



FMI

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# FMI QUARTERLY

## TOP 10 HITS FROM THE PAST DECADE

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# FMI QUARTERLY 2020

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# FMI Quarterly: Top 10 Hits From the Past Decade

By Chris Daum



Welcome to the first edition of the 2020 FMI Quarterly. As we enter a new decade, we thought it would be helpful to look back at the past 10 years and highlight some of the articles that had the greatest impact on our readers. These topics are still relevant in today's Built Environment and cover a broad range of industry issues.

Our authors provide updated introductions to their articles and describe how and why these topics remain relevant for today's business leaders.

Leading off this edition of the Quarterly, are two strategy articles that executives should take to heart in today's unpredictable business environment. Rick Tison, FMI's strategy practice leader, discusses four cornerstones of an adaptive strategy and comments on how to think about strategy in a time of industry disruption.

This is a time when E&C leaders need to ask themselves: How do I create a coherent and flexible strategy that allows my company to take advantage of the strong operating environment we're in today (in terms of backlog and available work) while also watching the horizon? This is critical because external factors (e.g., the corona virus COVID-19) could have a swift impact on today's operating environment.

Other articles address succession planning, risk management, the emergence of big data and its application across the industry, and how construction technology and innovation are gaining momentum in all sectors of the Built Environment.

And finally, we again bring forward an updated article about why contractors fail. Perhaps no other research-based article in the history of FMI—let alone the Quarterly—has had a greater impact on contractors than this seminal article about what causes contractors to get into trouble and ultimately fail.

So, as we look forward to an exciting but unpredictable new decade filled with change, we hope you'll enjoy taking a quick look back at 10 articles that Quarterly readers have engaged with the most. Use them to prepare to compete and succeed in the coming decade.

We hope you enjoy this special edition and thank you for being a loyal reader of FMI's Quarterly.

# Strategy in a Time of Industry Disruption

By Rick Tison

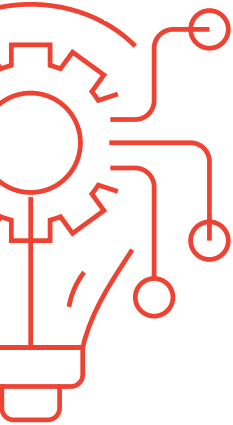




This article was written in response to the rise of venture capital focused on construction technology and disruptive startups, such as Katerra. In it, by examining case studies from other industries, we explored how industry disruption was unfolding. The article is as relevant today as when it was written; these drivers are just as present now as they were then.

For our research, we reviewed case studies such as Apple's disruption of the music industry, Netflix's disruption of Blockbuster and Kodak's failure to adapt to digital photography. Based on our evaluation, the notion of disruption as a "tornado in the night" is misguided. Instead, disruption follows a pattern similar to that of a hurricane—a force we see coming but can only avoid by staying out of its path. In each case, there was ample warning for incumbents to stay ahead of changes that undermined their business models, although each failed to do so for a variety of reasons, as we explored in the article.

As we look to the potential impact of industry disruption on the Built Environment, we would expect a similar pattern. When innovation and technology do significantly change how the industry operates, there will be companies that don't make changes necessary to stay ahead. At the same time, there will be others that do stay ahead. The primary difference between the two will come down to adept leadership with a disciplined focus on how to best serve client needs in the face of a changing industry landscape.



# Strategy in a Time of Industry Disruption

By Rick Tison

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

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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.<sup>1</sup> 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**).<sup>2</sup>

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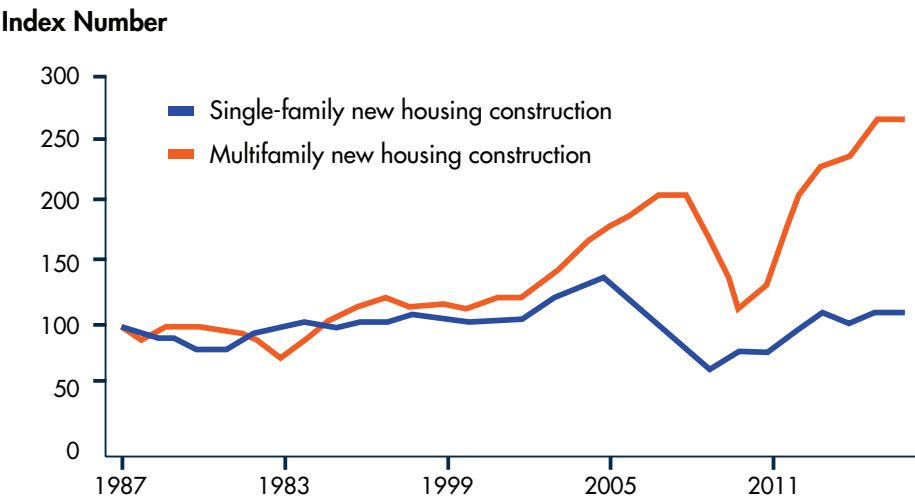
<sup>1</sup> Naughton, John. "Microsoft Once Ruled the World. So What Went Wrong?" The Guardian, Guardian News and Media, 18 Aug. 2012, [www.theguardian.com/technology/2012/aug/19/microsoft-ruled-world-what-happened](http://www.theguardian.com/technology/2012/aug/19/microsoft-ruled-world-what-happened).

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<sup>2</sup> Ze, Alisa. "Productivity Gains Found in New BLS Data." Engineering News-Record, 1 Feb. 2018, [www.enr.com/articles/43906-productivity-gains-found-in-new-bls-data?id=43906-productivity-gains-found-in-new-data](http://www.enr.com/articles/43906-productivity-gains-found-in-new-bls-data?id=43906-productivity-gains-found-in-new-data).



**Exhibit 1.** Index of productivity (output per hour) in single-family and multifamily new housing construction, 1987-2016 (base year 1987=100)



Note: Recession periods are July 1990 to March 1991, March 2001 to November 2001, and December 2007 to June 2009, as determined by the National Bureau of Economic Research.

Source: U.S. Bureau of Labor Statistics

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.

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.

## 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.<sup>3</sup>

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.<sup>4</sup> 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.<sup>5</sup> 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

<sup>3</sup> Downes, Larry, and Paul Nunes. "Blockbuster Becomes a Casualty of Big Bang Disruption." Harvard Business Review, 7 Aug. 2014, [hbr.org/2013/11/blockbuster-becomes-a-casualty-of-big-bang-disruption](http://hbr.org/2013/11/blockbuster-becomes-a-casualty-of-big-bang-disruption).

<sup>4</sup> Joseph L. Bower and Clayton M. Christensen. "Disruptive Technologies: Catching the Wave." Harvard Business Review, 11 Jan. 2017, [hbr.org/1995/01/disruptive-technologies-catching-the-wave](http://hbr.org/1995/01/disruptive-technologies-catching-the-wave).

<sup>5</sup> Anthony, Scott. "Kodak's Downfall Wasn't About Technology." Harvard Business Review, 24 Apr. 2017, [hbr.org/2016/07/kodaks-downfall-wasnt-about-technology](http://hbr.org/2016/07/kodaks-downfall-wasnt-about-technology).

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.” Kattera is a potentially disruptive innovator that is testing that assumption. Kattera’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 Kattera a successful industry disruptor, it does prove the case that disruption is possible in our industry. Kattera 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.<sup>6</sup>

<sup>6</sup> Merced, Michael J. De La. “Kattera, a Construction

## **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 high-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.

### **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

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Start-Up, Raises \$865 Million.” The New York Times, 24 Jan. 2018, [www.nytimes.com/2018/01/24/business/dealbook/kattera-softbank-vision-fund.html](http://www.nytimes.com/2018/01/24/business/dealbook/kattera-softbank-vision-fund.html).

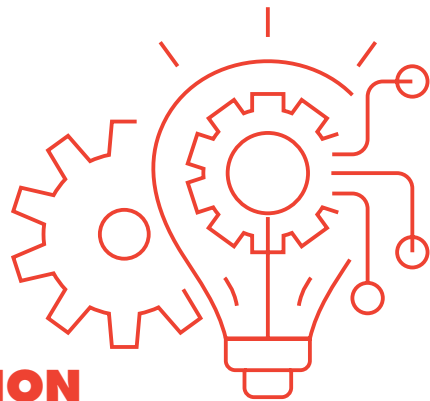


core customers, who wanted to rent new releases on demand. Blockbuster failed to appreciate that not all consumers of its movie rental offering valued the “new releases on demand” component of its offering. Other customer segments valued broad selection and did not mind waiting for them to come in the 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 the 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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# Four Cornerstones of an Adaptive Strategy for E&C Companies

By Jason Baumgarten and Rick Tison



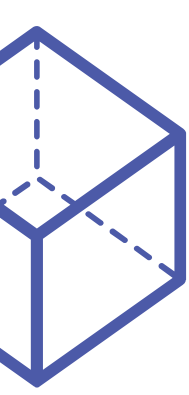


In a world and industry where the pace of change is growing exponentially, this article is a timeless reminder of how the management teams of best-in-class companies should be creating and implementing their strategies. The article was written in 2016 in response to rapid changes in an industry that was finally recovering from the Great Recession.

Back then, industry leaders were in the process of shifting from recovery to how to make the best decisions with limited resources and where to place bets on the most profitable growth opportunities. Fast-forward to today, and the industry has changed substantially and experienced continued strong growth with a limited supply of talent. This has led to significant changes in technology, innovation, project selection and collaborative building models.

Every contractor is dealing with its own particular context, and the “4C Framework” is a practical tool for defining your company’s specific strategy. It starts with clearly defining the four C’s of climate, customers, competitors and company. This is achieved through a fact-based, data-driven approach of research and analysis (and not through opinion). Defining context in this way allows management teams to align perspectives around a common and shared understanding of the current business environment, which ultimately leads to more effective decision-making.

Real strategic change only occurs when everyone on the management team is aligned around the context, the ensuing vision and the strategy itself. With the pace of change moving faster and faster, continuously updating your context—and adapting your strategy to the changing context—will differentiate good strategy from great strategy.



# Four Cornerstones of an Adaptive Strategy

By Rick Tison

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*How leading companies are using context analysis to drive their organizations forward when the foundation for strategy formation is shaky and untenable.*

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Baseball legend Yogi Berra famously quipped that, “It’s tough to make predictions, especially about the future.” His assertion seems even more accurate today when the pace of change in business, geopolitics, technology and nearly all facets of life seems to be in a constant state of acceleration. Classic approaches to strategy leave business leaders charged with navigating today’s environment feeling ill-equipped. The notion of a “normal” planning cycle no longer applies, harkening back to what we may now view as simpler times. In fact, for the majority of engineering and construction companies, standard three- to five-year business plans are no longer relevant in today’s constantly evolving business environment.

This is a fundamental challenge and frustration for many company leaders. In order to succeed, strategy must align with current and anticipated business conditions while those conditions are ever-changing and hard to predict. The question that is often asked is: How can leaders use strategy to drive their business forward when the foundation for strategy formation is so untenable?

The answer to strategy’s unfortunate reality comes from strategy itself. Put simply, strategy is no more than understanding the

current situation, deciding how best to respond, and acting on those choices. A general assessment of operating in today’s world is that context does not change in easy to foresee ways.

To that end, we present a framework for adaptive strategy that allows leaders to comprehensively assess their business surroundings—or context—in order to identify and monitor key factors influencing their daily “ecosystem.” This allows leaders to develop strategy based on that understanding and then monitor those key factors and adjust as needed throughout implementation.

The model presented is based on several years of successfully analyzing context during strategic planning endeavors with hundreds of executive teams in the engineering and construction industry.

## Why Context Matters

Developing strategy starts with an understanding of the current context. Context is the ever-changing picture of your business and its environment that blends the macro drivers of demand, the competitive landscape and customer needs with a company’s

capabilities and constraints. Understanding context creates the foundation for developing meaningful strategy. An effective assessment of context also allows leaders to identify opportunities in the marketplace that the company can exploit—and the challenges it must overcome in the process.

As an example, understanding the outlook for demand through a market forecast without understanding customer and competitive implications is not enough. What if demand is growing but customers are unable to fund necessary investments, as is the case in U.S. water infrastructure? Or what about a segment with significant long-term drivers for demand that is facing tremendous regulatory uncertainty, as is the case in health care design and construction?

In both instances, understanding the drivers of market demand is necessary but not sufficient for making strategic choices. Leaders must also understand how those drivers will translate to customer demand, how that demand is currently being served, how it may be served differently in the future, and how well their business can serve customer needs relative to the competition.

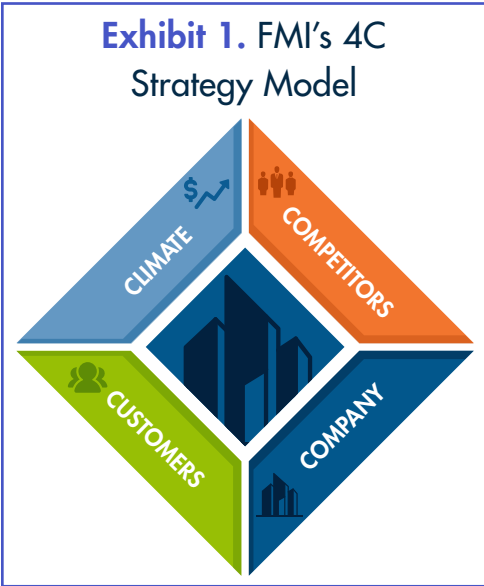
Proactive leaders keep a pulse on key factors influencing their business environment and monitor those external and internal dynamics on an ongoing basis. Indeed, they anticipate and prepare for different contingencies while taking a probabilistic view of the future as it relates to the factors influencing the big picture.

For example, a decline in tax dollars allocated to K-12 education is never good news for a business that depends on those dollars for projects. The relevant question, however, is not simply the directional question—is funding increasing or decreasing?

It is instead one of magnitude—at what percent decline in school funding would K-12 no longer be a priority segment for the business? Identifying the critical factors—and understanding the boundaries of any strategic option—allow leaders to know when to make a change instead of waiting for the negative effects to show up on financial statements (a lagging scorecard for business decisions).

## The Power of the Big Picture

A firm’s strategic direction ultimately depends on gauging the business environment correctly. Indeed, everyone needs to see and understand the big picture. Unfortunately, when developing and implementing strategy, companies generally lack a meaningful model or tool for assessing and monitoring context. To help fill this gap, FMI has been providing guidance on this topic for several years. The culmination of these efforts, the “4C framework,” provides a practical tool companies can use to evaluate critical elements of context.



Source: Model is based on in-depth industry research



Following is a breakdown of the 4C model and recommendations for leveraging them in today's constantly evolving construction and engineering environment:



Some of the most common mistakes we see companies make include complacency around market understanding; not conducting thorough research on external market forces (e.g., laws and regulations, technological advances, socioeconomic changes, etc.); and a leadership team that's slow to react and respond to changes.

By understanding the industry outlook for the next six to 12 months, firms can essentially get outside of their own four walls and develop adaptive strategies that factor in not only their own activities, but also those that are taking place around them.

Stock market activity, GDP growth, labor market trends and building cost fluctuations are all examples of key economic indicators that can have a significant impact on a firm's short- and long-term business strategy. These indicators will also help answer questions like:

- What is the demand outlook for our services?
- What are the drivers of that demand?
- How do we anticipate these demands changing over time?



Not all customers are alike. In fact, research indicates more partnering or long-term relationships among owners, contractors and designers, as well as increased specialization to suit the customer's unique needs. This, in turn, implies the importance of a good match between firm and client.

For example, today's engineering and construction firms realize that customer feedback and maintenance of existing customer relations are crucial to their endurance. Some vital questions to ask when looking at your client base include:

- Who are our current and prospective clients?
- How do they procure our services?
- Why do they buy our services?
- How do they perceive us relative to our competition?
- Are our clients well-positioned for the future?
- Would our clients recommend us to another company?
- How convinced are our clients of our value?
- Where do our missions overlap and where do they differ?

