy plant operations have all increased the design team's workload. They also require additional coordination among the trades. These systems require interoperability and are often classified as critical systems, requiring backup power and redundant systems connectivity. Smart buildings use interconnected technologies to provide building owners and occupants with both energy savings and non-energy benefits. These technologies can display real-time data, diagnose faulty equipment operation and reduce energy waste. Commercial buildings, including office, retail, hotel and hospital buildings, can all benefit from installing smart technologies. However, each of these sectors has its own unique business goals to achieve, stakeholders to satisfy and barriers to overcome, so the opportunities are different for each sector. Roughly 75% of the health care sector relies on building automation systems and, as a result, is more likely to leverage advanced smart technologies and analytics than the hotel sector (where fewer than 40% of buildings incorporate a building automation system). These systems are inherently complex, but the supporting infrastructure and interoperability raise their sophistication and complexity to a level that often requires substantial project planning and vendor coordination.
- **Regulation and social compliance** have taken hold in a big way in the industry. For example, environmental regulations affect the materials that are used as well as building performance, labor safety and accountability, and job site and building security. Furthermore, regulatory and social compliance introduce additional building components that must meet certain project requirements and follow specific accountability processes.
- **Construction projects are often undertaken in urban areas**, where the majority of the U.S. population (81%) resides.² Dense construction sites, and those that are adjacent or within facilities that remain in operation during construction, present their own unique challenges. These constricted site constraints demand more intricate planning upfront and throughout the project for storage (laydown) of materials, staging of equipment and access for deliveries, ensuring uninterrupted utility service and overall project phasing.
- **Due to skilled labor scarcity** (another factor driving industry change), labor resource management has become a critical imperative. With fewer experienced field leaders available (due to the ongoing exodus of baby boomers), project teams are at a higher risk of making mistakes or the wrong decisions. This in turn can jeopardize projects and ultimately lead to project delays and cost overruns. In [FMI's recent talent development research](#), our survey data showed that study participants expect to lose between 14% and 20% of certain employee groups, including executives, field managers, senior managers and project managers over the next five years due to attrition or retirement—the highest level of loss since our 2013 study (Exhibit 1).

² "Measuring America: Our Changing Landscape." U.S. Census Bureau. 2016. <https://www.census.gov/content/dam/Census/library/visualizations/2016/comm/acs-rural-urban-text.pdf>

EXHIBIT 1

Average expected loss to attrition or retirement within the next five years.



Source: 2017 FMI Talent Development Study

- Construction teams can no longer work in silos**, and those that still do experience poor project performance. Many of the factors mentioned earlier, along with the use of collaborative project management and building information modeling, necessitate (and enable) more robust coordination among all project stakeholders. This extends across the entire project and includes project programming, schematic design, shop drawings, construction execution and closeout. At the same time, owners have become more sophisticated and expect greater transparency, such as “on-demand” budget and schedule management—a necessary dynamic that truly complicates projects.

These and other challenges complicate the process of sequencing work and often require more frequent coordination among vendors, trades and other stakeholders. Concurrently, owners’ business needs are ever-evolving and sometimes change during E&C projects, demanding more flexibility and agility from all stakeholders involved. This is likely due to the rapid pace of market and industry changes, inadequate early planning or any number of other factors. Unfortunately, projects—and specifically, contractors—don’t typically build agility into their project plans or allow for significant scope changes.

Even in cases where construction begins with early-release packages, owners don’t expect to incur the cost of non-value added work (i.e., rework); this is a harsh reality in the E&C industry. And while achieving this reality has always been a challenge, doing so has become an owner expectation and in some ways a requirement, in order to kick projects off that help owners achieve their own speed-to-market goals. For example, the phrase “bid-build-design” refers to the unfortunate (and frequent) practice in which construction activities begin before design is signed off. This can even occur on projects that incorporate design-assist service from the contractor. However, in many cases the owner and project team have not developed drawings with enough specificity to ensure that the owner’s business needs are being addressed with the project’s design.

As a result, projects wind up incurring owner-directed changes to accommodate for design and scope adjustments that may not have been adequately defined at the project’s outset. This frequent occurrence causes a considerable strain on project resources, creates unforeseen financial consequences, and is completely avoidable with a better definition of the owner’s business use case, improved design coordination and visualization.

