The Future is Now:
Setting Yourself Up for Success
The Future Is Now: Setting Yourself Up for Success

By Scott Winstead

Welcome to the first edition of the Quarterly for 2018. First quarter is almost behind us, the E&C project pipelines are filled, and there’s promise of even more to come as 2018 progresses.

As I look around at the business environment right now, I’m reminded of a quote from science fiction author Wayne Gibson, who said, “The future is already here—it’s just not evenly distributed.”

We’re seeing this right now in E&C, where over the next few years, continued put-in-place growth will be similar to what we’ve seen over the last few years. With the continuing industry growth trends, labor and productivity challenges, and retiring boomers, addressing the opportunities and challenges of the “here and now” would be the easy choice. However, the risk in remaining solely focused on the short term is that the industry will likely look and operate very differently in 10 years than it does today. Firms that choose to ignore external trends—and then adapt their business models and approaches accordingly—may find themselves on the outside looking in.

For starters, we expect nearly 50% of construction to occur in just 20 metropolitan markets over the next three to five years, and just five of these metropolitan markets will make up one-fifth of total construction in the U.S. These include New York, Los Angeles, Dallas, Houston and Washington.
We’re also starting to see new entrants, new business models and a tremendous amount of venture capital coming into the industry—all designed to disrupt an industry that has long been accused of being stale and lacking in innovation. Technology is redefining both what the customer demands and who the customer is. Consider the health care segment, where systems are largely turning their attention away from the hospital and focusing on clinical and outpatient care. At the same time, CVS has announced its intention to buy Aetna, and Amazon, Berkshire and JP Morgan are combining forces to determine how technology can simplify the current health care system.

We’re seeing increasingly complex buildings and infrastructure. This complexity is not only what the asset represents, but also the expectations related to its delivery. For example, the average project value among state DOTs has increased by almost 20% in a little over 10 years, while the average schedule duration has shortened by almost the same amount.

With greater access to data and data analytics, industry leaders are beginning to incorporate these tools as a central aspect of their business and profiting from them. In most cases, profiting from data analytics means driving better results from more informed decision-making. But some firms are now employing characteristics of manufacturing and available technologies to improve project outcomes, both in the product itself and in the process. Moreover, some are finding ways to reduce costs or even create new profit streams from greater data insights.

In this edition of the “FMI Quarterly,” we explore the convergence of engineering, construction and manufacturing, and discuss the effects of technology innovation and how these trends are fundamentally changing the way firms do business. Our authors also tackle topics such as strategy in a time of industry disruption, show us how to address the workforce gaps and related risks for E&C, and discuss how the rise of solar photovoltaics is creating significant O&M opportunity for today’s engineering and construction firms.

Given the changes on the horizon, today’s leaders must have a truly strategic and transformative mindset and be open to exploring creative solutions anywhere they may show up. That’s what this issue of the Quarterly is all about, and we hope you enjoy it.

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Strategy in a Time of Industry Disruption

By Rick Tison

How to prepare for potential industry disruption driven by technology and innovation.

Steve Jobs introduced the iPhone on January 9, 2007, at the Macworld convention. Within five years, the product was responsible for more revenue than Microsoft as a company.¹ When we think of industry disruption, these are the types of data points that come to mind. We picture entire supply chains unraveling and leading incumbents going from industry leaders to footnotes of history, literally overnight.

The reality is far more nuanced. Disruption is more of a hurricane than a tornado—destructive but offering sufficient time to respond if industry participants are willing to do so. This is not to say that disruption doesn’t happen fast. Disruption can happen quickly, but rarely faster than a company could respond during a traditional planning cycle of three to five years. In fact, incumbents often fail to identify or respond to disruptive forces fast enough to stave off potential value destruction.

Prospects for Disruption in the E&C Industry

Recently, the construction industry has faced deserved scrutiny related to its productivity problem. A variety of sources have pointed out that the industry has seen no meaningful gains in productivity over the past several decades as compared to other industries. Concurrently, interest in construction technology and innovation channeled toward solving industry challenges is at a peak in terms of venture capital funding and the number and variety of startups focused on this market.

Data on the industry's productivity problem is inconclusive at best. Conventional wisdom shows stagnant productivity compared to all other nonfarm industries. A recent report from the Bureau of Labor Statistics shows productivity gains across several construction sectors, although the findings are not universally accepted (Exhibit 1).\(^2\) Regardless of its productivity track record, the industry does have a value chain problem. In our work with stakeholders from across the built environment value chain, construction is far too likely to create bad experiences for a variety of stakeholders to be insulated from disruption.

### Index of productivity (output per hour)
in single-family and multifamily new housing construction, 1987-2016 (base year 1987=100)

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<td>Index of productivity (output per hour) in single-family and multifamily new housing construction, 1987-2016 (base year 1987=100)</td>
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#### Note:

#### Source:
U.S. Bureau of Labor Statistics

This article evaluates the experience of disruption across several industries to glean common themes, best practices and lessons learned related to industry disruption. We hope you will take these lessons to heart and incorporate them into your own strategies and leadership during potentially turbulent times ahead for traditional industry participants.

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Stories of Disruption

For this article, we reviewed several case studies of industry leaders that were disrupted by innovators. Our analysis revealed three classic failed responses to industry disruption: head in the sand, slow to respond and insufficient response. The following two case studies highlight two of these failed responses:

**Blockbuster—Failure to Identify Disruption**

The first Blockbuster store opened in 1985. At its peak in 2004, the company operated 10,000 stores and had a market value of $5 billion. By late 2013, Blockbuster’s new parent, DISH Networks, shuttered all stores.³

Netflix was the leading contributor to Blockbuster’s demise. When Netflix launched in 1997, its business model was DVD rental by mail. This model helped Netflix limit costs associated with brick-and-mortar stores while offering a wider selection than Blockbuster traditionally had on hand in its stores. Blockbuster’s model, on the other hand, was to operate brick-and-mortar stores offering the latest releases. Given demand for new releases, Blockbuster charged fees for late returns and, as such, late fees made up a significant percentage of its business.

Netflix is a classic example of disruptive innovation.⁴ Its business model allowed it to offer a cheaper, albeit lower-quality, service compared to Blockbuster. As Netflix gained ground with Blockbuster’s less profitable segments, the latter held firm to its tried-and-true model, allowing the newcomer to build a toehold that it later exploited to offer a cheaper and better service with new streaming capabilities in 2007.

**Kodak—Failure to Embrace Business Model Shifts**

Kodak filed for bankruptcy protection in 2012. Analysts largely attribute the company’s failure to its inability to respond to disruption from digital cameras and a customer shift from printing pictures to sharing them online. To Kodak’s credit, it was a participant in both of these industry trends.⁵ Unfortunately, the company wasn’t willing to take either of these far enough to threaten its historically successful business model of selling film. As history revealed, the business of selling film was under threat, and Kodak did too little to adapt its business model to account for this disruption.

Kodak created the first prototype for a digital camera in 1975. Following the invention, R&D investments were made to further the underlying technology, which was not commercially viable at the time. In 2001 Kodak acquired Ofoto, a photo-sharing site. The acquisition was largely used to encourage customers to print more pictures. Kodak sold Ofoto as part of its bankruptcy plan for $25 million. One month later, Facebook invested $1 billion in Instagram.


Not guilty of sticking its head in the sand and hoping its problems disappeared, Kodak’s leadership diverted meaningful resources and R&D dollars toward digital photography and online photo sharing. However, the company failed to embrace new business models that accompanied disruption by not aligning with its core business model of selling film.