Exploring these questions will not only ensure that you garner honest feedback in areas for potential improvement, but they also reveal the efficacy of your business development and marketing efforts.



## Competitors

Short of devolving into commoditized low-bid operations, the smart engineering and construction firm wants to find a long-term space of its own by differentiating its services and targeting its audience with acuity. But when owners are inundated with dozens of proposals for a single project, individual strategy is often muffled by cries of “me too!” When everyone claims to be customer friendly, on budget, on time and superior in technological capability, there is no differentiation. The challenge is for firms to ask themselves, “What makes us unique?”

An effective way to assess your customers’ needs is by modeling your strengths and weaknesses, and those of your competitors. Ask questions like:

- Who are we competing with to fulfill customer demand?
- How do they compete differently from us?
- How do we anticipate the competitive landscape changing over time?
- Where are our competitors’ vulnerabilities?
- Where do our strengths overlap?
- Where are our services and strengths uncontested?

By building a holistic view of all advantages encompassed by your firm’s name—its resources, people, client relationships, assets and culture—you can begin to move beyond the value-cost tradeoff and create new demand.



## Company

In today’s fluctuating economic environment, design and construction companies must continually re-evaluate their cultures, core competencies and relationships; assess their competitive environment and client base; and implement strategic and operational changes to adapt to their new surroundings.

If this sounds like it’s easier said than done, there are several paths that design and construction firms can follow to exploit their unique attributes and features. A good starting point is to simply ask yourself questions like:

- How well-positioned are we to exploit market opportunities?
- What are our primary capabilities and constraints?
- What are the value drivers in our business that we can leverage or exploit to outperform the competition and take advantage of market opportunity?

Next, focus on improving your corporate strategy. Use resources efficiently by applying them to the right markets, sectors and clients, for example, and consider sectors related to your core competencies for opportunities to expand. Highlight your firm’s strengths and the services that set it apart. Identify the skills needed to meet future company goals, ensuring that new hires and existing employees can meet future challenges. Finally, align with strategic partners. Collaboration offers an opportunity for growth as well as a way to augment backlog during slow times (and scale up during busy times).

## If Change Is Inevitable, It's Time to Brace for It

The pace of change in business—and life in general— isn't expected to slow anytime soon. If anything, there is greater evidence that the pace of change in the engineering and construction industry has nowhere to go but up. Knowing that traditional planning methods no longer suffice, leading engineering and construction firms are finding new and innovative ways to stay out in front of the changes (or at least keep pace with them) while remaining profitable, productive and responsible.

In this environment, construction and engineering firms can no longer focus on setting direction, developing plans and then implementing those plans. Instead, they must clearly understand why certain strategic options are more attractive than others, and then monitor the situation throughout implementation to make sure that prioritization still holds. Taking this course requires a deep understanding of context and the ability to track in real time (and project far enough into the future) to commit the resources of the business. And, while Yogi Berra's assertion may still hold true, it's no excuse not to plan a brighter future for your business.

One strategy expert, Ron Ashkenas, summed up the value of context in relation to adaptive strategy well by noting that managers at all levels tend to assume that their people understand the firm's overall strategy and how their work contributes to it. This is particularly true if high-level presentations, town meetings and videos about the strategy have been disseminated to those team members.

"While these are necessary vehicles for creating context, they are insufficient for really aligning a company's strategy with various goals throughout the organization," he writes. "In addition, managers at all levels need to periodically bring people together to actively work through the connections. And this needs to be done not just once during the annual planning cycle, but at regular intervals so that new projects, initiatives, and issues are incorporated into the overall strategic fabric."<sup>1</sup>

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<sup>1</sup> Ashkenas, Ron; How Leaders Create the Context for Strategy Execution. Harvard Business Review.



**Rick Tison** is a principal and strategy practice leader with FMI Corporation. Rick works with clients across the engineering and construction industry to develop strategies to improve company performance and profitability. He specializes in strategy development and organizational change. He can be reached at [rtison@fminet.com](mailto:rtison@fminet.com).





# **The Continuity Mindset:** Managing Succession for Lasting Organizational Success

By Jake Appelman and Sara Tsahakis






Transitioning a business to a new generation of leaders, no matter what decade you are in, has always been a multifaceted, emotional and intricate process—one that is easy to put off due to the anxiety it can generate. On that front, the landscape in the Built Environment hasn't changed much since we wrote this article. In the last three years, the industry has seen an even more dramatic shrinkage of the talent pool, and there are still relatively few options to move equity in the construction industry. According to our most recent data, only about 5% or fewer firms in the industry are salable and around 60%-70% can sell internally. This leaves 25%-35% of firms in a position where they must liquidate.

As a rule, the succession process is much bigger than simply appointing a new leader to a role. It also often involves making changes in the organizational structure, transitioning internal and external relationships, and making tough decisions around the ownership transition. This process should be set in motion seven to 10 years prior to the official passing of the leadership and/or ownership baton (especially if you have never done it before).

While this article was written in a strong market that is now slowly cooling off, the key steps for the continuity of a business remain constant:

1. Clarify your vision: Make sure you are crystal clear on where you want your business to go, even after you leave.
2. Understand the necessary leadership roles: Given the vision, what are the requirements to lead?
3. Evaluate potential successors rigorously: More than anything else, the continuity of the business depends on the quality of future leadership.
4. Accelerate future leader development intentionally: To ensure readiness, you need more than just organic growth.
5. Don't spend all your time defining what you are moving from (the business); also clarify what you are moving toward (after exiting the business).



# The Continuity Mindset: Managing Succession for Lasting Organizational Success

By Jake Appelman and Sara Tsahakis

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*At its core, succession is a deeply emotional process for leaders. For seasoned executives, it often requires reflection and insight into one's career journey and legacy.*

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Perhaps not surprisingly, given the weight of the process, leaders avoid this necessary introspection, in favor of the more tangible decisions needed to transfer a business to the next generation. For example, leaders often dive into identifying and executing on equity transfer techniques, buy/sell agreements and organizational structure changes while neglecting a critical part of succession needed to guide the organization to lasting success beyond transactions: a continuity mindset.

We define a continuity mindset as “a framework of thinking that informs and guides the many critical decision points in a transition.” This article sheds light on the importance of developing and utilizing a continuity mindset in today's business environment, where succession is often approached hastily or completely overlooked.

## The Common Mindset

Through our research and work with E&C firms, we often observe senior leaders thinking more deeply about succession when the process coincides with specific milestones. For example, most senior leaders start reflecting about succession when they are considering transferring ownership and transitioning into retirement. Transferring

ownership generally means that owners choose among three options:

1. Sell the company to internal members (employees or family members)
2. Liquidate the business
3. Seek merger or acquisition options

Since it can be challenging to liquidate and still yield rewarding financial benefits, E&C leaders generally feel that selling internally or using mergers and acquisitions is the more desirable choice. The viability of these choices also depends on the quality of the organization's current and future leadership.

Like most talent-related decisions in the E&C industry, succession decisions are often based on instinct and tend to be highly emotional, especially when leaders hope to pass the business along to a family member or trusted partner. These emotional factors can cloud the use of facts and data to pick the right successor to lead the business into the future. As a result, companies will often promote people before they are ready, pick the wrong successor, or lose talent due to perceptions of a poorly handled succession management process. All of these hurdles can be avoided through the use of a well-



thought-out, fact-based approach to succession, and one that incorporates the continuity mindset into the equation.

In most situations, a bench of star performers or high potentials will fall short on the succession plan. That's because, while these candidates may represent top talent, they may not be aligned with the skills and competencies needed to lead the company to success in the future. Furthermore, winning the battle for talent means having the right people in the right place and at the right time in the first place, not simply having "lots of great talent." To overcome this perception, organizations must fine-tune their talent strategy for key positions and prioritize succession management efforts by building the bench for those specific roles, since they will serve as important business differentiators.

Succession is often viewed as simply picking a successor for the top leader (the CEO or president); the focus is usually superficial and emphasizes mostly replacement. However, good succession goes beyond putting a new leader in place. It also includes the conservation of a company's culture and values, the identification and development of future leaders for all key roles, and a smooth ownership transition. This type of transition is key to a company's success and requires a well-thought-out process to ensure that all of the pieces are in sync.

The effective organization makes succession decisions based on facts and data, focuses its attention on strategically important positions, and takes a holistic and proactive approach when looking at the organization's succession requirements. Embracing a continuity mindset will help prepare the organization for effective succession management and ownership transfer.

## The Continuity Mindset

Embracing the continuity mindset means establishing the necessary groundwork to prepare the organization for effective succession, including both leadership transitions and ownership transfer. It incorporates both data-and fact-based decisions that serve the company's long-term interests, even when those decisions are immediately unpopular or misunderstood. This goes as far as setting the leader transition in motion and seeing it through to the successful integration of individuals in their new roles, including the preservation of values and culture. These steps must be carefully orchestrated and then revisited whenever the strategy changes. Ultimately, individuals who possess continuity mindsets see leadership and ownership of a firm as a privilege and an ongoing responsibility to steward the organization for future generations.

## Clarity of Intent Is Critical

Our decades of experience guiding engineering and construction (E&C) clients through transitions have shown us that leader clarity of intent is crucial. Complete clarity of vision around the future company (e.g., the intent to maximize wealth) will drive a much more coherent and unified transition than an owner who speaks of continuity (but is unwilling to act from a continuity mindset because his or her focus is on something else). Effective leaders do not take continuity lightly and recognize that following that path is a conscious choice that takes place with a full understanding of the requisite courage, humility and long-term focus.

FMI's Peak Succession approach (see **Exhibit 1**) is built on a continuity mindset approach, which, on top of picking a successor, incorporates factors such as ownership transfer, preservation of the company's

## Exhibit 1. Peak Succession



Source: FMI's Leadership and Organizational Development Practice

culture and values, strategic identification of critical positions to replace, and fact-based selection and development of successors. In this approach, leaders must move away from gut instinct, intentionally create a wider pool of talent to meet tomorrow's challenges, and view succession as a system and organizationwide process versus a one-time reactionary decision.

### Continuity Mindset in Action

There are several steps that companies can take on the path to good succession planning that incorporate a continuity mindset. They are:

#### *Think Strategic Roles, Not High Performers*

After establishing a clear vision for where the organization is going (part of essential groundwork), the succession process begins with the identification of strategic positions. This allows companies to focus on identifying every role that has a major impact on the company's strategy, rather than just looking at those roles facing imminent need for

replacement. At this step, taking a continuity mindset means looking at the positions, not the people. When thinking about a business's strategic positions, the primary focus should be on the roles that directly impact strategy and not necessarily on the company's current star players. Take Joe, a current CEO, for example. Due to retire in three years, Joe has successfully made the company into a leading, national player, but he lacks international experience in an era where the company's new strategy includes major international development. While replacing Joe, we need to tailor the future CEO role to the new strategy and ensure that we hire for strategic fit. Instead of looking at the succession process as cloning Joe, for example, the company needs to look at the broader skill set required for the new CEO role in this global context.

In these situations, executives typically pay attention to high performers (A players) who come to mind when they think about getting something done. While those individuals may seem like the obvious choice for today, they may not produce the optimal company

results in the long term. Focusing on the latter helps organizations maintain objectivity and keeps the focus on what roles will contribute most to future strategy (instead of who's performing well right now). After all, the envisioned future of the company should bring new challenges that may require a different set of skills. That's what business is all about, right?

Now it's important to note that this process also requires a shift of focus—from A Players to A positions—to identify roles that are critical for organizational success and that need a succession plan.<sup>1</sup> This means identifying the roles that are key to driving and executing the strategy, and then identifying the individuals who are good fits for those positions. Of course, your A players might be the best candidates for these A positions, but the role identification should come first. (It is possible that given a shift in the competitive environment or changes in technology, looking outside the organization might provide a candidate who better supports a role of the future.)

### *Take the Time to Identify “A” Positions*

There are two main criteria that differentiate A positions:<sup>2</sup>

1. **They have a direct impact on strategy:** A positions have a direct impact on the company's ability to execute one or more of its strategic goals. These positions create value and contribute directly to an area that is a distinctive competitive advantage for a company. This implies that a company has clarity over its strategic capabilities—a measure that may

incorporate various data points. In an organization that has customer satisfaction as a strategic differentiator, for example, these metrics can be used to identify which roles have direct impact in performance variability:

- Existing customer satisfaction
- On-time completion
- Within-budget completion
- Speed to resolution of customer problem
- Performance in executing problem escalation processes
- Annual recurring revenue
- Net promoter score (percentage of clients recommending the business)

2. **They present great performance variability:** Along with having a direct impact on strategy, A positions typically present the potential for great variability in performance. For example, if a position is responsible for securing new clients, the potential for variability of performance is high. A person who performs above average can generate five to 10 times more revenue than a person whose performance is below average. Furthermore, these positions can also destroy value (i.e., losing client relationships in favor of competitors).

### *Clarifying “A” Positions*

Once you've identified your firm's strategic positions, you'll want to develop a Peak Profile for each of those roles. Peak Profiles include role requirements (what you do), technical skills (what you need to know) and competencies (how you do it). While creating these profiles might seem intuitive and something easily developed by HR functions, E&C leaders tend to overestimate the importance of technical skills and background needed and underestimate the need for managerial, leadership and people skills required by key roles. The truth is,

<sup>1</sup> <https://hbr.org/2005/12/a-players-or-a-positions-the-strategic-logic-of-workforce-management>

<sup>2</sup> <http://www.thedifferentiatedworkforce.com/pdfs/TDW-Chapter3.pdf>

both are crucial, and technical experts moving into leadership roles rarely transition smoothly in absence of adequately developed people skills. The establishment of a Peak Profile plays a critical role in rigorously assessing and developing the pipeline of potential successors for strategic positions.

Once competencies are established, the organization can make more objective and informed talent decisions, including:

1. Hiring individuals for A positions
2. Promotion choices for A positions
3. Ready individuals to transition into A positions by way of advanced executive development

### ***Evaluating an Individual's Potential for an "A Position"***

While many organizations use the gut instinct approach for successor selection decisions (see our recent article, ["Finding the Right Leader: How to Disrupt Your Leader Selection Process"](#)), the use of a structured approach is far more valuable for assessing candidates fairly and reliably. Assessment tools such as structured interviews and validated assessment instruments (e.g., The Hogan Battery, Pinsight Leader Simulation) are job-related and more accurate when it comes to capturing the level of individual proficiency competencies. Since competencies were identified for the Peak Profile as the key ingredients for success in a strategic position, assessment of these competencies is a useful predictor of leader performance.

### ***Readying Your Successor and a Broader Bench for "A Positions"***

## **Criteria for Great Competencies:**

- They align with organizational values
- They align with your vision for the future and your strategies for success
- They differentiate an average performer from a star player
- They should be concise and focused

Once individuals have been assessed and their potential for a future strategic role established, the next step is to provide structured developmental activities. The activities will equip identified successors for their future roles; they will advance individual development and accelerate future leaders. Specific tactics for development in the context of succession are referenced in the Quarterly article, "The Growth Mindset: Developing Your Successors With Intention, Purpose and Personal Focus."

## **Start Embracing a Continuity Mindset Today**

Embracing a continuity mindset and engaging in a systematic succession management approach allow organizations to minimize the likelihood of the wrong individual being put in place at the wrong time. When positions that drive strategy are identified early on, and when the competencies for success in those roles are clearly defined, the organization will be well-positioned to develop and select the best-suited individuals for the job.



Effective leaders with a continuity mindset understand that for the organization to succeed, they must make hard choices that may be unpopular in the short term. Succession management and ownership transfer for a long-term win requires courage, humility and a long-term focus. This broad and proactive approach to succession management ensures that the right people will be ready at the right time to

support effective transition, whether due to planned retirement or unexpected crisis. This systematic succession approach will make the greatest impact on the market. Having the best talent in the most strategic positions—and the bench strength to fill those key roles when the time comes—drives winning organizations.