Steps to Reducing Project Complexity

Fortunately, there are tangible ways to decrease project complexity, with technology being a key enabling solution accessible to any E&C firm. But this isn't just about throwing any device or software program at the problem. In fact, many times doing so only adds even more complexity, confusion and delays. For example, there is a high direct cost of implementing software platforms and devices that don't live up to expectations and that must in turn be "switched out" and replaced, usually resulting in poor user adoption due to technology or change management fatigue.

By following a specific process, E&C firms can turn technology into an enabling solution. This approach is both valuable and necessary, and should include these steps:

1. Refer to your company's existing technology strategy to ensure that the initiative aligns with it (Exhibit 2). If you don't have one, develop one.
2. Develop a business use case for the technology (i.e., the business "need"), focusing on the details of the problem you are addressing.
3. Review the technology strategy to revalidate that it supports the firm's overall business strategy. If it doesn't, reconsider the business need before moving forward.
4. Determine the magnitude of the problem and define the scale that the solution must be capable of handling.
5. Evaluate the company's culture and how employees will respond to technology as part of the solution.
6. Assess the company's and employees' level of technology and/or innovation fatigue. For example, has the amount of change (and/or new technology or innovation initiatives) been overwhelming to the organization? Does the company have an appropriate change management process when introducing new technology tools into its business processes?
7. Consider how a new technology impacts, integrates or enhances the company's current technology stack. For instance, does the existing technology stack require the technology solution to meet certain systems criteria, interoperability or architecture?
8. Map your software selection due diligence process by asking yourself questions like:
 - What planning document templates, such as a requirements traceability matrix, will we use through this process?
 - How will we identify the business use case and translate that into functional and technical requirements?
 - How will the project be awarded?
 - How will we determine our list of possible tech providers for this need?
 - What additional services—and to what degree—will we require technology implementation, change management, training, customization and follow-on support?

9. Consider the benefits of a technology that is compatible with your company's industry partners and clients.
10. Develop and manage the implementation/change management process to include implementation, application programming interface (API) integration, user training and phased adoption.

EXHIBIT 2

Technology Examples That Simplify Project Complexity

| | VDC/AR | Drone Tech | On-site Automation/Robotics | Offsite Construction | Productivity Tracking | PM Collaboration Platforms |
|----------------------------------|--------|------------|-----------------------------|----------------------|-----------------------|----------------------------|
| Arch/Structural Design | ✗ | | ✗ | ✗ | | ✗ |
| Advanced Build Systems | ✗ | | | ✗ | ✗ | ✗ |
| Regulation and Social Compliance | ✗ | ✗ | ✗ | ✗ | | ✗ |
| Project Planning/Site Management | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Labor Management | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| PM and Cost Transparency | | | | | | ✗ |
| Sequencing of Work | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Evolving Client Needs | ✗ | ✗ | | | | ✗ |

Ready, Set, Go!

Whether they are large and high-value projects or more moderate, manageable undertakings, all projects come with their own set of challenges. We don't expect this to change in the near future and, in fact, predict increasing complexities as the projects themselves incorporate more elements, requirements and entities—all of which must come together to meet owners' expectations and needs.

By taking a proactive approach that includes planning, maximizing current resources and fully leveraging technology, E&C firms can effectively address the various levels of complexity within their projects while assuring quality and timely project delivery. Equally as important is the need to fully understand these complexities and apply a well-thought-out technology strategy that improves your company's long-term performance.



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About FMI

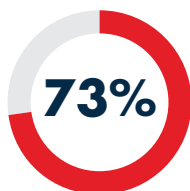
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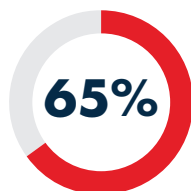
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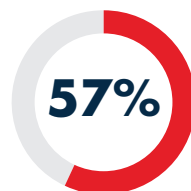
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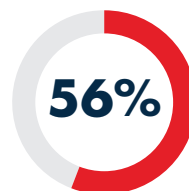
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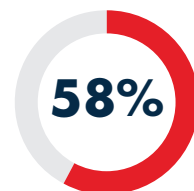
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