**Accelerating Disruption**

In addition to the classic failed responses to disruption outlined above, three critical accelerants of disruption also emerged. Their presence heightened the risk of disruption for an incumbent company and include:

- Disruptions in leadership
- Resistant company culture
- Previous success inhibiting future success

**Disrupting the Built Environment**

Our industry is not viewed as a model of technology and innovation—a reality that leads many to assume that “it can’t happen here.” Katerra is a potentially disruptive innovator that is testing that assumption. Katerra’s business model is to run a construction company the same way Toyota would operate a factory—fully integrated from architectural design through fabrication and installation. This allows the company to offer service that is faster and cheaper than a traditional competitor.

While it is still too soon to declare Katerra a successful industry disruptor, it does prove the case that disruption is possible in our industry. Katerra was founded in 2015 and booked $1.3 billion in sales in 2017. While currently operating at a loss, it recently secured $865 million in funding to invest in R&D and new factories and expects to become profitable as soon as 2019.6

**How to Love Disruption and Stop Worrying About It**

**Understanding Disruption**

The theory of disruptive innovation states that a cheaper, lower-quality innovator takes less profitable customers or segments away from an incumbent until the innovator is at a strength to take on the incumbent by offering a lower-cost, higher-quality offering in the eyes of the incumbent’s customers. Netflix’s pre-streaming service is a good example of disruptive innovation.

Instead of responding to disruptive threats, incumbent companies often defend higher-margin customers and invest in innovations that gold plate offerings to these customers to the detriment of price competitiveness with innovative new entrants. Over time, this allows the disruptor to beat the incumbent at its own game.

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How Industry Firms Stay Ahead of Disruption

Dealing with disruption pushes companies to go a step beyond traditional strategy. Classic thinking on strategy means focusing on who your customers are and how you deliver unique value relative to the competition. This remains essential in dealing with disruption, but it must also be paired with the understanding that you are not perfectly designed to serve all customer segments.

The absence of broader industry perspective creates an opportunity for disruption to occur. Blockbuster failed to effectively assess the competitive threat Netflix posed because it could not see past its own value proposition. Netflix did not threaten Blockbuster’s core customers, who wanted to rent new releases on demand. Blockbuster failed to appreciate that not all consumers of its movie rental offering valued the “new releases on demand” component of its offering. Other customer segments valued broad selection and did not mind waiting for them to come in the mail. Additionally, many of those customers didn’t like paying late fees.

Tackling Disruption on Its Own Turf

Understanding the source of disruption is just the first step. You also need the necessary leadership to make the difficult decision to act. In our research, several companies failed to act quickly enough or move far enough to stave off disruption.

A common theme in the research was an inability of leadership to embrace sufficient business model change to deal with disruption. Kodak understood the sources of disruption; it even responded through its R&D and acquisitions. However, it failed to embrace the need to change its business model in response to disruption. This level of change requires strong, effective leadership. A common theme across the case studies evaluated was leadership turmoil accelerating the ability to respond swiftly and sufficiently.

Preparing for Disruption

- Know the value you create for clients and how that differs from the competition
- Understand that you aren’t perfectly designed to serve needs of all customer segments – be mindful of “blind spots” that create opportunities for disruption
- Be willing to disrupt your own business model if needed, but don’t take the decision lightly
- Don’t overlook the importance of leadership and culture to your ultimate success

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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.”

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, it 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. 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).

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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**

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<tr>
<th>Arch/Structural Design</th>
<th>VDC/AR</th>
<th>Drone Tech</th>
<th>On-site Automation/Robotics</th>
<th>Offsite Construction</th>
<th>Productivity Tracking</th>
<th>PM Collaboration Platforms</th>
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<td>Project Planning/Site Management</td>
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<td>Evolving Client Needs</td>
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**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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How the rise of solar photovoltaics (PV) is creating significant Operations and Maintenance (O&M) opportunity for today’s engineering and construction (E&C) industry.

The rise and development of solar O&M presents an opportunity for many regional solar Engineering, Procurement and Construction (EPC), electrical and energy services firms. The economic and logistical challenges associated with systems maintenance at a smaller scale have provided an upstart to many middle-market providers. This opportunity continues to present itself for local providers that can serve the immediate needs of clients profitably—both in their locales and across various regions.

It is difficult to ignore the rise of solar PV as a contributor to the portfolio of power generation. More than 69GW of total installed solar capacity has been added across the U.S. during the last couple of decades, with an additional 61GW expected to be deployed over the next five years.\(^1\)

This fragmented landscape across various market segments has allowed many contractors to benefit from opportunities created by demand on the part of quality solar PV EPC providers. Top global E&C providers, along with smaller solar-focused EPC contractors, have all contributed to the growing base of solar assets connected to the grid.

\(^1\) SEIA, U.S. Solar Market Insight and GTM Research.
As with any infrastructure asset, the ongoing O&M is a critical component of long-term project success. But unlike many other long-standing classes of infrastructure, the recent explosion of solar PV has created an O&M landscape that is still in flux, particularly in specific segments. This leaves a potentially valuable opportunity for current and future providers that—as the landscape begins to settle—can serve fragmented market segments.

In this article, we explore the solar O&M opportunity, discuss why firms should care about it, and provide recommendations on how to tap into this growing market.

A Growing and Segmented Market
The solar PV marketplace is divided into distinct segments, including utility scale, nonresidential (sometimes referred to as Commercial and Industrial (C&I)) and residential. Each segment has its own market intricacies, resulting in differing landscapes of providers across these end markets as well as across these end markets and geographies.

Despite several changes that could dampen project pipelines, the growth in solar is poised to maintain its momentum. Investment Tax Credit (ITC) changes and the 30% tariff on imported solar panels are expected to have a muted impact compared to the industry’s initial worst fears. Most providers have already priced this speed bump into future projects and pre-bought panels—moves that will help ease the cost of higher panel prices over the next several years (as the tariff steps down). Looking past this slight headwind, the solar industry appears to remain cautiously optimistic about strong continued growth.

Regardless of the growth outlook, the assets in the ground (and those under construction) still require (O&M) services. The long-term, recurring revenue stream on the backend can help insulate the fluctuations in a project-based revenue stream that is at the mercy of development cycles. For companies that do both, the value of the complementary components can be greatest during times of muted construction volumes.

A Focus on Midsized Operation Services
Across the value chain of solar O&M services, consolidators value the operations component for these reasons:

- Its position of oversight and control—allowing providers to drive work across large portfolios and react to any changes in maintenance and service delivery, including flexibility in service delivery models.
- Efficiencies of scale—controlling the operations allows for centralization of geographically dispersed portfolios that can be simultaneously monitored, thus enabling the benefits and efficiencies gained from greater scale and service.

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2 Greentech Media, Cedric Brehaut, December 2017.
This level of the vertical chain currently commands a very high level of attention and is where the differentiation can really take effect. In certain instances, customer relationships, consistency of service and growth channels all sit at this level, creating a dynamic middle ground where the industry landscape is still in flux, leaving the opportunity door wide-open. It also acts as a natural area of bifurcation between the large utility-focused O&M providers and those smaller providers whose portfolios are made up of more localized assets that do not require full-time, on-site O&M personnel.

Factors That Can Impact Providers
A number of aspects contribute to the resulting solar O&M landscape, providing differentiating factors for those firms currently serving and looking to serve the market. They include:

The Impact of Critical Mass
The challenges of serving smaller-scale assets across multiple locations remain a key factor when looking at the variations in the landscape. The size of the asset, as well as its geographic relation to other assets, can lead to key synergies for personnel utilization, replacement part inventory management, distribution and general logistics. Plants of sufficient scale that have full-time, on-site personnel face different challenges than smaller nonutility-scale
plants do. With critical scale come efficiencies from increased labor productivity and quicker response times. However, smaller scale enables a more localized and diverse landscape of providers, thus allowing new entrants and presenting opportunities for the development of service efficiencies.