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# Why Large Contractors Fail – A Fresh Perspective

By Hugh Rice and Ryan Howsam



It's been nearly 200 years since French educator and writer Jean-Baptiste Alphonse Karr uttered the epigram, "the more things change, the more they stay the same"; but those words still hold true today. The question is, is history repeating itself, albeit on a larger scale. The challenges of increasing project sizes and complexities are creating negative impacts across the Built Environment and threaten the balance sheets of many construction firms.

Large contractors fail for the same reasons that they did back when FMI first conducted its groundbreaking research into the subject in 2008. The question is, what have we learned from the past and how have we strategically positioned ourselves to protect firms from the risk of default.

In 2014 we experienced the significant failure of Truland Electric. Five years later McDermott filed for Chapter 11. Bondfield's massive surety default in the hundreds of millions of dollars in 2018 represented the largest loss in Canadian history, partially due to unsustainable growth in a short time period. That same year, Carillion, the U.K.'s second largest contractor, became the largest failure in British history.

Of course, failure is never far from the doorstep of one of the riskiest business environments. Contractor failures may be a reality of the industry, with the same root causes of past failures impacting today's performance. Megaprojects, for example, don't meet all stakeholders' goals, with one industry study stating that just 1 in 1,000 megaprojects is successful.<sup>1</sup>

Large failures of contractors and megaprojects continue to remind us that no one is too big or small to fail—and that contractors do not die of starvation but of gluttony. Hopefully, we do not see history repeating itself with contractors making the same strategic errors of recent failures, but instead learning from the past.

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<sup>1</sup> "Changing the game. How Australia can achieve success in the new world of Mega-projects." Australian Constructors Association. 2015.



# Why Large Contractors Fail – A Fresh Perspective

By Hugh Rice and Ryan Howsam

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*During the past few decades, there have been dozens of large contractors that, after many years of growth and apparent prosperity, experienced notable financial disasters, resulting in bankruptcy or a reincarnation of the business in a much different form.*

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Most recently, firms like the Truland Group Inc. have proven that construction firms are not too big to fail, even though they have operated successfully for generations with annual revenues ranging from hundreds of millions to several billions of dollars.

In one of FMI's classic studies—"Why Contractors Fail"<sup>1</sup>—we investigated root causes responsible for bringing down industry giants over time. Almost a decade later, we conclude that despite the changing business environment in today's engineering and construction industry, many of our findings still hold true, particularly in a growing market where contractors are significantly more likely to go bankrupt compared to during a downturn.

As we like to say, "Contractors don't starve to death; they die from gluttony. They get too much work, too fast, with

inadequate resources, and then they get into financial trouble and run out of cash."

In this article, we look at today's changing risk environment and revisit the five fundamental factors that conspire to cause contractor failure. These five factors are timeless and can help contractors avoid some critical mistakes while they continue to survive and thrive in good economic times.

## Today's Risk Environment: A Changing Landscape

Hit hard by the Great Recession, the construction industry has struggled to bounce back to pre-recession levels. Still, there are a number of positive trends taking place. For example, the industry didn't witness nearly as many surety losses or large contractor failures as expected during the downturn—a sign that surety companies and banks have learned their lessons and are not letting companies overextend themselves any longer. It is also a reflection

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<sup>1</sup> "Why Contractors Fail: A Causal Analysis of Large Contractor Bankruptcies." Hugh Rice and Art Heimbach. FMI Quarterly Special Issue. 2007.

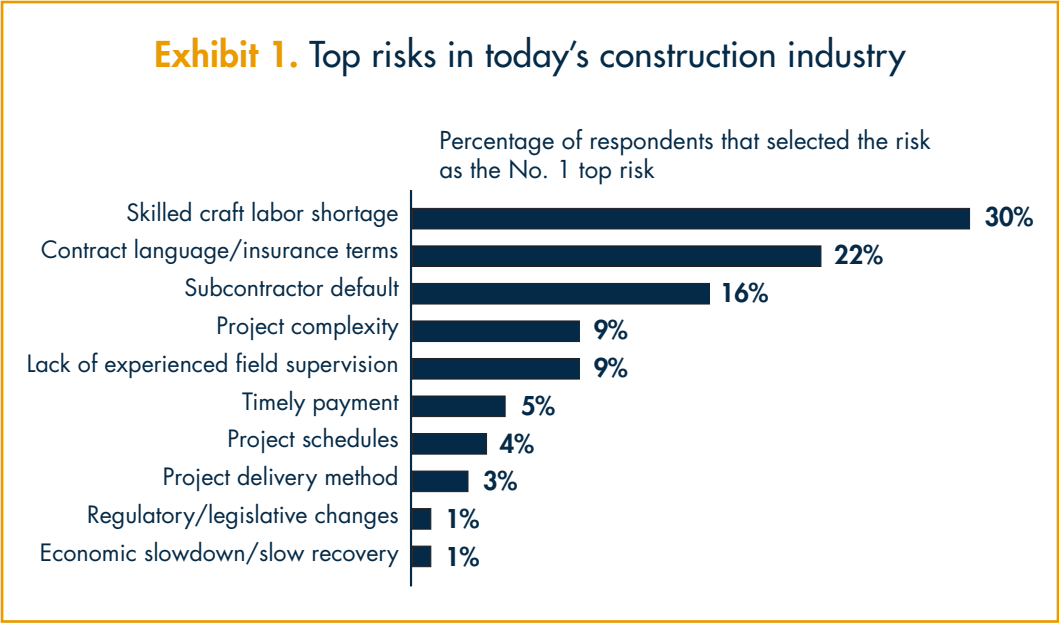


that the industry is becoming increasingly sophisticated: leaders are better educated and more apt to run their organizations effectively.

Working with hundreds of engineering and construction firms, we have also witnessed heightened risk awareness among business leaders. This was confirmed in a recent study where AGC and FMI surveyed the general and specialty contractors in AGC’s Surety Bonding and Risk Management Forum: 86% of respondents stated that today’s risk environment is different compared to five years ago, with skilled craft labor shortages being one of the biggest risks they currently face (**Exhibit 1**).<sup>2</sup> In response to the heightened risk environment, the majority (90%) of the survey

respondents are managing risk differently and applying new tools and programs to assess risk more rigorously compared to five years ago.

However, initial findings also indicate that the majority of contractors struggle to manage risk effectively. This is particularly alarming as we face another perfect storm in our industry. Consider the fact that between 2009 and 2015, the average number of months of contractor backlogs (for all types of contractors) has increased 33%.<sup>3</sup> At the same time, contractor margins are tighter, contractual conditions and projects are more complex, and 1.5 million fewer construction workers remain in the industry (compared to pre-recession levels) unable to keep up with increasing demand.



Source: AGC/FMI 2016 Risk Management Survey

<sup>2</sup> Key findings of this study “Managing and Mitigating Risk in Today’s Construction Environment” will be published by AGC and FMI in July 2016.

<sup>3</sup> See our Quarterly article “Managing and Mitigating Subcontractor Default Risks” by Mike Bond, Zurich. June 2016

Compounding these dynamics, baby boomers are reaching retirement age at a rate of 10,000 per day, and a younger and more inexperienced (millennial) workforce is moving into the industry. Moreover, contractors are winning more work in today's recovering environment, which in turn is placing increased stress on their working capital. In other words, they're trying to do more with less. That kind of pressure on working capital—coupled with craft labor shortages, fluctuating market dynamics and a dramatic loss of industry knowledge and leadership—creates a recipe for a potential disaster. It is within this environment that contractors face a higher risk of financial reversals.

Now more than ever, company leaders need to focus on five key organizational areas in order to navigate the unsettled external factors shaping today's industry. Following is a summary of these five factors that we identified in 2007 and that are just as applicable and significant today.

## What Causes Large and Historically Successful Contractors to Self-Destruct?

In our investigation of why large contractors fail, we isolated about 200 potential factors that can lead to contractor failure. Upon examination of these factors, we determined that no single factor would usually signal the impending doom of a construction firm. We found that failing companies usually exhibited a combination of interacting factors that caused company performance to spiral toward inevitable financial failure.

During our analysis, we identified five root causes for contractor failure. Poor strategic leadership is the common thread among all these factors. External factors (e.g., economic conditions, risk environment, etc.) are not primary causes but can accelerate the chain reaction of company failure. In essence, when contractors fail, “They do it to themselves—it doesn't happen to them.”

FMI's five root causes of contractor failure identified in the original study continue to be responsible for contractor failures today. Yet all of the causes can be controlled and mitigated.

## The Five Root Causes of Contractor Failure

### Factor #1: Poor Strategic Leadership

This is by far the biggest reason for failure in today's business environment, where strong leadership can serve as a cornerstone for success in even the most difficult market conditions. For example, many companies get into financial difficulty when ownership changes hands from one generation to the next. To ensure successful ownership transfer and management succession, owners need to prove that the company can grow and succeed without them. The only way to do this is by having the right successors in place who are capable and willing to lead. At that point, the question becomes, can the next generation carry the business forward. This is frequently where firms get into trouble—regardless of whether they are family-owned or not. Companies that do not define a clear vision, purpose and a fact-based strategy often find themselves reactionary without

setting true direction. Under poor strategic leadership, people begin making bad decisions (i.e., poor project selection, hiring the wrong employees, putting the wrong systems in place and so forth), and before the company's leadership is aware, the firm can find itself on the path to failure.

FMI's recent millennial research<sup>4</sup> also underscores the importance of strong strategic leadership in the context of attracting and retaining a young workforce. Our findings showed that millennials are 25% more likely to stay long term when the company's vision and direction are clear and inspire enthusiasm for work. For employees, this noticeable difference underscores the importance of understanding the key elements of an organization's vision and strategy as well as recognizing what leadership expects from them, which is especially important for younger people who are just beginning their careers.

### **Factor #2: Excessive Ego**

Another root cause of poor decision-making is the leader who exhibits an excessive ego. Extremely confident and often unwilling to listen to the opinions and suggestions of others, this person can literally take down the entire company. In our original study, we referred to this personality as the "Mind of the Contractor" (see our 2016 Quarterly article "The Icarus Leader: How High Will You Fly" for a more in-depth view on this topic). In order to be a successful contractor, you must

have self-confidence and a high tolerance for risk. Contractors also must possess a high degree of optimism, or they would have a difficult time winning any bids and securing work. The key is to avoid carrying that optimism and risk tolerance to the extreme—a scenario that can lead to bad business decisions and ultimately company failure. There are many examples of construction firms that have run into financial problems due to the leader's hubris and perception of being invincible. Sometimes this is referred to as "driving the business off a cliff at 100 mph"—self-destruction at its worst.

### **Factor #3: Too Much Change**

The research and one-on-one interviews we conducted indicated that in 90% of the company-failure cases, "too much change"-related issues were a crucial element in the actions that led up to the disaster (**Exhibit 2**). When too many things happen too quickly, it's easy to get overwhelmed and thrown off course. Any company can absorb some level of change, but there's a limit to what most organizations can handle at any given time. 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.

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<sup>4</sup> Millennials in Construction: Learning to Engage a New Workforce. 2015 FMI Industry Survey

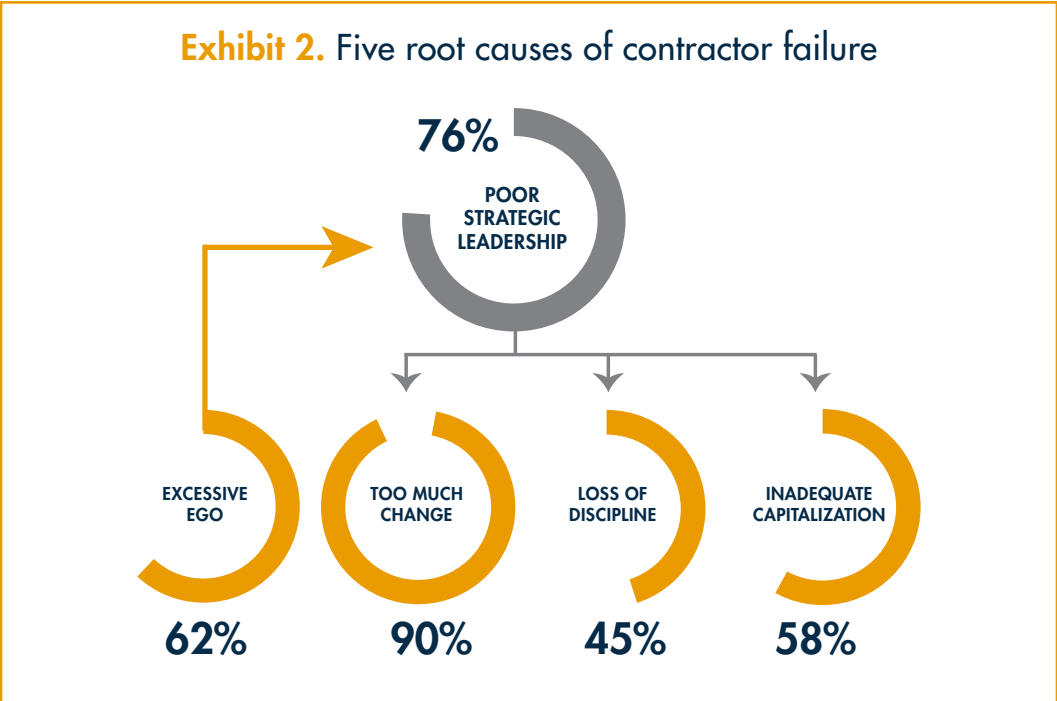
**Factor #4: Loss of Discipline**

Successful construction firms tend to be extremely well-disciplined in all areas of their business. 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. On the other hand, there are a few world-class contractors in the U.S. that operate with an incredible amount of discipline. They do the same thing the same way—every day and everywhere that they operate. This discipline is built into the company’s culture, transpires throughout the organization and can last for generations.

**Factor #5: Inadequate Capitalization**

Cash is King, and inadequate capitalization will bring a company to its knees in short order. In the construction industry, a single job (depending on its size and scope) can have a profound impact on a firm’s success or failure. The difference between a good year and a great year or a bad year and a catastrophic year can be one or two jobs.

Sometimes people will ask us, “How much money should I keep in my construction company?” And we always answer this question by asking, “How much money can you lose on a single construction job?” And when you think about this, the answer is, “All you’ve got.” Construction projects have upside limits on the level of profit that you can earn, but the amount of money you can



Source: FMI industry analysis. Percentages indicate company-failure cases in which specific root causes played a crucial role in financial reverses. For example, in 62% of the company-failure cases, ego-related issues were a crucial element in the actions that led up to the disaster.



lose is unlimited. Overcoming this failure factor requires an adequate capital base that allows you to withstand inevitable problems and live to fight another day.

## Controlling Your Own Destiny

Construction is a dynamic and inherently risky business. Our research indicates that the causes of contractor failure are similarly dynamic and involve a number of difficult-to-manage risk factors. While many point to external factors as the primary culprits for failure, we see many examples of companies that succeeded despite the same difficult external forces being present while others failed. In our study, many seasoned industry executives emphatically rejected the notion that luck or other extraneous forces were responsible for their companies' decline.

Nonetheless, we do see a need to identify the role that external economic conditions can play in hastening the demise of firms that are already on the road to failure. Our study indicates that these external factors are not root

causes, but that they are actually accelerants that quicken the pace of demise for companies already suffering from one or more of the root causes noted. Successful contractors live on a thin edge.

However, the good news is that all the root causes identified are controllable—regardless of the external environment—which means leaders can shape their own destiny and not be victims of fate. As the industry continues to shake off the effects of the Great Recession and adapt to new labor market trends and competitive pressures, the companies that take these factors to heart and strive to overcome them will survive and come out the winners.

To assist companies with this charge, FMI is continuing its research and publication on topics aimed at helping companies more effectively control their fates. Future Quarterly issues will investigate causes of contractor failure associated with different business areas and provide effective strategies for managing those risks in the future.