**Technology as a Differentiator**

Technology is allowing improved capabilities to be implemented across the O&M spectrum and is being employed as:

- A barrier to entry (via cybersecurity requirements).
- A cost-saving tool.
- An avenue for improved future performance.

Cybersecurity is a critical area of growing importance that creates both a barrier to entry and a differentiation factor for providers in certain markets. Meeting cybersecurity compliance requires strong capabilities in system security and benefits companies with built-in expertise (while acting as a barrier to others). This all contributes to a concentrated landscape of sophisticated utility scale O&M providers.

For example, at the centralized operations center of SOLV, a division of Swinerton and one of the leading solar O&M providers with more than 4GW under O&M, an in-house cybersecurity team of three people works to maintain the highest level of protection. “The cybersecurity aspect is a key hurdle that we are skilled at handling in-house, providing a critical capability that has helped SOLV lead in serving large utility-scale portfolios,” says Angelo Purpa, operations director.

Immediate response to performance guarantees is crucial in avoiding significant costs associated with unexpected downtime on large-scale utility portfolios. This economical driver for utility O&M providers pushes the continued implementation of technology to help avoid unplanned outages or material malfunctions.

The benefits associated with technological advancement and better utilization range from improved monitoring systems and software to more reliable and durable balance of system (BOS) components. Technology can also help address logistical challenges associated with workforce and inventory management. With the falling cost curve of many system components, O&M providers can leverage less expensive BOS components, leading to lower costs and better plant performance.

**What Does This Mean for Potential Providers?**

Opportunities for service providers are plentiful. Here are just three key areas to consider:

**Easy Opportunities Can Add Up.** Obtaining significant scale of solar PV under management might be a distant goal, but obtaining smaller scale by aggregating these projects can certainly add up. Service providers across the value chain have been leveraging this need, gradually growing their footprints and capabilities with each new asset under management. As long as O&M providers are serving these assets profitably and achieving critical scale, the portfolio impact achieved through this “bundling” can be significant. Providers can grow assets under management, both by serving self-constructed projects and as a third-party O&M provider—which is the ultimate goal of many large providers associated with major EPC or product companies.
**With Scale, There Is Demand.** While there are providers that have O&M business models that service projects they have developed, constructed and occasionally own, the ultimate goal for many is to be able to be a significant third-party O&M provider. The third-party O&M landscape does not currently have a large number of options for companies looking to enter the space via an acquisition. This creates an opportunity for smaller companies that can reach a critical scale (of assets under management) and those EPC, electrical and energy services firms that have O&M divisions of scale. Growing to become a third-party provider of choice has its roots in the ever-expanding landscape of power-producing assets. By expanding the O&M focus to include all of the distributed energy resources, the market opportunity and landscape of providers can grow significantly. Ultimately, the pairing of batteries with solar, wind and “negawatt”-focused initiatives will greatly increase O&M needs. Solar is a key component of that distributed energy resource (DER) portfolio.

**Long-Term Stabilization.** In addition to growing revenue and associated margin, long-term O&M contracts can add a valuable component of stability to historically project-based businesses. The value that consistent service contracts can add for these companies has internal benefits from the insulation it provides from market cycles as well as the potential value in the event of a sale of the company. In mature geographic markets, the pace of solar installations is more muted compared to emerging markets. However, the revenue stream from solar O&M could eventually rival development and EPC revenue streams. While in certain cases, margins remain modest (and can be subject to increasing pressure on larger and more competitive projects), providers focused on the midscale opportunities can often recognize healthy margins for these services.

Additional revenue streams (such as O&M) on the back end and development fees on the front end allow solar providers to offer the “full-service” package and benefit from diversified revenue streams for the entire project cycle. By acting as full-service providers, firms can effectively develop a “self-feeding” loop.

With a fragmented local and regional market for midsized projects, companies that are ready, willing and able to serve the solar PV market should take advantage of this opportunity. As solar PV continues to grow, and as additional DERs are added alongside it, the outlook for certain areas of the O&M landscape appears bright.

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A simple shift in perspective regarding boards of directors can lead to a cascade of the best decisions an E&C industry owner will ever make.

Sometimes it's hard to tell the difference between a threat and an opportunity.

One electrical contractor sees a clear trajectory in the growth of clean energy and complains that tax policy and governmental meddling give wind and solar an unfair edge. Meanwhile, a competitor across town is already building a strategy and positioning its business to dominate that emerging sector for years to come. Or consider the small to midsized heavy civil contractor that sees the nature of public infrastructure projects shifting dramatically—both in increasing job size and alternative delivery methods—and starts planning for an accelerated retirement. Another contractor sees those same trends and begins overhauling its business by forging new relationships with potential design-build and public-private partners.

Some of this difference in response is simply a matter of personality. For many, it’s about not knowing how to anticipate and take advantage of these disruptions to the status quo. In most cases, companies lack the internal talent to make what feel like seismic shifts in focus, because they’ve hired to meet the needs of their current reality.

Those who can’t answer the question “what’s next?” often find themselves stalling, hoping that clarity will miraculously show up like a sign from heaven. To quote former New York City mayor Rudy Giuliani, “…hope is not a strategy.”
One frequently overlooked means of preparing for the future is through a high-performing, strategically focused board of directors (BOD). Most FMI clients don’t utilize a true, functioning BOD beyond the minimum statutory requirements, and those that do have a functioning BOD often lack directors whose competencies and experiences are well-aligned to anticipate and execute on potential future opportunities. In both instances, the business lacks the right people in the right place to see beyond the day to day and craft a winning vision of the future.

Five Signs Your Board Needs an Overhaul
In FMI’s work with CEOs and owners across the industry, we frequently see evidence of BODs in need of a fresh infusion of energy and vision. Do these characteristics ring true for your board?

Any combination of these five factors can significantly hamper an organization’s ability to anticipate future trends and position itself for success. Even worse, without directors who can anticipate and respond, a company is at significant risk and may be left behind.
Identifying the Distance From Here to There

We encourage companies to start by assessing the competencies and experience of both management and directors compared to overall business needs in order to accomplish long-term strategic objectives. This comparison should span all major business functions (technology, people practices, market segment focus, operational excellence, etc.) as well as its characteristics (insiders vs. independents, degree of diversity, strategic thinking capacity, etc.) This process is commonly called a “gap analysis.” From this exercise will emerge substantial new information that helps a business owner or leader make decisions to close (and even eliminate) those gaps.

Next, ponder these critical questions relative to your business’s future and the BOD’s role:

- Does the organization currently have the necessary resources to achieve its long-term objectives?
- Conversely, do we have directors who are not adding substantial value toward the goal of building an exciting future for the business?
- What types of directors are needed to close the critical gaps identified?

Finding the Right Balance

Determining the optimal ratio of independent, outside directors and inside directors can be a challenge for any organization. For example, it’s difficult for people who work full time in the business to distance themselves from its politics and dynamics. Consequently, they may provide skewed evaluations that are motivated by purposes other than the accurate assessment of executive or organizational performance. A wealth of current research supports the inclusion of outside directors. Their valuable contributions include:

- With independence, the freedom to more effectively monitor the organization and deliver more objective decisions and recommendations
- More likely to ask objective questions, evaluating management and assessing firm performance
- More likely to exercise appropriate checks and balances with management
- Valuable in securing additional resources
- Bring new perspectives and ideas

Along with added value, there are potential challenges as well. Having a greater proportion of outside directors may also lead to:

- Increased conflict
- Reduced firm-specific knowledge, skills and information
- Lower group cohesiveness
Hence, while outside directors can greatly contribute to the BOD, there are strong reasons to include internal directors. Perhaps the most important reason to have director insiders is to prepare them for future leadership roles. By stepping outside their normal operational or tactical role on a regular basis, internal directors can learn strategic thinking skills, gain a broader sense of perspective and build relationships with other leaders.

Overall, it seems that a high-functioning BOD benefits from the right mix of independent directors and organizational directors.

**Factors That Matter**
Regardless of inside versus outside status, it is important to remember that subject matter expertise alone does not make someone a great director. In addition to having a reservoir of relevant knowledge, a strong advisor must:

- Model proactivity, offering ideas and information readily
- Display excellent listening, diplomacy, negotiation and communication skills
- Demonstrate both functional/general and firm-specific knowledge and skills

**A Case in Point**
Consider this real-life scenario: The CEO and independent directors of a regional electrical/energy services contractor approached FMI for advice on shaping the board’s future to better address the compelling challenges facing the business. The company generated approximately $250 million a year in revenue, with just over 800 employees and a strong presence in the Southern U.S. Performance was good: $15 million NIBT (6% net pre-tax) and a three-year trailing average annual growth rate of 7.5%. The BOD had set strategic goals of 10% compounded growth, primarily through expansion into the Northeastern U.S. markets. The key business risks were succession and commodity price fluctuation.

Internally, the company wanted to begin transitioning from a third-generation CEO to the fourth generation. The internal candidate was in his early 30s and unprepared to lead the business. The BOD wanted to hire a nonfamily CEO, most likely an external candidate.

Externally, more than 75% of the firm’s revenue was linked to the relationship of crude oil versus natural gas prices. When the spread of oil to gas was greater than a ratio of 20-to-1, the company couldn’t keep up with all of the work opportunities. Yet when it fell to a ratio of less than 10-to-1, there was little to no work. The midterm outlook was for a large spread, but rapid growth in the energy complex had resulted in a severe shortage of engineers and designers. As a result, the buyers of construction services began shifting the delivery method from a traditional GC to a more integrated EPC model. Thus, the availability of internal engineering resources became critical.

The firm’s BOD makeup was fairly typical in that the average director age was over 67, with board tenure being about 13 years, and all were Caucasian males. There were four internal directors (CEO, CFO and two next-generation family members) and three independent directors (a retired CPA—former managing partner of current auditors; an attorney—current corporate counsel; and a retired banker—former market president of the company’s current primary lender).
At this particular firm, BOD meetings were arranged around a single-page agenda prepared by the CEO with no input from other directors. There was no meeting calendar or predetermined rhythm of meetings over the year. Materials were distributed at the meeting—so there wasn’t time for advance preparation. The primary functions of the BOD were twofold: first, to approve dividends to shareholders and, second, to listen attentively as the CEO “pontificated” about current quarterly results.

These independent directors could see out far enough to anticipate some big challenges. They knew they had more to offer and were frustrated by the lack of opportunity to provide input.

**Taking Action**

After FMI’s assessment and recommendations, the following steps were taken over the next 18 months. Key changes involved BOD composition, which was modified extensively, with one replacement and two additional directors appointed:

- An internal director (the current CFO) was removed/resigned from the BOD. He was then replaced with an outside director who was a 30-plus-year retired COO from a similar business. The CFO continues to participate in BOD meetings as a member of management and as an observer, yet he has no vote.

- One additional fourth-generation director was added: the daughter of the current CEO who holds a Master of Business Administration from Wharton, and who is currently CIO of an international software company based in New York.

- One new independent director was added: an energy complex consultant with extensive knowledge of commodity price fluctuations and hedging strategies, who is also currently a director on the board of a publicly traded oil and gas master limited partnership. He was also the former owner/CEO of a Pennsylvania-based oilfield services construction company.

*Note: This maintains internal director control of board (five internal directors).*

The following BOD roles were also modified:

- One of the current independent directors (corporate counsel) was named lead director to partner with the CEO in setting the agenda and facilitating meetings.

- A new succession committee was formed and chaired by the retired banker (who still has access to the bank’s HR team and consultants) with the initial charter to launch the management succession and ownership transfer process, while doubling down on the inexperienced fourth-generation family member’s professional development.

- A new audit committee was also formed, chaired by the retired CPA, with the initial charter to develop strategies to lower commodity price fluctuation risk to the business.
Measuring the Results

By honestly facing the cold, hard facts around the gaps they saw, the gutsy leaders in the above example delivered immeasurable influence to bear on the future of this company. By making a few needed changes and a few key additions to the BOD, they found clarity around their challenges and took intentional deliberate steps toward their preferred future. Through it all they maintained a strategic focus, refusing to delve into operational issues in their quest for solutions.

For an owner/CEO, it takes significant ego strength not only to bring in outside directors with specific expertise aimed at the future, but also to actually empower those directors to affect change. For those individuals with the courage to share the strategic leadership platform, those dark clouds on the horizon that once looked like a vicious storm now begin to look like unprecedented opportunities. Rather than focus on a perceived loss of control or feelings of being accountable to others, a simple shift in perspective can lead to a cascade of the best decisions an E&C industry owner will ever make.

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Managing Risk in the Face of Industry Disruption

By Ryan Howsam

How smart E&C companies must get ahead of disruption by finding ways to adapt and innovate to remain relevant.

Technology is evolving at an exponential rate. In fact, approximately 90% of the world's current existing data have only been collected in the last two years, with the amount of data being produced worldwide now exceeding 1.8 zettabytes (which basically means there are now as many bytes held electronically as there are stars in the universe).

For engineering and construction (E&C) firms, harvesting this data, deriving meaningful insights from it, and then using those insights to drive business innovation to increase productivity and profitability are all critical to survival. Of course, these imperatives wouldn't be as disruptive had the industry evolved and advanced over the last two decades. Unfortunately, most firms lack the vision, strategic initiative, will or expertise—and most importantly, the financial capital—to evolve at a rate to ward off disruption.

For example, research and development investments are not part of the traditional E&C industry's vocabulary—the vast majority of contractors invest 1% or less of their revenue compared to other industries that invest conservatively an average of 2-3%, and rightly so. After all, the average general contractor's net profit margin is 1.46% (source FMI Insights; RMA). As such, there is little incentive to innovate because there is no significant return on investment, given the limited financial resources.
The problem is that only when your business model is obsolete do you realize disruption has occurred. Back in 1900, for example, Fifth Avenue in New York was filled with horses and buggies. By 1913, the horse and buggy had disappeared from the picture. A similar disruption took place in the photography industry, where Kodak's inability to adapt to digital photography (a technology it created) as a disruptive technology led the company to filing for bankruptcy. And AT&T, hoping to get ahead of the disruption curve, in 1985 hired consultants to project the usage of cell phones in the year 2000. The answer at the time was 900,000 users, concluding there was no need to adapt to a threat that wouldn't be disruptive.

The actual number of cell phone users in 2000 was 109 million, disrupting the antiquated business model, and AT&T's failure to adapt from a declining landline market resulted in missing out on a multitrillion-dollar opportunity in the marketplace. The question is, why can't companies, insiders and experts see disruption coming and leverage the opportunity effectively. How can E&C companies take advantage of opportunities resulting from disruption.