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# A Blueprint for Risk Management in Construction

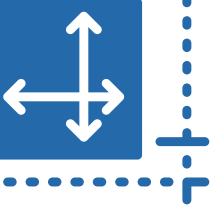
By Ryan Howsam





Define risk management in construction, and what would your answer be? Many would argue that safety and insurance define the term risk management. True, they are cornerstones to any robust risk management function but serve as only a partial definition. “Risk Management: A Blueprint for Success” provides an industry model for clearly defining the key elements of a contractor’s risk management function, beyond safety and insurance, which can be placed in three primary categories: strategic, structural and operational. Formalizing the risk management function creates the benefit of having both defensive and offensive risk strategies. Armed with this model and the ability to derive insight into a contractor’s risk management function, companies can transform risk management from being simply a cost center into one that leverages risk management as a profit center, creating a strategic asset.

As the industry continues to evolve and as executives spend more time managing risk, this model of a best-in-class risk management function should serve as a blueprint for success.



# A Blueprint for Risk Management in Construction

By Ryan Howsam

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*Nine elements that should be included in every construction firm's formal risk management strategy.*

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Construction is all about managing risk. Whether the concern is employee safety, contract terms, subcontractor selection, material choices or another one of the myriad issues that go into a successful project, at some point or another, every juncture comes with its own level of risk. By conducting a formal corporate wide risk assessment and implementing a risk management process, construction firms can more effectively recognize, address and mitigate potential risks before those issues develop into negative outcomes.

In today's construction environment, managing risk is no longer just a defensive strategy. It's not enough to just sit back and hope that a problem won't happen, because it most likely will. The more sophisticated and formalized a company's risk management processes are, the more opportunity a contractor has to profit from mitigating and managing the associated risks.

In this article, we explore the underlying reasons for developing a solid risk management program in construction, show why it's smart to take a holistic view when developing a plan of action, and outline the nine key elements—based on our industry research—that should go into every firm's risk management blueprint.

## You're in the Risk Management Business

Contractors work in an inherently risky business. Tight time frames, multiple stakeholders up and down the value chain, and dangerous working conditions are all “just part of the job” for contractors. Risks are so common, in fact, that contractors can become numb to the wide range of issues that they face (or could face) on a daily basis.

The ever-changing construction market has added fuel to the fire. Good, bad or indifferent, all contractors are now operating in a new post-recession landscape characterized by tighter margins and less room for error. The days of high margins and favorable contractual language are gone. Owners are more educated, the competition is tougher, and companies are facing acute skilled labor shortages. As a result, businesses are running fast and hard, and increasing their risk exposure while decreasing their prices. It's the perfect storm that can ultimately lead to company failure and bankruptcy (see our FMI Quarterly article on “Why Contractors Fail”).

In this new business landscape, contractors must manage risk differently than they did just five years ago. This notion was confirmed in a recent study where AGC and FMI surveyed the general and specialty contractors in AGC's Surety Bonding and Risk Management Forum: More than 90% of survey respondents stated that they were managing risk differently compared to five years ago.<sup>1</sup>

Based on our ongoing industry research, FMI has witnessed and helped successful construction companies reinvent their risk management practices and turn them into intentional and formalized programs at the enterprise level, rather than piecemeal or reactive on an individual basis. This is a very different approach compared to how risk has been managed historically and allows contractors to take a more holistic and strategic view of their business. Using a formalized risk management process centered on potential risks (i.e., compliance, finances, fraud, customers, etc.) and specific actions that address those risks, firms can take steps to support the overall organization in its quest to minimize risk. Rather than viewing risk as an inevitable evil, risk-averse firms have embraced it as a strategic opportunity.

## Playing Offense and Defense

Let's face it — risk management is not a new concept for anyone in the industry, and it's not something that can simply be mandated. Like safety, risk management requires constant communication, education and efforts to build awareness and provide value to both employees and clients.

Alex Munoz, vice president of safety and risk management at Messer Construction Co., stated, "One of the easiest ways to create a corporate culture around risk management is by making it everyone's job. That means moving from an 'It's the department's role' mentality to one that says, 'We share a job, and that's to create a risk-aware culture.'"

Many firms are taking this enterprise wide approach to risk management with two overarching objectives: offense and defense. Here's the difference between the two:

- **Offensively**, risk management aims to increase the value of the business by formalizing risk tolerance, potentially increasing profit margins and stabilizing earnings.
- **Defensively**, risk management protects the business by guarding the balance sheet, profits and legacy of an organization.

Firms that want to do a better job of managing risk—or launch an entirely new, formal program that tackles the issues outlined in the beginning of this article—must incorporate a mix of offense and defense. Digging down to deeper levels of understanding, FMI has identified nine elements that should be included in a formal risk management strategy. By incorporating these elements and taking a more holistic approach to risk management that goes beyond just insurance or safety programs, firms can begin to realize the positive impacts of their efforts.

Here are the nine key elements—organized into three primary categories—that should be included in your firm's formal risk management plan (**Exhibit 1**):

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<sup>1</sup> Key findings of this study "Managing and Mitigating Risk in Today's Construction Environment" will be published by AGC and FMI in June 2016.

Exhibit 1. Blueprint for risk management



Source: Model developed by FMI. Concept is based on in-depth industry research.



Strategic Elements

**Enterprise Risk Management** — The traditional approach to risk management involved a “siloes” approach in which individuals (or teams) were only responsible for risks that impacted their respective silos, with the assumption that someone else would manage the other risks. An enterprise approach to risk, on the other hand, involves the collective identification, assessment and management of risks that a business faces. This occurs not just on a

local level or within its business sector, but on a global level in areas that may not correlate directly to the business. This global perspective can help leaders identify risk areas more clearly and serve as an important precursor to strategic planning.

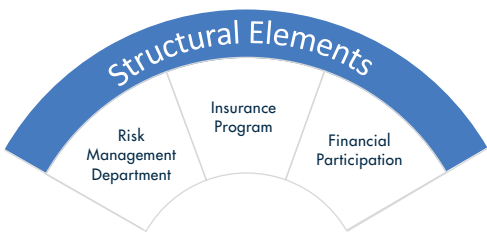
“Everyone in the company is now included in our risk management practice,” said Dallis Christensen, CFO at Layton Construction.

“Our superintendents are more involved with both quality and safety issues, project managers might be looking at subcontractor or owner contract clauses more closely, and our estimators review our subcontractors’ pre-qualifications and financial strength in much more detail.”



**Risk Management Partners** — As in any business, the right partners are vital to a firm’s success. In the construction industry, those partners include both insurance and surety partners that possess construction industry expertise, commitment to the construction industry, industry-focused research (e.g., emerging issues) and sufficient bench strength. The top insurance brokers and companies in the industry understand their clients’ business and serve as strategic partners, equipping companies with the right suite of products to navigate an ever-changing marketplace.

**Leveraging Risk Management** — As the industry has evolved, contractors have had to shift how they view risk management. Today, best-in-class firms are able to protect themselves better, increase the value of their organizations, and identify new ways to improve profit margins. At its essence, company leaders are starting to accept and manage appropriate risks that have the potential to add value to their businesses. This is a far cry from the past, when contractors had a fairly consistent knee-jerk reaction to risk, either refusing to accept it in the contract and/or immediately passing it on to others (i.e., subcontractors and suppliers).



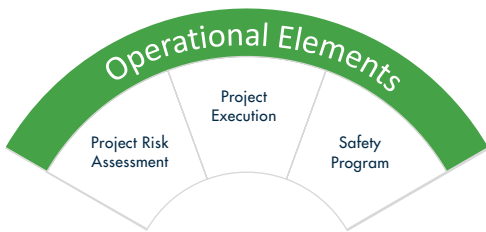
**Structural Elements**

**Financial Participation** — The majority of today’s construction leaders lack a full understanding of their company’s risk tolerance. In other words, they may be exposing their businesses to more potential

economic loss than they can tolerate, either reputationally or financially. On the flip side, some companies have risk management functions that are benefiting others more than they should (e.g., owners, insurance carriers, competitors, etc.). This so-called financial over- or under-participation can make or break a firm and represents a critical step in balancing risk versus protecting the balance sheet.

**Risk Management Department** — Leading contractors have a formalized risk management department embedded in their organizations, led by a professional (usually full-time) risk manager with a defined role and specialized responsibilities. This role should not be relegated to an outside broker, de facto safety manager or someone else in the organization. Risk managers contribute significantly to the overall management of a construction business and should have a seat at the executive table, embedding risk management into the corporate strategy.

**Insurance Program** — The role of insurance is simply to allow companies to “rent” the insurance company’s balance sheet when risks and the potential losses exceed an organization’s risk tolerance. Understanding that need for protection, companies must ensure that the suite of insurance products sufficiently protects their balance sheet and earnings stream—should something undesirable occur. The key is to have an insurance program that appropriately matches the risks of the company’s specific business and exposures.



## Operational Elements

**Project Risk Assessment** — Leading contractors have a systematic and consistent process to evaluate and analyze potential project risks prior to pursuing a project award. This process involves a team of internal experts with specialized experience who review key areas of project risk (i.e., contract terms, constructability, financing, partners, location, logistical issues, equipment needs, etc.). Armed with a clear understanding of their enterprise risk tolerance as well as a strong project risk assessment, contractors are better-equipped to incorporate appropriate contingencies and margins on specific projects, which ultimately results in more accurate job costing.

**Safety Program** — All contractors have safety programs in place these days, but the leading organizations have created a culture of safety throughout their organizations and up and down their value chains. Leading organizations also aggressively track and manage claims—focusing on the process and the costs, including robust return-to-work programs—and understand that safe jobs tend to be profitable jobs. A strong

safety program not only has the “right” components, but it also has the appropriate measurements and metrics in place to monitor performance and accountability.

**Project Execution** — Whether acting as a subcontractor or a general contractor, there is an inherent and obvious risk in executing a project. When a contractor’s operations involve subcontractors and vendors, that contractor still has both financial and reputational risks on the line—yet someone else is doing the work. With this dynamic in mind, it’s easy to understand why subcontractor management is a key focus for leading firms.

## Steps to Success

The idea of managing risk as an “offensive” strategy is not a new concept. Best-in-class companies understand the value of a formalized and intentional risk management program and long ago embraced the idea of strategic risk management. Whether in reaction to tight markets with demanding and impatient stakeholders, or with the foresight to see the advantage of this type of planning, the industry is evolving its view of risk management. As the industry continues to change, and as executives spend increased time considering risk, this model of best-in-class risk management will serve as a blueprint for success.



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# How to Turn Big Data Into A Strategic Business Advantage

By Jay Snyder





We're now generating [2.5 quintillion bytes of new data every day](#), which means organizations around the world and across all industries are literally drowning in data. With 90% of the world's data created over the last two years—and with each “connected” person interacting with data every 18 seconds—[IDC predicts](#) that the global datasphere is on track to grow from 33 zettabytes in 2018 to 175 zettabytes by 2025. (Hint: One single zettabyte equals one trillion gigabytes.)

With individuals, companies and organizations worldwide generating a staggering volume of data right now—and with [30% of that data requiring real-time processing](#) to be useful and actionable—the opportunity to turn data into a strategic business advantage remains largely untapped.

Consider this: Some of the largest infrastructure projects require 130 million emails, 55 million documents and 12 million workflows, on average. With such vast amounts of data being captured from so many sources, many firms don't know how to use or process this much information, which is why right now 95.5% of all data captured goes unused in the E&C industry.

All this to say that the article you're about to read may have been scribed several years ago, but it's still relevant in today's E&C environment, where companies continue to overlook the power of the big data that they're generating every day. Read on to learn how E&C firms can take their huge data sets and transform them into useable, actionable intelligence that improves competitive advantage, creates efficiencies and increases overall productivity.



# How to Turn Big Data Into A Strategic Business Advantage

By Jay Snyder

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*How E&C firms can take their huge data sets and transform them into usable, actionable intelligence that improves competitive advantage, enhances efficiencies and supports high levels of productivity.*

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Our world is producing more data than ever—roughly 2.5 quintillion bytes of data every day, or just enough to fill 10 million blue ray discs (you remember those, right?).<sup>1</sup> With so much data being created and the use of data analytics starting to gain traction in engineering and construction (E&C), understanding what big data is and how your organization can leverage it to improve business processes is becoming an increasingly critical aspect of doing business.

In fact, some of the largest E&C infrastructure projects require an average of 130 million emails, 55 million documents and 12 million workflows.<sup>2</sup> With such vast amounts of data being captured from a multitude of sources, many firms can't manage and process this much information, which is why right now 95.5% of all data captured goes unused in the E&C industry.<sup>3</sup>

And while the challenges associated with managing and implementing big data processes are obvious, companies that don't embrace the new norm of data-driven operations could lose traction in the market and become obsolete in the future. In this article, we'll explain what big data is and why harnessing it is so difficult, as well as provide recommendations for E&C firms that want to leverage their huge data sets into actionable intelligence.

## What Is Big Data?

Extremely large data sets that may be analyzed computationally to reveal patterns, trends and associations—especially relating to human behavior and interactions—big data in the E&C industry is collected by:

- Sensors
- Drones
- Wearables
- Global positioning systems
- Email
- Transactions
- Financials
- Design plans
- Weather data

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<sup>1</sup> Watanabe-Crockett, Lee. "The Daily Data Diet: Information Creation in Numbers." Global Citizen. 2016.

<sup>2</sup> Famous, Gabriele. "Three Technology Trends Shaping the Future of Design and Construction in 2018." Aconex Group. 2018.

<sup>3</sup> Hill, Brian L. "Digging for the Big Data Gold in Today's Construction Projects." Xpera Group. 2017.

Often considered unwieldy and difficult to capture, review and process efficiently, big data can be analyzed to reveal patterns or insights about an organization's processes, effectiveness, productivity, financials and other operational areas. For example, leading E&C firms are already using data for early risk detection to track equipment and productivity measures, leverage predictive analytics, and manage software integration and real-time data reporting.

"Like it or not, every construction company—and solutions provider—is now also in the data business," says Jon Fingland, Trimble's general manager, Collaboration Solutions. "How well we help our customers transform that data into intelligence that drives better decisions to deliver projects more efficiently and more sustainably, with higher quality, lower costs and fewer risks is what defines the next frontier of construction management."

"Data is the key to improving the bottom line as well as protecting it," Fingland continues. "Our ability to break down data silos and transform raw data into action and intelligence is the crux to solving most challenges that rear their head in our industry."

## Leveraging Big Data to Your Advantage

When it comes to leveraging big data to your advantage, Reggie Arichabala, co-founder of startup Riskcast, says, "It's critical that you begin with the right foundational data for the analytic problem at hand. Oftentimes, data builds upon itself, and so ensuring that you have the correct strategy for capturing that data, in the correct order, is critical to success."

Using big data to gain insights about your organization presents an interesting array of challenges that include, but aren't limited to:

### ■ It takes the right talent, tools and

**processes.** Big data presents unique challenges for the E&C industry, and many organizations are either unprepared for or overwhelmed by the magnitude of information.

Understanding which data can be useful and how it translates into business intelligence, for example, requires strategic planning and a clear understanding of your organization's overall goals and vision. Once you have a clear direction of what you want and need from your data, then you can begin to extract meaningful insights to help guide your organization. And while a data analytics platform can greatly improve business performance, those results won't come overnight. By having a clear understanding of the time frame and rollout process, you can more easily manage expectations during this transition.

### ■ Collecting and analyzing it can be a challenging task, especially if you

**don't know your end goal.** Many firms struggle to understand how big data can be used to improve performance or processes. While getting the right tools may be as simple as buying a software program, finding the right people is a more difficult task. To successfully gain insights from your data, assemble a team that not only has a background working within the built environment and understands the life cycle of project work, but also has strong research and analytical skills to best leverage your data to improve business performance. Companies that don't invest in the right

people often experience disappointing failures and are slow to realize a return on their investment. One new role to explore within the E&C industry is the “construction technologist.” This position combines industry knowledge with a background in research analytics to drive performance and generate strategic business insights.