Driving Innovation Today
In his TEDxBerkley talk, “The Art of Innovation,” Silicon Valley-based author, speaker, entrepreneur and evangelist Guy Kawasaki illustrates why disrupters come from outside most industries rather than from within. He illustrates how, in the late 1880s and early 1900s, ice block cutters, sellers of blocks of ice, dominated the ice harvesting industry (9 million pounds of ice were harvested in 1900) in cold winter climates. Thirty years later the ice factory disrupted the ice block cutters with the introduction of the ice man, coupled with the rise of ice-delivery trucks that were no longer limited by season or climate. Then, another 30 years later, the ice factory was disrupted by the refrigerator, providing all consumers an in-home “ice factory,” regardless of climate, season or location.

Herein lies the real lesson in disruption: It rarely is led by the current industry experts or insiders. Ice harvesters did not innovate to become ice factories, and ice factories did not innovate to become refrigerator makers. “Most companies define themselves in terms of what they do, not as the benefits they provide,” Kawasaki points out. Thus, most disrupters are innovators from outside the industries that they disrupt. There are indicators that a similar “outsider disruption” is occurring in the E&C industry today. If you narrowly define yourself as a contractor who builds buildings, then you may be destined to stay on the builder’s curve.

Innovation occurs on the next “jump curve,” not simply by modernizing, but by creating an entirely new business model. This opens the possibility of being a disrupter by moving from defining your firm as a builder, for example, who stick-builds projects using craft labor, toward becoming an innovative construction manufacturer that leverages technology to reinvent the entire construction value chain.

Today’s Risk Environment: A Changing Landscape
Looking at E&C market conditions in the U.S. and Canada today—and barring any unforeseen events—project opportunities, margins and resulting profitability are all positive indicators of a robust climate. Broadly speaking, looking across the breadth of the built environment as a whole, industry backlogs are (on average) fully booked through the end of 2018, and the next 12 months should be as positive as—or even better than—2017 (see “FMI’s 2018 Overview” for more details).
FMI continues to see signs that the industry is becoming more sophisticated and company leaders are better educated and have increased aptitude to run their organizations effectively. However, when it comes to the “digitization” of E&Co, firms are lagging significantly. For example, the financial and insurance sectors are digitizing at a far greater rate than E&Co companies are, and they are adapting to the changing risk environment of disruption while others continue to do “business as usual” or innovate “around the edges.” The adoption of BIM capabilities that don’t go beyond clash detection and relatively small utilization of multitrade prefabrication on projects (see FMI’s recent offsite construction study) are indicators that firms are too slow to adapt to the rapidly changing business landscape (Exhibit 1).

Working with hundreds of E&Co firms, we have also witnessed a heightened risk awareness among business leaders and a certain level of unease about the future. In FMI’s most recent 2018 survey conducted with the AGC Surety Insurance and Construction Management Conference, over half of all respondents expect more change in the next five years than in the last 50 years combined (Exhibit 2). Those who expect change are over six times more likely to innovate than those who disagree that disruptive change is coming. The question is, are these firms truly innovating, or are they simply modernizing, integrating new technologies into their existing processes and operating models.
Given this dynamic, fast-changing industry context, company leaders need to focus on five key organizational areas in order to navigate the unsettled external factors shaping today’s E&C business environment. Following is a summary of these five root causes of contractor failure that we identified in FMI’s 2007 study “Why Contractors Fail” and that are still relevant in adopting to today’s digitized world with technology disrupters at the gate:

1. **Poor Strategic Leadership.** This remains by far the biggest reason for failure in today’s business environment, where strong leadership serves as a cornerstone for success in even the most difficult market conditions. For example, many firms ignore technology and innovation strategies in favor of the status quo and fear of change. Chris Daum, FMI’s president and CEO, recently stated, “Most importantly, owners and leaders of E&C firms must not mistake a healthy robust market as an excuse to practice business as usual. Instead, pay attention to the fundamental transformations and irreversible trends that are currently impacting the industry, look carefully at how you’re operating today, and then come up with ways to become more proactive about transforming your company to become even more competitive and agile in today’s new and changing marketplace.”

2. **Excessive Ego.** A majority of E&C firms still refuse to believe that their markets and business models are at risk of being disrupted by new technologies and external competitors such as Katerra, a technology firm that is changing the traditional construction business model. The mindset that “my business is different and will remain relevant” and that “true disruption is not going to occur during my tenure in the industry” might put more E&C firms at risk today than at any time in recent history.

3. **Too Much Change.** Many E&C firms are adopting technology, new systems and processes, led by new leadership with inexperienced hires. However, this adoption is occurring without the proper procedures, processes and accompanying training to facilitate change management for successful implementation. Our research shows that in 90% of the company-failure cases, “too much change” was a stated root cause and a crucial element in the actions that led up to the disaster. To avoid driving too much change in the organization and managing it more effectively, we suggest companies make a list of everything that’s new, including customers, projects, geographical targets, superintendents, project managers, systems, etc., to fully understand the speed of change the organization is currently going through. The more changes they can name, the higher the risk of failure. Therefore, it is critical to manage the rate of change on an ongoing basis, balanced with the necessity to adapt to irreversible trends.

4. **Loss of Discipline.** Successful construction firms tend to be extremely well-disciplined and well-informed in all areas of their businesses. In our research, most companies that experienced failure grew from small, regional operations into national powerhouses (e.g., J.A. Jones, Guy F Atkinson, etc.). Along the way, these firms almost universally lost their internal business discipline, became overall bureaucratic and started doing things outside of their core competencies. Today, advances in big data and information sharing are allowing companies to transmit knowledge across operations and place relevant information into the hands of those who need it most. Leadership teams that orchestrate effective information flow will see operational advantages—quicker decision-making, earlier identification of risks, increased employee engagement, etc. (see more details in our Quarterly article “Technology and Operational Excellence: Catalyst or Obstacle?”). Executives who don’t leverage data collection—and associated business intelligence—in strategic ways to improve productivity are putting their firms at risk.
5. **Inadequate Capitalization.** Most firms lack the financial resources needed to compete in the digital age and, as such, continue to funnel only a small fraction of their overhead dollars into innovation and technology. This was also confirmed in a recent JB Knowledge technology report, in which the authors reported the following staggering statistics:

- 46% of respondents have an IT budget of less than 1% (of annual sales volume).
- Almost 13% of respondents don’t know the percentage spent on IT.
- Only 50% of survey respondents have a dedicated IT department.

**Keeping Up With Change**

Today’s fast-paced E&C environment is pushing firms to reinvent themselves not only to keep up with the competition, but also to stay relevant in the future. The productivity status quo is demanding a better approach to designing, manufacturing and constructing projects, and requires a tight focus on the present while also keeping an eye on long-term positioning. And while technology and innovation are clearly industry disruptors, the most important thing to remember is that the core success of a business remains its greatest asset—its people. Where historically outsiders are the disrupters, E&C firms must prioritize technology strategies to innovate corporate cultures and antiquated mindsets to buck the status quo and embrace disruption as an opportunity to win in the future in order to remain relevant.

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How to select a technology solution that aligns with your company’s overall direction and optimizes resources and information.

Digital technologies are rapidly transforming the way industries conduct business. The engineering and construction (E&C) industry is no exception. To keep pace, many E&C firms are focusing on developing strength in adaptability—the ability to react quickly to opportunities or threats and implement changes effectively across the firm. In today’s world, lack of this ability can be fatal for any good company.

In this article, we discuss how technology is driving “adaptive operations” and provide recommendations on how E&C firms can effectively align and integrate today’s technology with processes, people and business intelligence.