■ **Within the E&C industry, many data sources are heavily siloed or stored in disparate places.** Recent research showed that 30% of companies are using applications that don’t integrate with one another.<sup>4</sup> This happens when data is stored on different systems, including desktops, phones, tablets, servers, hard drives and in the cloud. Unstructured data can also be captured from materials such as blueprints, timecards, emails and PDFs, leaving 49% of firms to transfer data between applications manually. A [recent construction technology report](#) indicated that over 83% of construction workers rate mobile capabilities, such as the use of phones and tablets, as important. This suggests that as technological capabilities advance in the E&C industry, we’ll continue to see greater implementation of various data sources from devices such as wearables, augmented or virtual reality, or new software applications.

## Data as a Strategic Business Advantage

Developing a good data strategy helps you get the most out of your data by laying the necessary groundwork and putting all the



pieces in place, ensuring that the information is both available and usable. Dustin Devan, CEO of Building Connected, explains, “With 10,000 projects a month going through BuildingConnected, we are amassing data about the construction market at an incredible rate. Our data intelligence gives us deep insight into developments in the construction market and economy. This helps inform product decisions and strategic vision for the company. Additionally, our quickly growing data set ensures we can build one-of-a-kind machine learning solutions that separate ourselves from the competition.”

<sup>4</sup> “2017 Construction Technology Report.” JB Knowledge. 2017.



Similarly, contractors and other stakeholders in the E&C industry should consider the value that their data can provide not only to better run their businesses, but also to improve project outcomes. Information is held within your technology solutions; developing a plan for managing that data leads to harvesting that information and developing associated actions and initiatives. As you leverage data as a strategic advantage, consider the following steps:

**1. Determine what it is you are trying to achieve.** Articulate your data strategy goals and explain the envisioned future state. Take the time to determine what key performance indicators or metrics and insights you would like to have in order to meet business objectives.

**2. Identify various information sources in the business and on projects.**

Sometimes these sources are within a company's technology stack, and sometimes they are external sources. This may uncover limitations or challenges related to data ownership and intellectual property (IP). In such instances, be careful not to violate IP laws. One way to do this is to include a data sharing agreement in all your contracts.

**3. After you identify the various information sources, assess data fidelity and data accuracy as well as consistency of data flow.** In other words, you want to ensure that the data captured is the correct type of information and that it meets a stipulated level of accuracy. Consistency of data flow means that the frequency and size of data are significant enough to be part of your analytics.

**4. Consider developing data protocols and adopting solutions to aggregate, restructure and securely store your data** to create the proverbial "single source" of truth. This single source summarizes the most technically challenging aspects of your data strategy.

**5. Continue by creating data integrations** that allow unidirectional, bidirectional or omnidirectional data flow to feed into systems across the data stack.

**6. Establish corporate governance and business rules** for interacting with information systems and the data itself.

7. After all this, you have created a significant competitive advantage by reducing multiple instances of data entry (thus improving data accuracy and access to information that is more reliable and current than that of your competitors). **Through intentional management of your information systems and data, you'll be able to more easily pursue business intelligence tools and advanced technology solutions.**

8. Lastly, **accept that this is a living data model that requires ongoing nurturing to manage technical integrations and data management.** The plan also requires continuous effort and adjustment to ensure that it keeps meeting your business's needs.

## Breaking Through the Barriers

Intimidating for many companies—and especially those that are just beginning to wake up to its value—big data can't be ignored any longer. Cumulatively, we're generating roughly 2.5 quintillion bytes of data every day—a number that's on track to grow over the coming years. The organizations that take the time to gather the data, analyze it and turn it into actionable insights will gain a competitive advantage. The ones that bury their heads in the sand and hope it goes away will be quickly left behind.

Using the recommendations in this article, E&C companies can more effectively leverage their big data without having to

make a big investment in labor, equipment or devices. Its use is becoming commonplace among organizations that want to outperform their peers and rise to the top in their industries. In most industries, existing competitors and new entrants alike will use the strategies resulting from the analyzed data to compete, innovate and capture value. Finally, big data helps E&C organizations ferret out new growth opportunities, leverage new resources and optimize processes in unprecedented ways.

For the complete white paper on big data, please see "[Big Data = Big Questions for the Engineering and Construction Industry](#)."



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# Health and Wellness: The Next Disruption in Sustainable Building Design

By Greg Powell







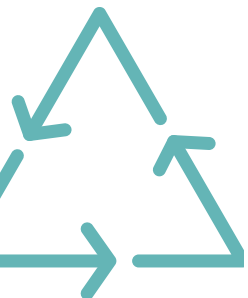
Every year we see increasing attention paid to sustainable building design—and with good reason. Defined as something that has staying power, sustainability has become a popular buzzword across all industries. The E&C industry continues to play a central role as this trend gains momentum due to economic, environmental and consumer influences.

As we pointed out in our article, sustainability continues to become the “new normal.” Building stakeholders are increasingly looking beyond basic green certifications and striving for an improved Built Environment that prioritizes the human experience.

The rise of wellness in design is, in part, due to increasingly vocal discussions on macro issues like climate change. The Built Environment is a major contributor to the climate change problem, so designers, building owners and tenants all understandably want to be part of the solution. Consumer demand is another catalyst for growth in wellness standards. Employees are prioritizing the health of their working environment, and are choosing to work for companies that share those same priorities.

Good, old-fashioned capitalism is also a powerful force behind the growing adoption of wellness standards. Healthier building environments tend to be more energy-efficient—and more cost-effective. Healthier work environments are a competitive advantage in attracting talent. A healthier workforce benefits a company’s operating profit. And companies will admit that, even with the most altruistic intentions, becoming known for promoting a healthy environment makes for great PR.

Wellness certification remains a relatively small subset of the overall sustainability market, but it has continued to expand in the two years since we wrote this article. As basic LEED certification becomes “table stakes,” savvy and aware developers, owners, employers and employees want to take the sustainability of the Built Environment to the next level. Wellness standards are a key piece of this evolution in sustainable design. Those design, engineering and construction firms best equipped to meet this market demand for health and wellness standards in sustainable design stand to benefit greatly from this evolution.



# Health and Wellness: The Next Disruption in Sustainable Building Design

By Greg Powell

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*How companies can effectively transform environmental- and health-related disruption into true opportunities now and in the future.*

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In today's global economy, building owners and employers are looking for ways to compete for talent, reduce operating costs and benefit the environment. While Leadership in Energy and Environmental Design (LEED) certification continues to be the leader in U.S. commercial real estate sustainability certification market share, trends in the market are causing building owners and employers to consider new aspects of sustainability, new certification systems and new technologies.

Millennials have now surpassed Generation X to become the largest generation in the American workforce.<sup>1</sup> This group's preferences for sustainability, wellness and business transparency are expected to be major influences on building design. This trend creates significant opportunities for architecture, engineering and construction (A/E/C) firms well-positioned to meet this generation's demand for all things green, healthy and innovative.

## LEED Reigns in A/E/C

The most prevalent green building rating system in the world, LEED is used in over 165 countries and territories.<sup>2</sup> Expanded to serve practically all building, community and home project types, this certification addresses both human and environmental health, primarily by rating various components of a building's design and construction. However, there are varying tradeoffs with LEED's holistic human and environmental strategy. Among them is the inherent challenge that comes with engineering a building to bring in more outside air for improved human health without compromising energy efficiency goals.

LEED continues to dominate the green building certification market and appears to have as many as 65,000 projects in the pipeline for the next few years. As shown in **Exhibit 1**, LEED adoption rates<sup>3</sup> have

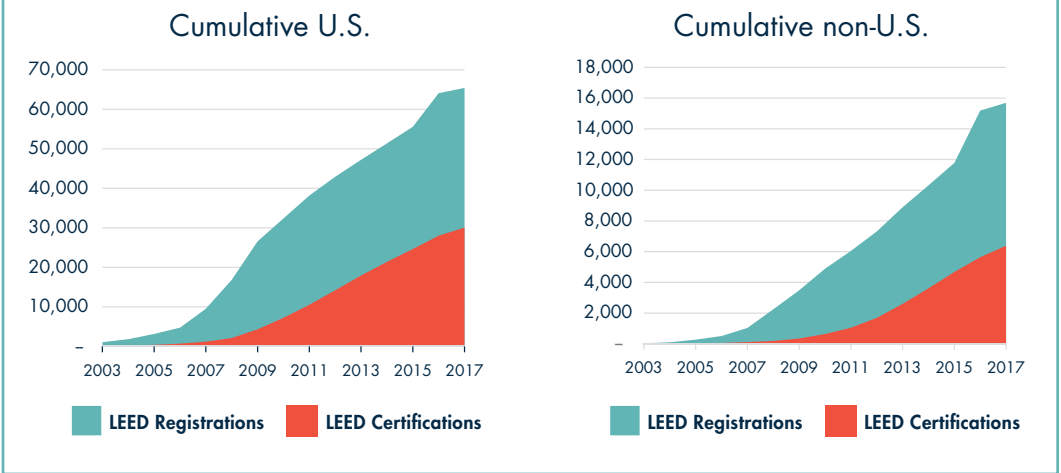
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<sup>1</sup> Feeney, N., "Millennials Now Largest Generation in the U.S. Workforce", Time, May 11, 2015.

<sup>2</sup> LEED, <https://new.usgbc.org/leed>, November 2017.

<sup>3</sup> LEED, "Country Market Brief", <https://www.usgbc.org/advocacy/country-market-brief>, November 2017.

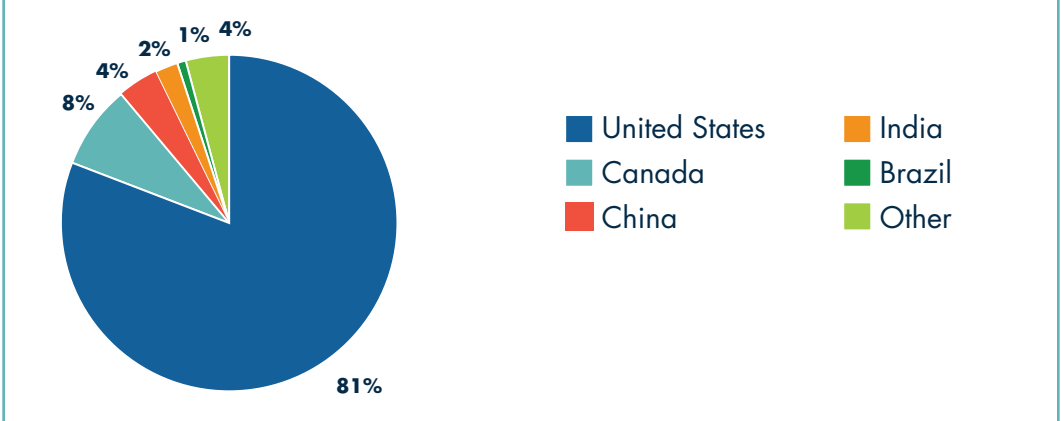
## Exhibit 1. LEED Adoption Rates



grown consistently over the last 15 years; as of July 2017, there were 90,900 total commercial LEED certifications. The larger number of LEED registrations serves as a proxy for anticipated future growth in LEED certification and sustainable design.

While the U.S. is by far the most active country in the world for LEED certifications, it's by no means the only supporter of green building. Many global markets are pursuing widespread measures to reduce carbon footprints and maximize energy efficiency. China, Canada and India, for example, are all increasing adoption of green building standards (Exhibit 2, LEED Certifications by Country<sup>4</sup>).

## Exhibit 2. LEED Certifications by Country<sup>4</sup>



<sup>4</sup> LEED, "Country Market Brief", <https://www.usgbc.org/advocacy/country-market-brief>, November 2017.

## Growing Diversification in Sustainability Measurements

LEED has responded to the trends in transparency, wellness and technology with the addition of a new Performance Path to LEED certification using Arc, which allows building owners or consultants to collect energy, water, waste, air quality, occupant satisfaction and transportation data to benchmark themselves against other projects. This level of benchmarking helps to improve overall building performance.<sup>5</sup> Arc can be used both to recertify LEED certified buildings and to certify non-LEED buildings. The program uses data from occupant satisfaction and other key performance indicators to influence a daily or monthly dynamic LEED score.

Over the past two decades, many new green building certification programs have emerged with and without LEED alignment. Some are geographically focused, such as BREEAM, which dominates the U.K. market. Others are focused on a sector or issue that LEED does not specifically address, such as Living Building/Zero Energy Certification, Passive House and Green Globes, all of which have shown rapid adoption rates, but still with far fewer certifications in place compared to LEED.

## The Next Phase in the Evolution of Sustainable Design

We're now witnessing the increased **convergence of green and wellness**. While green certifications such as LEED focus more on the environmental impact of a building, wellness rating systems emphasize the health and well-being of the building's occupants. According to Leigh Stringer, EYP, workplace

strategist and author of "The Healthy Workplace," "Many of the strategies for creating a healthy and productive physical work environment stem from the efforts to make buildings greener or more environmentally friendly."

This progression is driven by, in part, a growing focus among employers on health costs as U.S. health care expenses spiral out of control. Studies have shown that the building environments affect human physiological systems. Americans spend more than 90% of their time indoors, on average, yet indoor air is generally two to five times more toxic than outside air due to poor ventilation and off-gassing of toxic chemicals from a host of products, from carpeting to furniture.<sup>6</sup> The Harvard T.H. Chan School of Public Health identified these nine foundations of a healthy building: air quality, thermal health, moisture, dust and pests, safety and security, water quality, noise, lighting and views, and ventilation.<sup>7</sup>

The benefits of "healthy buildings" have been documented in numerous studies and include reduced illness and absenteeism among workers, higher worker productivity, higher test scores among students and greater workplace satisfaction.<sup>8</sup> One such

<sup>6</sup> National Geographic, "5 Surprising Ways Buildings Can Improve Our Health", <http://www.nationalgeographic.com/environment/urban-expeditions/green-buildings/surprising-ways-green-buildings-improve-health-sustainability/>, February 2017.

<sup>7</sup> Harvard T.H. Chan School of Public Health, "The 9 Foundations of a Healthy Building 2017", <http://www.forhealth.org>, November 2017.

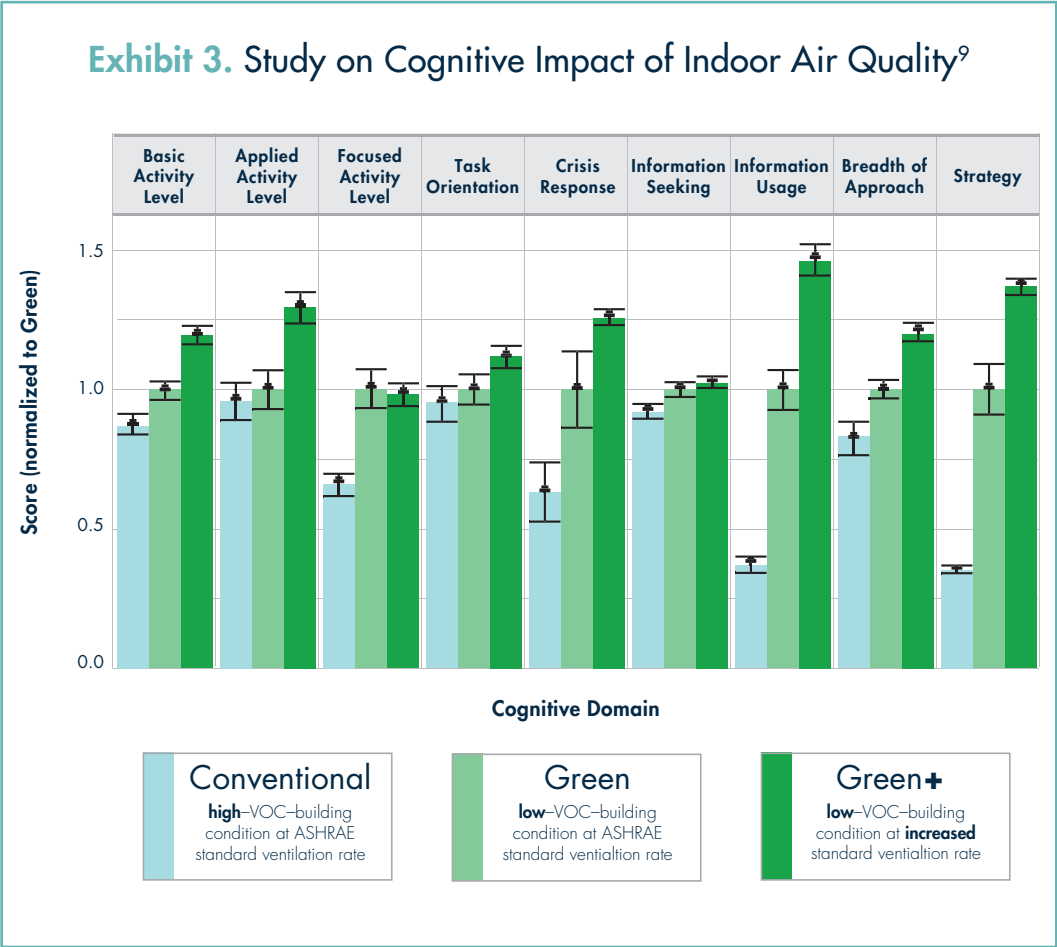
<sup>8</sup> Allen., J, MacNaughton, P., Satish, U., Santanam, S., Vallarino, J., & Spengler, J., "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments", <https://ehp.niehs.nih.gov/15-10037/>, Volume 124, 2016.