It Starts at the Top

Company leaders must provide customers a clear and unique value and build capabilities to deliver that value consistently. Technology is an important tool that can assist in the delivery of such value. Therefore, leaders must strategically assess how technology will benefit the company’s operations and projects.

A clear value proposition drives an internal sense of urgency or cause for change and the ability to generate buy-in and clarity for the future vision. A shared purpose and awareness are essential to
driving change across the company, producing a more flexible and adaptive organization. Integrating technology across an organization is often done more effectively using small teams of peers piloting and leading “local” change.

Companies that are clear on their value propositions and that have secured buy-in can embrace the right technologies and implement them effectively. When a company applies technology appropriately to its operations, it can enjoy a competitive advantage.

“Wherever the new technologies have properly permeated this fragmented industry, the outlook is an almost 20% reduction in total life cycle costs of a project, as well as substantial improvements in completion time, quality and safety.”

How Today’s Technologies Are Driving Adaptive Operations

There are three digital capabilities that are greatly impacting operations. These alone are impactful capabilities. Combined with operations, they become “multipliers” of capabilities.

Data Capture and Analysis

As an industry, we generate extreme amounts of data; consider the number of estimates, submittals, RFIs, as-built, invoices, pictures and videos that we produce daily. Costs of storing data are increasingly inexpensive, allowing for effective managing and sharing of information and the opportunity to analyze big data through predictive analytics and performance dashboards, among many other things.

Today an E&C company can place sensors on buildings, equipment, vehicles, parts or other valuable components. These sensors track and report numerous variables, including, but not limited to, location, capacity, temperature, pressure, fuel levels and overall usage. Data collected from the readings can be used for tracking assets, predicting maintenance on equipment, planning projects, generating safety analytics, making schedule decisions and improving workflow and efficiencies.

Just how companies capture and analyze their data determines which strategic and operational advantages they have over their competition. Done well, companies focus on what matters and use data to improve their businesses—from accurate cost pricing to predictive business analytics.

Information Sharing

Never has it been as easy to transmit “almost real-time” information across a company, thus empowering the “edge” of the company with the accurate and timely information to make good decisions. Gathering information back from the field can be transmitted as easily and have incredible impacts across the company.

There are many digital technologies and tools that assist E&C firms with information sharing, including tablets, smartphones, BIM, VR, AR, cloud-based project management systems and client relationship management (CRM) software, to name a few. For example, BIM has been one of the most impactful information sharing solutions to hit the E&C industry. With BIM, multiple parties can interact with the same digital model of a project throughout the project life cycle.

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According to the World Economic Forum, “By providing a lifelong view of construction projects, including the TCO, it offers owners great benefits in the commissioning and operations phase, and enables new business models, particularly in asset management. Such a life cycle BIM eventually produces a continuous buildup of know-how by enabling a seamless flow of information across different construction phases and stakeholders.”

Advances in information sharing technology have helped companies transmit knowledge across operations and put relevant information into the hands of those who need it most. Leadership teams that orchestrate effective information flow will see operational advantages—quicker decision-making, earlier identification of risks, increased employee engagement, etc. And, as a result, the organization is no longer forced to rely on a fixed and static hierarchy of information flow and access.

**Value Provision**

Gathering, transmitting and analyzing data across projects allow firms to explore nontraditional business areas, including the overall supply chain, operations and maintenance, and a combination of assemblies. We are seeing new technologies impact the integration across project teams, enabling seamless information flow and even creating real-time awareness of materials in use across multiple project sites.

These changes are most evident with offsite construction and modular components and systems. As these delivery methods continue to gain momentum, owners are benefiting from reduced project risk, and E&G firms are recognizing increased productivity. In a 2017 FMI study, “Prefabrication: The Changing Face of Engineering and Construction” participants reported that the need for productivity was a key factor influencing the demand for prefabrication (Exhibit 1). Companies that can implement offsite construction and modular components will be positioned to leverage the opportunity and capture more market share across the value chain.

The costs involved in these capabilities are not significant, allowing any size firm the ability to embrace and gain (or enhance) capabilities to better serve its customers. In some cases, smaller firms that employ the concepts and integrate them into their operations program may see disproportionate gains among their competition.

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How to Get Started

Before investing in technology to improve operations, firms should ask themselves the following questions:

1. How will the technology add value for our customers? Our company?

2. How will the technology impact our existing systems and structures? (people, culture, skills, resources, policies, etc.)

3. Does the technology have to integrate with existing systems?

4. How will we get our team to embrace technology? What time investment and resources will be required?

When considering technology solutions that drive operational capabilities, we also recommend making the decision in the context of “FMI’s Operational Excellence” model. Over the years we have worked with hundreds of clients to improve their operations. Through this work, we have found that there are three primary elements of operations that a company should be focused on: direction, engagement and optimization. When all three of these elements are functioning effectively, companies can achieve true operational excellence (Exhibit 2).

If a firm chooses a technology solution that aligns with its overall direction and optimizes resources and information—and if it engages its staff throughout the implementation of the solution—then technology can be used as a catalyst for operational excellence.
Embracing Change
As the E&C industry continues to evolve, companies must aggressively embrace change and adapt. We know that digital technologies have the potential to positively impact most, if not all, operational performance objectives (e.g., cost, schedule, quality, speed, etc.) for many E&C firms. Firms can boost that potential by implementing technologies that are in concert with the three elements of operational excellence: direction, engagement and optimization. In the end, technology can serve as a critical catalyst that helps a company adjust and adapt to the evolving built environment.

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A look at what types of employees the E&C industry will need over the next few years and how top companies are working to fill those positions now.

As the U.S. business climate continues to improve and as the labor market tightens, this year is likely to be just as difficult for engineering and construction (E&C) firms that need to fill key positions within their ranks. According to the Bureau of Labor Statistics’ most recent numbers, total nonfarm payroll employment increased by 200,000 in January 2018, and the unemployment rate was unchanged at 4.1%. Construction led the pack in new job creation, followed by food services and drinking places, health care and manufacturing.

Construction added 36,000 jobs in January, the BLS reports, with most of the increase occurring among specialty trade contractors (+26,000). Employment in residential building construction continued to trend up over the month (+5,000). Over the last 12 months, construction employment has increased by 226,000 workers.

These numbers should get E&C firms’ attention. This year, 75% of U.S. contractors have plans to add to their workforces, according to a recent AGC survey. Concurrently, the growth expectations within the industry remain strong, even after several years of expansion. While promising for the industry at large, the healthy business environment will most benefit those firms that have already identified their target job roles and are acting quickly to recruit or internally develop candidates to fill these future critical positions.
Help Wanted
In FMI’s recent talent development study, 89% of contractors reported difficulty finding qualified workers to hire, and the vast majority believe the challenge of attracting and retaining staff will only intensify (Exhibit 1).

So how can companies prepare for the future with the best possible workforce? This is the million-dollar question in today’s business environment, where these five strategies can help firms prepare now for the workforce of the future:

1. Strategic Planning and Execution
   From time to time, companies will take an approach of bringing on “the best, no matter what” and then find a role for the new hire; but this rarely works favorably in practice. More often than not, the company finds it has overpaid for an employee who isn’t performing well in a role that was never well-defined. E&C firms should instead take a conscientious look at their operational status and ask themselves questions like: Where are opportunities? What competitive advantages do we have? Can we beat established competitors and other firms that are pursuing the same opportunities? And what are our financial goals, including owner expectations, bonding requirements and so forth? Use the answers to these questions to develop a broad strategy for your individual business and be sure to factor in talent needs and employee compensation.

2. Consider Future Staffing Needs
   Effective planning is key, but without proper execution, E&C firms risk both future financial performance and their reputations. Taking the time to evaluate current employees’ skills, knowledge and abilities (KSAs) against those that are most likely needed to complete future projects is essential. Even top performers with the inadequate qualifications are destined to fail unless sufficient resources are devoted to training and development.

Each year FMI requests input directly from leading contractors regarding “hot jobs” and new jobs that should be included in future surveys. Interestingly, the areas attracting the most interest for 2018 are not operational roles, but, instead, key support functions, including safety, risk management and marketing/business development. There are two primary reasons for this:

1) These roles have been slow to be established among smaller contractors, and as companies seek to take advantage of the industry’s growth, these areas must be addressed immediately and effectively.

2) There is a natural and obvious evolution to safer work environments and projects, and coupled with potential savings through risk management and revenue growth through business development, these three functions can be continuously improved upon for the benefit of the firm.
One recent article speculated on why craft shortages exist when the potential income opportunity is so high relative to U.S. average pay. However, as the industry seeks to take advantage of technological innovation, construction professions may become more attractive to younger workers. For example, FMI has observed significant heightened interest in BIM/VDC compensation levels in recent years and expects the trend to continue as virtual pre-construction becomes commonplace and as remote work sites become possible for many positions, given evolving technology advancements.

Going forward, contractors should assess the current workforce, with an eye toward future expected needs—which may be defined by specific jobs, KSAs or functional areas, and develop a workforce staffing plan that considers human resources as well as available technological support systems.

3. Know the Market

Understanding the marketplace can be as influential on talent management as the staffing plan itself. For example, one E&C firm may want to recruit business development positions in the highly competitive, union shop-heavy Mid-Atlantic, while another firm recruits for a project executive in the active, but largely settled Midwest. These two markets are dramatically different in terms of labor supply, market span and relative competitiveness. As a result, firms must consider the recruitment pool—including where candidates might come from—when organizational size, headcount, geographic location and industry are key criteria to consider.

The rate of salary growth is also a natural indicator of market conditions. A market that is undergoing expansion, particularly when combined with a shortage of qualified labor, generally leads to accelerating salaries. The red areas identified in Exhibit 2 are regions recognized as having the highest pay increases for project managers in FMI’s latest “Construction Professional Compensation Survey.” Conversely, the blue areas highlight slower salary growth rates.

Though not surprising, it is worth noting that no U.S. location surveyed shows a trend for pay reductions. With the National Center for Construction Education & Research, among others, predicting the construction worker shortage to rise well above 1 million by 2020, we can expect salaries—and the rate of salary increases—to continue to rise. The greatest gaps exist for craft labor.
4. Gauge Employee Perceptions
Along with understanding the external influences on pay, gathering employee input on compensation programs is also important. You can do this via one-on-one discussions with management, focus groups reflecting similar roles, or employee surveys. Senior management and owners should have a sense of what employees think of their compensation packages and what elements have the most benefit and lasting impact.

Employees working for fast-paced, technologically advanced design-build contractors are best-suited for less competitive salaries that are offset by lucrative incentives, which include synthetic equity to resemble high-tech firms. But without knowledge of perceptions and values among the workforce, management is only guessing based on what others are doing, or worse, what “feels right.” However, employee views should not be the sole, or even primary, determinants of the structure of compensation packages. (Hint: See #1 above.)

5. Set Aligned Compensation Packages
As we evaluate the industry outlook, there are multiple factors to consider, especially when it comes to the war for talent. When developing an “aligned” compensation package, these previously identified task outcomes should be considered:

- Corporate strategy
- Staffing needs
- Labor market conditions
- Employee perceptions

Armed with this information, management can develop a talent management strategy for attracting and retaining the necessary positions. Then it can create or revise supporting compensation and benefits programs that recognize and reward staff for achievements that advance overall strategies. Based on the quality and quantity of talent needed across various job functions, a firm may consider one or more of the following pay approaches:
Top grading
Identify the most important employees in the firm and make sure they’re getting the most advantageous compensation packages. The employees who fall into this category may be determined on a highly subjective basis, provided there is a justifiable, and documented, rationale. They may be the highest performers, have the greatest potential, be recognized as future successors, serve in key job roles or management levels, or any combination thereof.

High-performance orientation
Many E&C companies are progressively working toward a more performance-driven organization to reward top contributors to corporate success. As a result, salaries may simply keep pace with cost-of-living adjustments, but high performers receive bonuses that are notably higher than average and low performers. Some firms may double down on performance by providing higher bonuses and higher salary increases to high performers. By awarding little to no incentive pay to others, a company can still maintain a conservative budget for raises and bonuses.

Mission-critical distinction
Evaluating jobs for relative importance can play an important role in determining staffing needs and employee compensation plans. Some companies develop a checklist or voting system among senior leadership to identify jobs that are essential to ongoing organizational performance and then develop an aggressive approach for recognizing and retaining employees in those jobs through compensation, development opportunities and other benefits.

One-time incentives
Most companies should not make regular use of one-time incentive awards, particularly if those rewards are largely discretionary, as these can create confusion, entitlement and jealousy among employees. However, sign-on bonuses for highly valued or difficult-to-hire jobs may enhance a firm’s ability to quickly attract good candidates. For example, monetary recognition through a modest pay increase or one-time award may be appropriate for an employee who assumes extra duties or earned a new certification that will benefit the firm. In these instances, the increase should be temporary (if the expansion of job roles is not permanent), and there should be a clear policy related to employee changes that warrant a pay increase or bonus.

Total rewards optimization
As new technology systems help E&C companies better monitor talent management activities, understanding the needs and wants of the workforce will get easier. Over time, firms will have employee data that can allow for customized total compensation programs. This way, employees who are good workers—but who are more settled in their roles—might receive packages that are benefits-heavy and have incentives for providing training and collaborating with others. On the other hand, high performers seeking promotions may receive compensation packages that are skewed by merit and achievements, with rewards for pursuing new skills.
Workforce Planning for the Future

Every firm is different, so there is no “right” or “wrong” way to prepare for the E&C workforce of the future. There is also no best path to recruiting and retaining the most suitable workers, but companies that take a thoughtful approach to their employment needs will be best-equipped to thrive. With the right people in place, it’s much easier to capitalize on future opportunities, persevere through cycles and overcome critical challenges.

As outlined in this article, the key considerations during this process include an array of factors that range from job function to organizational level to work location. Other important factors include less tactical characteristics like workers’ values and perceptions. Once an E&C firm’s talent needs are known, different compensation strategies can help that company attract, motivate and retain the ideal workforce. With these strategies in place, companies can start to piece together the picture of their future workforces and work toward turning those ideas into reality.

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Addressing the Workforce Gaps and Related Risks for the E&C Industry

By Jon Tate

Assessing the role of emerging technologies in easing workforce gaps for engineering and construction firms.

The robust construction industry projections for 2018 (FMI forecasts a 5% increase in total spending this year over 2017\(^1\)) are being tempered by the continuing challenges of a shrinking workforce. Although a Bureau of Labor Statistics report from January 2018 projects construction employment to grow 12% through 2026, faster than the average for all occupations, filling jobs will continue to vex an industry that’s ready to hit the gas pedal.