<sup>5</sup> ARC, <http://arcskoru.com>, November 2017.



study directly quantified the impact of indoor environmental quality on cognitive functions. By changing levels of air ventilation, carbon dioxide and volatile organic compounds, the study measured how the indoor environment in which we work and live affects our health and productivity. The results show a clear correlation between improved indoor air quality and cognitive performance (**Exhibit 3**, Study on Cognitive Impact of Indoor Air Quality<sup>9</sup>).

These cognitive benefits translate into documented monetary cost savings for building owners and employers. In turn, building certification standards are evolving to hold designers and contractors accountable to deliver these cost-reducing and revenue-boosting benefits. However, a survey conducted by Virgin HealthMiles Inc. illustrates some of the challenges with wellness initiatives: 89% of employees reported a company’s health benefits as



<sup>9</sup> Allen, J, MacNaughton, P., Satish, U., Santanam, S., Vallarino, J., & Spengler, J., “Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments”, <https://ehp.niehs.nih.gov/15-10037/>, Volume 124, 2016.

significant to their choice of employer, but only 36% of employers reported having the information needed to be able to make actionable decisions about an employee health strategy.

Partly in response to the financial potential in addressing occupant health in the built environment, industry stakeholders developed the WELL Building Standard, which integrates health, design and management.<sup>10</sup> According to the International WELL Building Institute, 90% of the costs associated with the life cycle of a commercial building come from the people inside (salaries and benefits), while only 10% come from operating the building itself. Wellness certifications have emerged to improve returns on the 90% invested in human assets.

As Rachel Gutter, senior vice president of the WELL Building Institute, explained to FMI, “Our indoor environments have a profound effect on our health and wellness, impacting everything from our stress levels to alertness to productivity. The WELL Building Standard was developed with this relationship in mind. Designed to be as interactive as possible and to work in harmony with other building certifications like LEED, WELL encompasses over 100 features addressing seven core concepts of building performance that have been scientifically proven to impact the occupant experience.”

It’s important to note that WELL certification is not the only certification gaining a significant amount of attention in the market. “A new wellness program, the Facility Innovations Toward Wellness Environment Leadership (Fitwel) certification program, was developed by the Center for Disease

Control (CDC) and was piloted on General Services Administration buildings, an organization also known for its early adoption of LEED certification,” Stringer explains. “Many of my clients are adopting Fitwel as a certification tool because the strategies have been vetted by CDC’s research team and are intentionally low-cost and fairly easy to implement, even in existing buildings.”

## Wellness Implications

Wellness standards have yet to achieve broad market adoption, with 28 WELL certified buildings and 159 Fitwel buildings currently operating in the U.S. However, it’s clear that human health and wellness in the workplace are both high priorities for millennials, and more certifications are on the way. In the U.S. alone, there are currently 224 registered projects. Worldwide, 522 projects are registered for WELL certification. Studies show that millennials are increasingly emphasizing a healthy work environment when making employment decisions.<sup>11</sup> Rising demand for human wellness-focused work environments among this most influential component of our workforce is leading more companies to respond by considering wellness certifications in both new and existing buildings. Architects are beginning to witness this uptick in building owner and employer interest in wellness. Maria Papiez, sustainability leader at design firm EwingCole, notes “There is now a critical mass for wellness in the marketplace as big brands compete for talent.”

<sup>10</sup> International Well Building Institute, <https://www.wellcertified.com/>, November 2017.

<sup>11</sup> Rigoni, B., and Nelson, B., “Millennials Want Jobs That Promote Their Well-Being”, <http://news.gallup.com/businessjournal/196985/millennials-jobs-promote.aspx?version=print>, November 2016.

One such brand is technology leader Lenovo. “To attract today’s top talent, Lenovo committed to both LEED Platinum and WELL certification for its new building at the North American Lenovo headquarters,” explained Erin Bolduc, Lenovo technical project manager. “We pursued WELL late in the design process as we recognized a significant amount of overlap between the two rating systems while pursuing LEED v4. Where LEED and WELL did not overlap, Lenovo corporate policies made it obvious that, with our benefits and the site characteristics, we would be able to achieve WELL certification.”

In addition, the demand for wellness and “healthy buildings” has driven—and continues to drive—advancement in building innovation and technologies that monitor and enhance health benefits for building occupants, as illustrated in **Exhibit 4**. Technological innovation has a rapidly growing influence on the broader design and

construction industry, and its role in fostering healthy building environments is growing in equal measure.

In time, buildings that achieve wellness certifications may earn health insurance incentives, as insurance providers continue to explore ways to reduce risk. Companies pursuing less formal employee health and wellness initiatives—such as lifestyle and disease management programs—have accrued similar benefits.

## Impact on the Design Industry

### Moving Forward

When sustainability became the new normal, designers adapted to the demand for LEED and similar capabilities. Building stakeholders are now broadening this environmental focus toward the human experience, and the industry must once again adapt.

## Exhibit 4. Building Technologies Targeting Wellness



- Cloud-integrated sensors and apps
- VOC sensor-controlled ventilation in laboratories
- Sunlight-sensitive smart lighting
- Stress relief via appliance-manipulated occupancy sensors
- Programmable indoor air quality sensors
- Acoustics and sound-altering emitters
- Smart water detection and filtration systems

As the convergence of green and wellness continues to gain momentum, the design industry will be facing new demands. To deal with these shifts, firms will need to address the various wellness programs gaining in prominence; navigate new and emerging building technologies; and cater to shifting priorities among building owners, employers and employees. As these demands grow, design firms will also need the right balance of talent and capabilities to compete and thrive in this evolving environment.



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# Four Steps to a Winning Divestment Strategy

By Dan Shumate and Carter Brenneman



Consolidation in the construction industry has steadily increased over the past 10 years. In the utility construction segment, we've seen the market capitalization of the top 10 public companies grow by 65% over the past decade, with most of the growth driven by acquisition.<sup>1</sup>

As companies grow through acquisition, there will inevitably be elements of the businesses acquired that don't align with the acquirer's strategic focus. Occasionally, these pieces can be worth more separated from the parent company than they are embedded within a larger construction company.

Divestment remains an important part of the toolkit for a corporate development team and for executives assessing how to unlock the highest value for the company. For example, one company we worked with recently held a product distribution company inside of a large specialty construction company.

As a standalone entity, that distribution company had a multiple that was almost two times the value of the larger construction company. By divesting of the company, the owners would be able to unlock the smaller business's value and then either distribute the cash or invest in the areas of the company where management was strategically focused.

By implementing a strategy that factors in not only growth through acquisition but also strategic divestment, executives can gain both operational and financial benefits that far outweigh a passive buy-and-hold approach.

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<sup>1</sup> Source: S&P Capital IQ, Tickers for companies included are: MDU, PWR, MTZ, DY, PRIM, ARE, GVA, AEGN, MYR, MTRX



# Four Steps to a Winning Divestment Strategy

By Dan Shumate and Carter Brenneman

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*In a business environment where 83% of E&C firms are interested in acquisitions, it pays to set your criteria, establish your team and lay down the rules of the road before jumping in.*

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As project sizes grow, and as the share of megaprojects rises as a percent of total construction put in place, the demand for large, technically sophisticated firms has increased. We're also seeing a continued integration of design and construction, both in terms of project delivery and business models. Combined, these trends have led large E&C players to increase their acquisition activity, especially engineering and design firms.

In FMI's recent [M&A trends study](#), 79% of firms with over \$1 billion in revenue stated that acquisitions were a current part of their strategy, compared to 42% of firms with less than \$500 million in revenue. Mirroring recent deal history, engineering and integrated E&C firms indicated they were much more likely to be acquisitive in 2017, with 83% stating acquisitions were a current component of their strategy.

Similarly, of the nearly 4,000 M&A transactions FMI has tracked since 2007, roughly 5% were acquisitions by eight firms, primarily large engineering-led companies such as Stantec, WSP Global and AECOM. This trend is less pronounced on the

construction side, where competitors are more fragmented, projects are delivered locally, and economies of scale are less pronounced.

Over the last few years, the ENR 400 has accounted for roughly one-third of all construction put in place in the U.S., a ceiling it has not topped since the 1970s. Despite this, we are seeing increased buyer appetite in the construction segment, especially among self-performing contractors.

In this article, we'll explore the current M&A trends, show where the challenging points are, and provide four rules of the road that all E&C firms should follow when considering and/or orchestrating mergers, acquisitions and divestitures.

## Is It Worth It?

In tracking nearly 400 E&C transactions in the U.S. and Canada in 2016, FMI found activity to be roughly on pace with that of 2015 and 2014. Fast-forward to 2017, and acquisitions remain a component of most E&C firms' current strategy, with many companies prioritizing small strategic deals over major transformational acquisitions. For



those firms currently considering an acquisition, the ability to integrate effectively was identified as the most important factor in achieving a successful transaction.

Before executing a strategy of “growth through acquisition” or “strategic refinement through divestiture,” company leaders need to ask themselves this important question: Is this worth it? For acquisitive growth, this next question is: Does the risk of investing capital in a business outweigh the risk of loss or setback? And for divestitures: Do people in a division that have been with the company through the thick and thin outweigh the potential advantages that come with a focused strategy?

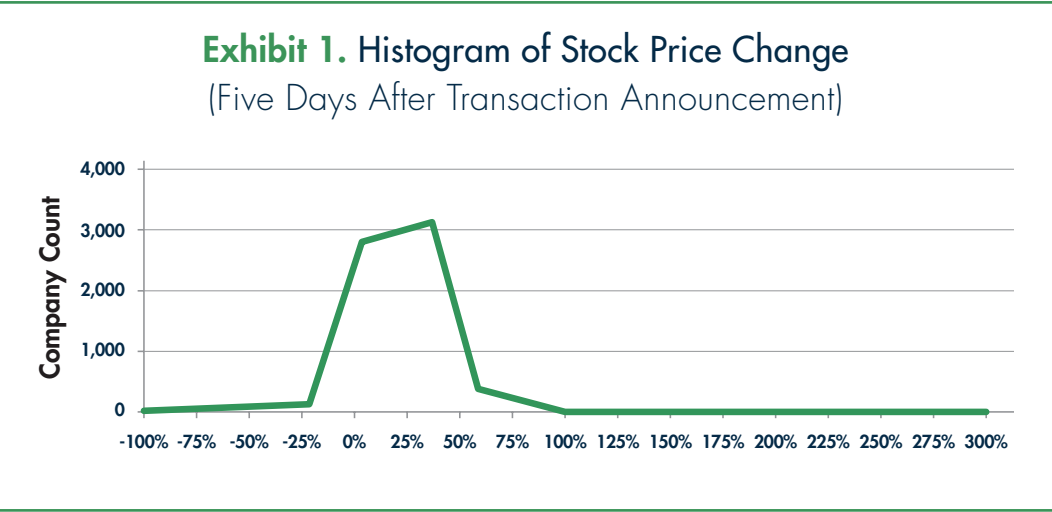
### Creating a Focused Strategy

Many construction companies never complete an acquisition. Instead, they are passed from generation to generation and tend to grow at a measured and predictable pace. Contrast this with a company like

Quanta Services, which over the past 20 years grew its revenue from \$80 million to \$7.6 billion. This growth was due to a focused acquisition strategy in a segment where Quanta understood the end market and was disciplined in pricing—strategies that drove the growth of the largest power services company in the U.S.

In addition, Quanta has not simply purchased companies and held them indefinitely. Also shaping the firm’s strategy and improving shareholder returns were strategic divestitures of business segments that were underperforming due to changing market dynamics. Companies that engage in both acquisition and divestitures to actively control what is in their portfolio deliver increased shareholder returns.<sup>1</sup>

Let’s look at an analysis of the valuation and share price return of over 6,000 divestitures or spinoffs by public companies since 2000. In **Exhibit 1** below, a pattern emerges that



Source: Data compiled from S&P Capital IQ and analyzed by FMI.

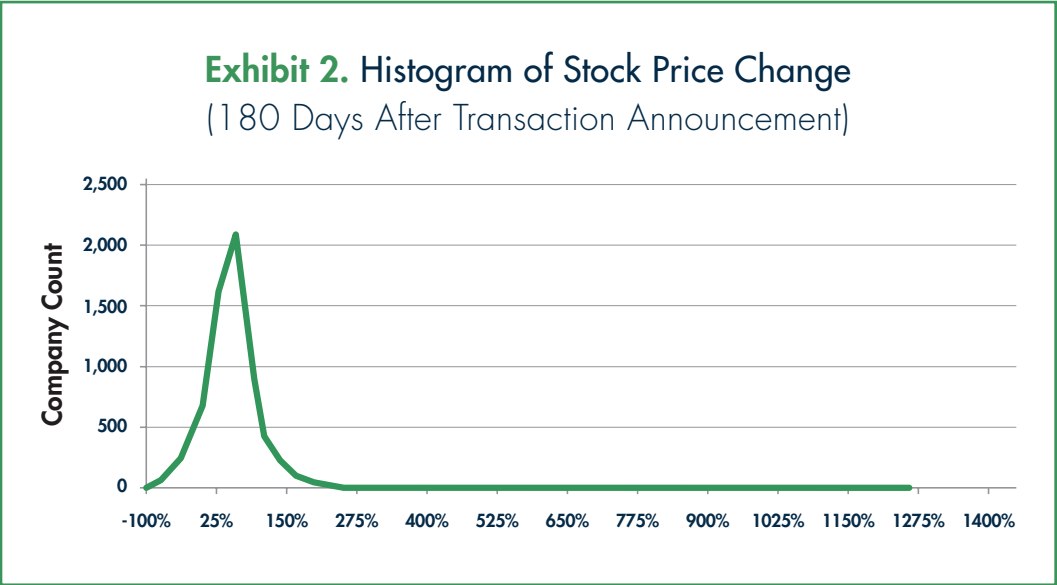
<sup>1</sup> Dranikoff, Koller, Schneider (2002). Harvard Business Review.

persisted throughout the data: a right skewed histogram that has a very long tail on the positive end of the spectrum. We would expect the right skew because there is a natural barrier to price (\$0); and if a company makes a decision that has very negative effects on the business, then there is a downside to the percentage decrease of the company's stock price. However, the magnitude of positive increase in stock price results in a notable finding, with both the short-term (5 days) and middle-term (180 days) results showing an increased chance of outperforming the market.

Further study has demonstrated that over longer time intervals, excess returns for companies that complete divestitures averaged 4.4% globally.<sup>2</sup>

**Exhibit 2** illustrates not only the right skew, but also the significant long tail that can occur, resulting in outsized shareholder return. The average stock price return over 180 days was 10.9% alongside a median of 4.5%. Additional analysis by other firms produces similar results. In a study written by Bain consultants for HBR, “An investment of \$100 in the average company in 1987 would have been worth approximately \$1,000 in 2007, but a similar investment in the ‘best divestors’ would have been worth more than \$1,800.”<sup>3</sup>

While the divestiture can be a boon for a shareholder, many of these transactions actually produce limited returns. The reason for the divestiture, strategy moving forward and the financial changes after close all



Source: U.S. Census Bureau, July 3, 2017

<sup>2</sup> Restructuring and Repackaging Corporate Assets, May 9, 2008, Citigroup Global Markets. Excess return is defined as: Actual Return – ( $\beta$  x Market Return).