In an Associated General Contractors of America (AGC) survey, 70% of construction firms reported difficulty filling the hourly craft positions that represent the bulk of the construction workforce, and the majority foresaw continuing hardships in the future.\(^2\) In addition, the AGC estimates that 3.7 million construction workers will be approaching retirement age by 2027, with a smaller pool of younger workers with the skills to replace them.\(^3\)

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An Industry That’s Innovating

Industry innovations couldn’t come at a better time, particularly as engineering and construction (E&C) projects become more complex and demanding. Technology, modularization, and project delivery and management—all of which can increase productivity, communication and efficiency—can help fill the gaps created by a smaller workforce. Some of these tools can also help mitigate risk by replacing onerous and/or dangerous tasks previously performed by workers. Finally, implementing this technology can help attract a younger generation that is not only equipped to do the work but also excited about the possibilities.

Yes, technology can be costly. Yes, it’s constantly evolving, demanding flexibility and nimbleness on the parts of stakeholders. However, technology is a reality. And as it continues to evolve, E&C firms need to keep pace with the competition.

Though technology does impact upfront expenses, a recent study showed that if E&C companies can help close the global labor-productivity gap in construction using these new tools and solutions, the industry’s output would increase by $1.6 trillion per year.4

It’s also worth noting the costs associated with having too few workers. A Construction Industry Institute report linked workforce shortages to risks in three key elements of project execution. The report found that depending on their severity, labor shortages could negatively affect safety, raise costs by creating project escalations of more than 17%, and adversely impact schedules, causing projects to experience delays of more than 22%.5

Many of the emerging technologies and innovations available to E&C can help address these profound shortages. Though some—such as drones—may be familiar, their potential continues to evolve in newfound ways. Here are snapshots of some of the most exciting developments.

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5 “Is There a Demographic Labor Cliff that Will Affect Project Performance?” Construction Industry Institute. 1 September 2015.
Technology

- **Building Information Modeling (BIM)** has arguably been one of the most important technological advancements in the E&C industry. The three-dimensional successor to Computer-Aided Design and Drafting (CADD), BIM has revolutionized the way structures are designed and built. A design team can now “virtually” create an entire project down to the last minor detail before even putting a shovel into the ground. A 3-D virtual reality walkthrough of the project can be performed to check design details, functionality, constructability and clash detection. In an article focused on design and construction, Digitalist Magazine reported, “SAP estimates that this digital process for facility life cycle management will result in 10% fewer engineering changes, 45% less rework and 79% lower accident frequency.”

BIM allows all the various subcontractors and suppliers to provide input for their particular components. Any changes can be made prior to the start of fabrications. The model also can incorporate a timeline for schedule, labor and cash flow, creating substantial financial efficiencies.

- **Robotics** includes any type of machinery that enhances or replaces the human worker. Under this definition, a power tool, bulldozer or excavator could be considered as a type of robotic. Looking ahead, the newer technologies fall under the prime categories of “autonomous” and “assistive.” Much of this technology is still very new but is poised to transform the industry.

  **Autonomous robotics** refers to machines that can perform semi-complex tasks with minimum human oversight. Examples could include robotic bricklaying equipment, reinforcing bar-tying machines, laser-guided graders and excavators.

  **Assistive robotics** encompasses the self-supporting exoskeleton type of apparatus that workers wear to enhance their lifting and carrying capabilities and help prevent fatigue and injuries. These robots bring the technology used in the manufacturing industry out to the job site. In addition to improving worker safety, these devices can increase productivity.

- **3-D building printers**, which can also be considered a type of robot, function similarly to commercially available small-object printers but on a much larger scale. Utilizing a flowable, fast-setting concrete-type media, these printers are primarily used for footings and walls. Their advantages include a reduction in overall time and labor, elimination of formwork, ability to print complex-shaped structures, and fewer layout errors. 3-D printers remain an emerging technology, but tremendous advances have been made in the past few years, with many unique and functional structures having already been printed.

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- **Unmanned Aircraft Systems (UASs)** are commonly (and somewhat incorrectly) referred to as drones. This technology has probably experienced one of the biggest growth areas in construction. Drones (aka unmanned aerial vehicles, or UAVs) started out taking progress photos of a project. Today, equipped with a wide array of software applications and cameras, UAS’ potential has blossomed: They still capture progress photos, but they also can overlay that information with the BIM model, letting engineers and contractors see what they envisioned against what actually exists. It doesn’t stop there; monitoring various types of measurements, safety, quality control and worksite security are just a few additional benefits.

- **Wearable device systems** worn by employees (attached to clothing or on safety equipment, such as hard hats) keep everyone connected and help improve efficiency, productivity and safety. Smart goggles can use augmented reality to access a BIM model with the blink of an eye. Wearables can capture and monitor data in real time, such as determining workers’ precise locations and movements to identify workflow efficiencies, locating workers in the event of an emergency, alerting personnel when they’re entering a restricted area, or performing a task in an ergonomically harmful way.

**Modularization**

Modularization, which allows a building’s components to be produced in a controlled, off-site environment, can be a boon to an industry grappling with workforce shortages, tighter schedules and the subsequent threat of schedule delays. In addition to construction taking place at the same time as site and foundation work, building in a controlled environment provides many other benefits, including: a greater likelihood of producing a more consistent-quality product, less work to do out on the job site itself, lower turnover rate of workers when compared to the turnover on job sites, and a decrease of weather challenges. Modularization also facilitates prefabrication, another antidote to E&C’s emerging needs that also delivers increased efficiency, consistency and safer working conditions.

**Project Management and Delivery**

Innovative project delivery and management methods such as design-build, integrated project delivery, lean and bundling will continue to grow in popularity as owners, engineers and constructors experiment with ways to more successfully deliver projects. Here are two that we think deserve attention:

- **Lean project delivery (LPD)** was brought into the design and construction fields as a response to the dissatisfaction of stakeholders in the industry. Compared to many other industries, construction labor efficiency and productivity continue to be a challenge.

  LPD seeks to improve project outcomes by fostering collaboration, enhancing accountability, reducing waste, ensuring a smooth flow of value-added activities and encouraging continual improvement in the preconstruction and construction processes. Lean construction is a production management-based approach to project delivery that changes the way work is done throughout the delivery process, extends from the objectives of a lean production system utilizing specific techniques, and applies them in a new project delivery process. Lean tools and concepts commonly used on projects include daily stand-up meetings; weekly work planning; pull planning; six-week, make-ready schedules; prefabrication of construction material; just-in-time deliveries and “nothing hits the ground” concepts.
Prevention through Design (PtD) was developed in the industrial and manufacturing industries to ensure that safe work environments were incorporated into the layout and design of a new or renovated facility. An emerging practice in construction, PtD finds designers and contractors—early in the design process—improving job-site safety by using BIM, wearable devices, robotics and UASs to eliminate many of the hazards normally encountered on a job site.

The design phase includes elements that may incorporate a plan for safe access or egress to confined or elevated areas, tie-off points on structural elements, and the movement of equipment and material. Employers pay almost $170 billion per year in costs associated with occupational injuries and illnesses; OSHA estimates that safety and health management initiatives can help save 20 to 40% of these costs.

More to Come
Data and information collaboration, always an essential part of any project, will be transformed in the coming years. A common thread linking all these new technologies and innovations is the availability of enormous amounts of data, with information being collected at a high rate of speed from multiple sources. Collaborative cloud platforms enable project participants located around the world to instantly receive and respond to the updates, questions and issues that typically arise during a project. This world of shared data creates opportunities for a new kind of construction worker, offsetting the challenges as the E&C industry builds for the future.

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7 Occupational Safety & Health Administration. "Safety and Health Add Value to Your Business."
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For over 65 years, FMI has been the leading management consulting and investment banking firm dedicated exclusively to engineering and construction, infrastructure and the built environment.

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