<sup>3</sup> Mankins, Harding and Weddigen (2008). Harvard Business Review.

impact the likelihood of success. Reasons for a divestiture can vary widely from operationally focused to financially focused. Common reasons include:



### Operations Focus

**Strategic Focus:**

Management aligns the business with its primary strengths.

**Operational Improvement:**

Management exits from low growth and profitability segments.

**Highlight Growing Business:**

Rather than focus efforts on underperforming groups, management can highlight a business unit by divesting of others that do not meet the same expectations.



### Financial Focus

**Capital Structure Change:**

Management can reduce leverage, improve credit rating and increase financial flexibility.

**Increase Cash:**

Management increases cash to allow for acquisition or significant capital purchases.

**Market Timing:**

Management determines that a business segment is overvalued by buyers and exits that business.

## The Four Rules of the Road

Acquisitions and divestments do not come without risk. Many of the best-in-class acquirers have dedicated teams to select the appropriate companies and then integrate those firms into their organizations. Employee turnover and risk management impact operations while capital structure, distributions, investor profile and credit impact the financial decisions.

We reviewed the work on “how the best divest” for application to the construction industry to determine the four rules of divestment.<sup>4</sup> Here they are:

**Rule 1: Establish a dedicated team.**

Whether determining to complete a major spinoff such as Babcock and Wilcox from McDermott or selecting whether to keep a division in place, a team of individuals dedicated to the analysis of the fit and opportunity of business units within a company is critical. For smaller companies with limited resources, management should take on the role of reviewing business units and service offerings annually.

**Rule 2: Set your criteria.** While market timing is stated as a potential financial reason for divestment, timing the market is incredibly challenging in practice. It’s important to establish a set criterion to effectively determine whether a division or subsidiary should be a candidate for divestment. For example, a division’s return on investment must meet a three-year average of 15%, or that division could become a candidate. The specific values should be highly focused

<sup>4</sup> Mankins, Harding and Weddigen (2008). Harvard Business Review.

on the individual market and industry; however, the criteria can prevent hasty decisions or market-timing mistakes.

**Rule 3: Dig into the details before pulling the trigger.** Removing components of a business can be as impactful as incorporating new ones. Management should select the people who will be involved in the divestment and assess the associated impact on existing operations. For a materials company that can easily separate an individual quarry's people and operations, this can be straightforward. However, the decision to sell the service division of a large commercial electrical company can be much more difficult. Often, the service division of the company will have similar estimators, dispatch and controllers, and be a component of active contracts held in the construction division. The best divestors have a strategy of de-integration before making the decision to go to market.

**Rule 4: Articulate the benefit to a potential buyer and motivate employees to stay on board.** The last rule is a requirement of any acquisition or divestiture in the engineering and construction space. Without the people

involved in the transaction, there is no transaction. Therefore, it is important that you clearly articulate the potential benefit to an acquirer of the division or subsidiary that is being placed on the market. This process helps ensure the divestment does not fail or receive a poor valuation. In addition, it's crucial to retain key employees to facilitate the successful divestment of a unit. A champion within the division can be very helpful for selling the concept internally and presenting the asset for sale. Incentivizing the unit's management team with compensation, and providing select management with knowledge of the eventual sale, can also positively impact the outcome.

As the E&C industry becomes increasingly dotted with mergers, acquisitions and divestitures, the success rates for these deals will depend heavily on the teamwork, legwork and due diligence that take place long before any documents are signed. Utilizing divestments to illuminate value, create liquidity and flexibility, and improve operations has a clear valuation benefit. In both the short term and the long run, companies that align their acquisition and divestment strategy with the core competencies of their business can outperform their peers.





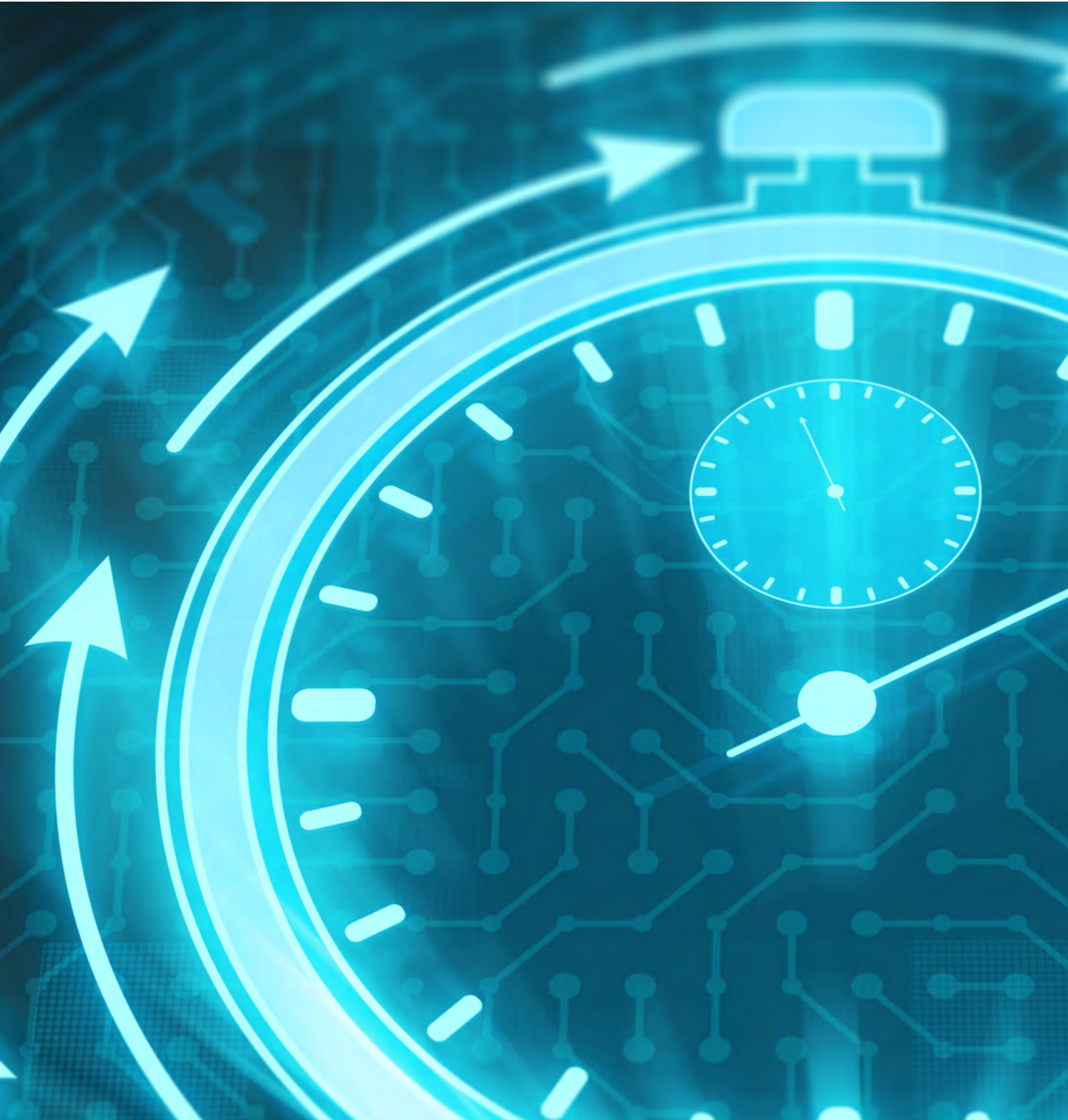
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# The Maturing Construction Technology M&A Environment

By Andrew Henderson



Construction technology investment and overall mergers and acquisitions (M&A) activity are stronger than ever. Strategic acquirers remain very active, and companies like Procore are continuing the M&A push to broaden solution offerings and provide more technology-enabled options for customers.

As technologies mature, private equity and venture capital dollars make more financial sense in the space as well. In 2019, for example, Brick and Mortar Ventures announced a \$97 million fund that's backed by several big names in the construction industry. At the same time, underlying market dynamics that serve as key investment drivers are continuing to present challenges for the industry. A shortage of quality labor, along with rising labor costs, presents major hurdles that can be addressed by improving construction technology.

Concurrently, we continue to see minimal change in construction productivity, although business owners are now looking to technology to finally move that needle. The problem is that construction executives still have a long way to go in their efforts to develop a coherent technology strategy. Siloed project sites and a lack of technology training for key project managers mean that significant structural changes are still necessary to make tech adoption a success.

With more approved budgetary dollars going toward construction tech, it will be important to monitor those investments in order to see where true value can be acquired.



# The Maturing Construction Technology M&A Environment

By Andrew Henderson

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*Assessing the key M&A deals for construction technology and what they mean for the E&C industry.*

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When it comes to technology deployments, the construction industry is severely lagging other industries. While many variables come into play here, there are a few root causes. For example, rolling out new technology across multiple, offsite construction projects is downright difficult. Furthermore, many smaller subcontractors that comprise a large percentage of the industry lack the scale to invest in technology that may not realize returns for some time. And finally, many industry players are so deeply rooted in the “old ways” of doing things—many of which continue to produce results for them—that they don’t want to shell out the money or devote the time to new technology implementations.

Whatever the root cause of the problem, the fact is technology plays a critical role in meeting the ever-changing needs of customers and internal stakeholders. An industry that is known for project delays, lagging labor productivity and an acute shortage of quality labor, engineering and construction (E&C) needs technology more than ever to ensure long-term growth.

Fortunately, the E&C industry does have deep pockets and is currently experiencing significant growth. So, while this multitrillion-dollar industry may be currently

lagging others on the technology front, E&C is well-positioned to quickly reverse that trend and bring its technology into the 21st century.

## Where Does the Money Go?

Over the last decade, more than \$10 billion has been allocated to funding construction technology. Most of that money came through early-stage venture capital deals. Brick & Mortar Ventures, for example, completed 24 deals (with a median deal size of \$5 million), all of which have been minority investments.

Both financial and strategic investors have been active, but we have not seen the types of majority investments that are common across the rest of the industry. Given that many construction company boardrooms lack technology experience, many firms have used the minority investment approach to simply try out specific technologies of interest. We do expect the construction industry, which generally experiences a few years lag between early-stage venture capital funding and larger-scale, majority M&A activity, to follow the M&A trend we see across other industries.

Looking at recent deals, construction technology was distributed across three



main verticals: collaboration software, physical construction technology and data analytics/artificial intelligence/Internet of Things:

- **Collaboration software** can be any software tool that helps connect teams and assets across a business that helps them maintain and further grow mobility. This can be as simple as basic communication software or as complex as highly engineered sensors embedded in assets across multiple sites with built-in notification capabilities to help teams make better decisions.
- **Physical construction technology** includes digital mapping, design platforms, highly engineered materials, 3D printing, prefabrication and robotics. These technologies can be so different that, in many cases, it may make sense to further delineate subverticals when discussing comparable metrics.
- **Data analytics, AI and IoT** are all solutions that help E&C firms get good data from job sites (and from the employees who are working there) and then use it to generate actionable insights and make good decisions. Right now, for example, we see many IoT plays in this space that will hopefully one day help teams make more efficient, well-informed decisions.

## The Deal-makers

As construction technology companies mature, larger acquirers are stepping in and making full (or at least majority) acquisitions. These acquisitions are being driven by both strategic and financial (e.g., private equity) acquirers. For example, strategic

acquirers have started making significant construction tech investments for various key reasons, including talent acquisition. Leveraging acquisitions to acquire and build talent can be a very efficient alternative to internal hiring and development practices. Trimble's \$1.2 billion acquisition of Viewpoint, for instance, added not only a leading construction management solution but also a team of over 700 experienced individuals capable of driving future business growth.

Another reason we are seeing an uptick in construction technology acquisitions is that the technology itself is maturing. Used as a testing phase, the traditional venture capital approach is no longer necessary because of the higher probability of investment success. With a proven technology comes the ability for acquirers to model projected cash flows and to more accurately identify the projected rate of return. Caterpillar, for example, made an initial investment in Yard Club, a provider of an online equipment rental platform, back in 2013. Caterpillar was then able to follow that business and prove its future profitability, which then led to the eventual full acquisition of Yard Club in 2017.

## Key Acquisitions

The landscape of construction tech firms is very broad, and some acquirers are consolidating similar or complementary firms into larger entities in order to gain market share and increase company value. JDM Technology Group just acquired Integrity Software Solutions along with an add-on acquisition of Estimate Software, both of which further built a strong product portfolio of leading construction software solutions. And Autodesk just bought PlanGrid for \$875 million in one of the most significant

acquisitions in 2018 in an effort to further drive interoperability among E&C firms.

Vertical integration is also driving M&A activity among E&C firms. Companies like Katerra see the value in vertical integration with the ability to better control the full supply chain and reduce double marginalization with various third-party transactions. Additionally, as collaboration software matures, it's facilitating vertical integration even further.

Private equity (PE) deals have been driven by many of the same factors as strategic deals; however, given PE's business model, some additional factors come into play. Given the leverage used by these private equity firms, recurring revenue and cash flow generation are key in order to repay the debt. As such, private equity has been drawn to many construction tech targets that have an "as-a-service" model, which in many cases comes in the form of a software licensing model.

Genstar Capital took this approach when it combined iSqFt and BidClerk within the ConstructConnect platform to create a vertically focused software-as-a-service platform. The platform provides project data, analytics and software tools to the construction industry. This approach was successful for Genstar, as the firm later exited this investment and sold the platform to Roper Technologies.

The long-term contracts that come with this "as-a-service" model give investors more confidence in companies' future performance and allow them to more easily model out the return of that investment. In instances where future performance is uncertain, financial acquirers look to targets with a large, addressable market.

This situation occurs with many software-based construction tech companies that may not currently have a significant customer base but instead do show significant headroom to expand into the broader global construction industry.

Additionally, some buyers haven't been lenient when it comes to requiring a track record of historical profitability if the target—usually a software company—has a significant number of pre-existing users. In such situations, the acquirer can leverage that large user base, for growing not only the target in question but also potentially other platform companies that can cross-sell into that market.

In the end, the most significant driver for financial buyers in E&C is the maturation of the construction technology space. Investors want to know that they are going to generate a strong return on their investment, so it is crucial for mature constructing tech firms to provide greater transparency and clarity around future performance indicators.

## Top Valuation Trends

Construction tech companies come in all shapes and sizes and serve various markets. As such, there is no one-size-fits-all model for company valuations in this space. In E&C, we generally see EBITDA multiples as the main base for valuation. We expect to see deals like Quest Integrity Group, a technology-enabled asset integrity and reliability management services provider, that was acquired by Team Industrial Services for a conservative value of nine times EBITDA.

This valuation approach makes sense until a construction management software

provider like CONJECT is acquired by Aconex, an Oracle subsidiary, at 81 times EBITDA. This proves that we must consider a broader range of metrics to better understand relative value among different acquisition types. Accepting that this still may be somewhat of an overgeneralization, we have seen a few broad deal types across the space. These include the acquisitions of nonprofitable construction technology businesses, profitable construction software companies and profitable construction technology service providers.

When acquiring nonprofitable construction tech firms, buyers are looking for some of the factors already mentioned in this article. The total addressable market, existing user base and strategic synergies are just some of the key points that they consider. For many construction tech deals, acquirers pick targets where they feel further consolidation would yield a significant strategic value. The idea that “ $1 + 1 > 2$ ” has been a key driver of M&A activity in this space. Acquirers of these types of businesses also rely heavily on valuation multiples from similar transactions in the market, given the fact that stand-alone cash-flow modeling may not be possible due to a lack of profitability.

## Finding Profitable Targets

When it comes to profitable targets, software companies have their own requirements for generating accurate valuations. Cash flow projections are a key source for valuers when they are looking at companies in this space. Acquirers will also look to the licensing base of software companies to value the recurring revenue stream that comes from that base. Additionally, as we see in any deal, acquirers of software companies will also look for

strategic synergies. For example, a general contractor with a large volume of assets across multiple project sites could gain significant value from a smart asset tracking system that allows management to make precise and potentially cost-saving decisions.

A significant number of deals in the construction tech space have revolved around service provider targets. In many cases, valuing these companies is like valuing a traditional construction company. To gain greater value, acquirers want to see (and therefore model out) cash flows based on a recurring revenue. The project-based nature of many construction companies is generally a value detractor, and the same



holds true for construction tech companies if they do not have long-term recurring revenue streams. The people aspect of the acquisition is also key here. From acquiring individuals with key expertise to gaining full teams of employees trained in a new technology, human capital can become a significant piece of the financial model for construction tech service providers.

## More Transformation Ahead

Overall, we are still seeing significant variability in construction tech company valuations. Cash flow modeling can be very tricky at times, given the many variables and assumptions. Acquirers generally look

to comparable trading multiples and valuation metrics from similar transactions to determine the true market of such targets.

Given the infancy of the construction tech M&A space, these market metrics are still few and far between. For over 65 years, FMI has successfully led M&A transactions in the E&C space, and we see the market metrics in our deals every day. FMI, along with the acquirers in the construction tech space, will continue to develop a much narrower view on valuation as construction tech firms continue to mature and engage in M&A activity in the future.



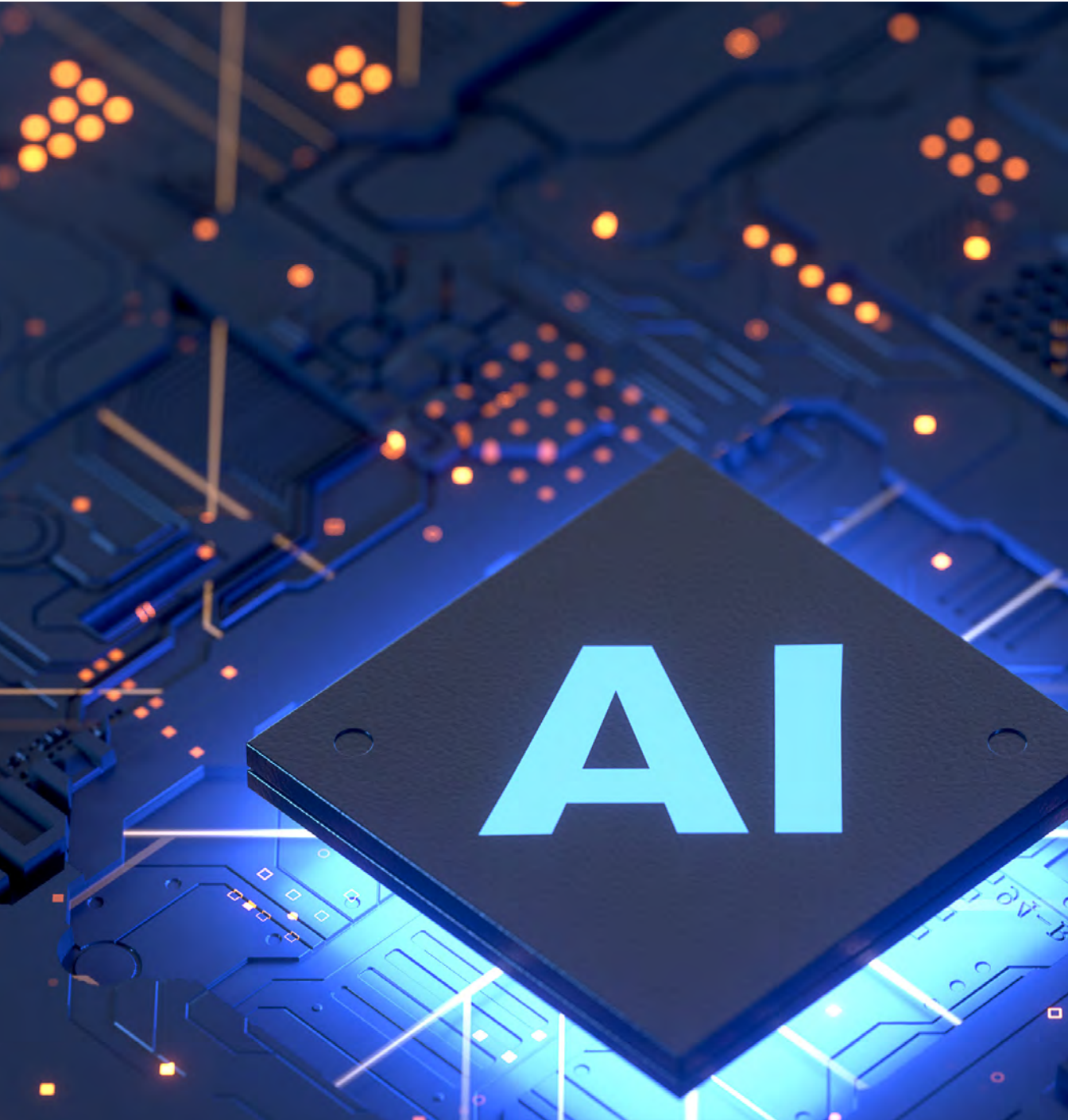
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# AI: Engineering and Construction Firms Are Watching Early Adopters

By James Boileau



Artificial intelligence in construction was just in its infancy when this article was published. The technology remains in very early stages and is expected to continue to evolve for years to come.

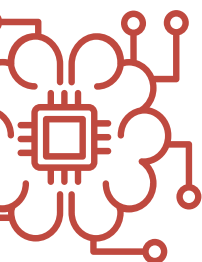
As with any disruptive technology in any industry, it takes time to grasp the new possibilities, let alone identify which new tools have the greatest potential value for your particular business. For AI to gain more ground in construction, for example, a few hurdles must still be overcome.

Integrating new technology can require a shift in mindsets and skill sets among workers. This challenge is complicated by the labor squeeze. It's not easy to learn a new process or system when there are barely enough hours or hands to complete the familiar tasks. Firms must have a long-term view, understanding that struggles upfront will pay off over the long run.

As an industry, engineering and construction have yet to fully digitize and analyze data. A great deal of E&C work is still done via paper and pencil, which never makes it into a database. A movement toward digitizing data, however, is gaining momentum. The next steps are managing, understanding and leveraging the data.

As E&C firms see their peers putting AI's potential into practice on real job sites, adoption of this and other technologies will continue to gain momentum.





# AI: Engineering and Construction Firms Are Watching Early Adopters

By Andrew Henderson

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*Four ways artificial intelligence can transform an industry that's finally poised to embrace technology.*

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As technology continues to disrupt many industries, offering exciting and meaningful opportunities to improve how we work and deliver evermore complex projects for our customers, it has long been acknowledged that construction has been slow to implement these tools.

Although the most sophisticated engineering and construction (E&C) professionals collect data and use technology to analyze that data and become more effective, in my experience, it's still a small percentage.

The tide appears to be changing, necessarily so: Projects continue to grow in number and complexity while the labor shortage continues to challenge the industry. Recent investment in construction technology has been robust, according to recent research, noting that between 2008 and 2012, construction technology received \$9 billion in cumulative investment. That number doubled to \$18 billion between 2013 and February 2018.<sup>1</sup>

The technology solutions being proposed and/or implemented in E&C are still in the early stages and run the gamut—3D printing, robotics, digital twin technology and modularization are a few examples. The applications that promise to drive real change involve artificial intelligence (AI) and machine learning. AI's capabilities include, but aren't limited to, document analytics, cognitive services and cameras, risk analysis and prediction, and data analytics.

## AI and Machine Learning

AI consists of software or computer systems that, upon receiving either structured or unstructured data and learning from it, can mimic human decision-making. Given that the E&C industry can now collect enormous amounts of data, the possibilities for AI truly are exciting.

To cite one example, if you input thousands of images of people wearing hard hats as well as thousands more images of people without hard hats, a computer can learn to identify noncompliant workers, whatever their size, shape or gender, on any given building project. The more data a system

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<sup>1</sup> Blanco, Jose Luis, et al. "Seizing Opportunity in Today's Construction Technology Ecosystem." McKinsey & Company. September 2018.



receives, the closer it will come to attaining complete accuracy in its assigned task.

For the purposes of this article, we consider machine learning a subset of AI. Machine learning differs from AI in that it uses statistical information to provide computer systems the ability to learn from data, but within a stricter framework. For example, let's say you want to prevent a fire. If you teach a machine to alert you when the temperature in a room has exceeded 100 degrees Fahrenheit and to shut off the thermostat at that temperature, that would be machine learning. To meet the definition of AI, the machine would be able to recognize fire and make independent decisions based on that event.

Most applications currently used in E&C involve machine learning. However, AI has the potential to transform the industry in many ways, helping us keep projects on track and boosting the safety, efficiency and bottom line of any given work site.

Here are four examples of AI's potential that we find particularly intriguing:

**1. Predictive Analytics.** As its name suggests, this type of analytics can predict future events based on current and historical data. The E&C industry has always collected data, but we haven't always known what to do with it. We are capable of collecting a dizzying amount of data—roughly 2.5 quintillion bytes every day<sup>2</sup>—so the potential applications of AI in our industry are vast. For a construction job site, examples could include

optimizing supply chain logistics, identifying the impact of weather trends on project scheduling, or managing budget overages through analysis of the team's experience level and contract type. As a risk engineer for an insurance company, I especially welcome how predictive analytics can predict safety hazards on a job site, thus allowing stakeholders to track and mitigate risk.

John Mavros, sales and marketing director for Predictive Solutions, a company that uses predictive analytics to reduce workplace injuries and fatalities, explains how predictive analytics can help general contractors (GCs): "On any given project, you might collect 5,000 to 6,000 data points a month. If a GC has 50 different projects, do the math and you realize how difficult it is to digest and interpret all that information at the same time," Mavros says. "A predictive analytics model is essentially interpreting all of that information for you and delivering a more intelligent data point that is capable of considering everything all at once and presenting you with the risk."

By recording data from inspections and on-site observations, the model creates a matrix of leading indicators and predictions on future risk in real time.

"We can provide intel on not only whether a location has a high-risk score but also the top high-risk elements on any given site—say, falls, struck-bys, caught-between— that the model is triggered to detect," Mavros says. "We put certain services around that to say, 'Okay, when it triggers, what are the appropriate actions to take?' So you can

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<sup>2</sup> Marr, Bernard. "How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read." *Forbes*. 21 May 2018.

ultimately plan how to mitigate that risk before it actually happens.”

As more data is added, a predictive analytics model becomes even more intelligent, eventually able to identify what “normal” is for a particular project and eventually what “good” looks like. With the Internet of things (IoT), he adds, the increased ability of passive devices, such as optical fibers and electrical resistors to record data, further expands the enormous potential.

- 2. Photo Documentation.** Capturing images to provide data is one of the more exciting applications of AI. Software is now capable of recording photos and highlighting meaningful information to help GCs monitor projects and track progress.

OnSiteIQ is one company that is doing this work and expanding the possibilities of photo documentation with AI. “We walk through a customer’s entire site every week, so they’ll always know the current conditions of every single square foot of their project as we build a digital archive of its progress,” says Ardalan Khosrowpour, CEO and co-founder of OnSiteIQ.

After capturing high-resolution 360-degree imagery (think of the experience on Street View), the tool can collect a variety of information, allowing stakeholders anywhere in the world to view the results and collaborate on the model’s outputs. This technology can also be used to narrow its focus to perform more specific tasks. For example, teaching a system how to identify a defective ladder would allow it to inspect all of the ladders on a 1

million-square-foot job site in a matter of minutes.

“It would take a person a long time to complete this task, and there’s no benchmark for human accuracy in finding, say, all of the ladders that might be defective and need to be removed,” Khosrowpour says. “Plus, remember that a machine doesn’t get tired like a person can. It will detect all the ladders and is able to identify the defective ones, with a very high probability that you aren’t missing any. This is an example of AI allowing your skilled employees to focus on more difficult and complex tasks.”

### **3. Augmented Reality (AR) and Building Information Modeling (BIM)**

**Technology.** BIM creates a 3D computer-generated model of an entire project before a shovel even hits the ground and includes the schedule of erection. It has already begun to transform our industry.

On a construction site, it’s all about the schedule. Applying AR to a BIM model allows stakeholders to see not only what the building is supposed to look like when it’s completed, but also where they’re at in any given moment—as well as the ability to step back in time or look ahead, courtesy of a digital archive built within the system. By teaming this up with AI, the computer can compare in-place construction to the model and where stakeholders are in the process (compared to the schedule) at any given point in time.

Imagine putting on a pair of glasses and viewing the project in every phase of its development. You can stand in a “room”

at the beginning of a project and see where it is at the moment and where it's supposed to be in one month, two months or further down the road.

To offer an even more basic example of AR's value: If the computer shows you on day five that a stud is in the wrong place, it takes very little effort to get back on track on day six or seven. If that misplaced stud is discovered weeks or months later, it will take a lot more effort to correct that problem and get back on schedule. This is particularly significant, considering [a recent survey from FMI and PlanGrid](#), which found that poor communication and poor project data collectively accounted for a total of \$31.3 billion in rework in 2018 for the U.S. construction industry.<sup>3</sup>

Moreover, once a project is completed, AI can create ever-smarter buildings that can optimize energy usage and enhance safety, among other capabilities

**4. Autonomous Vehicles.** Heavy construction equipment is becoming semiautonomous and even autonomous, creating the potential for huge productivity boosts. Feed a machine structured data—information you typically get from a drone or laser scanner—and let it identify the most effective way to do the job. Think of cranes, bulldozers and dump trucks not only doing the work, but also making intelligent decisions. More realistically in the near future, consider a backhoe that can optimize the way to dig a ditch:

It can recommend the specific size and depth to excavate and can correct itself, when necessary, to decrease or increase the amount of material it's cutting.

A few companies are already beginning to use these smart vehicles in their construction fleets to boost efficiency and productivity. One example is a 400-ton hauler truck that can make 20 trips per day. The safety impact can't be underestimated either, because these machines are operated remotely, keeping workers out of harm's way. Remote diagnostics also boost efficiency, ensuring equipment lasts longer and is more fuel-efficient.<sup>4</sup>

## Tech's Time Has Come

Although E&C will be playing catch-up compared to other industries in technology adoption, research suggests that AI applications in other sectors, such as transportation and retail supply chain, may have relevance for the E&C industry as well.<sup>5</sup>

Despite some early adopters in the E&C space, leadership across the industry must step up its game and recognize the opportunities that technology offers. E&C leaders also need to address the industrywide reluctance to technology adoption by reassuring their teams that these new systems are designed to optimize the skills and knowledge they bring to a project.

<sup>3</sup> Schott, Pete. "Construction Disconnected: The High Cost of Poor Data and Miscommunication [Report]: New Construction Survey Reveals a \$177 Billion Industry Problem." PlanGrid. 1 August 2018.

<sup>4</sup> Alderton, Matt. "The Robots are Coming! Driverless Dozers and the Dawn of Autonomous Vehicle Technology in Construction." Redshift by Autodesk. 3 May 2018.

<sup>5</sup> Blanco, Jose Luis, et al. "Artificial Intelligence: Construction Technology's Next Frontier." McKinsey & Company. April 2018.

“Technology, including AI, is empowering the construction industry to focus on the things that matter,” Khosrowpour says. “But the state of AI right now can’t fill the human connection for the foreseeable future. At OnSiteIQ, for instance, we do a lot of risk assessment. We never claim that what we’re doing is risk management. A machine cannot attain human emotion and intelligence for now, and it’s hard to imagine AI fully replacing that.”



**James Boileau** is construction segment director for The Zurich Services Corporation of Zurich North America, a role he has held since 2014. Responsible for the technical direction of loss control services provided to customers and underwriters, James manages a team that studies emerging risks in the construction industry and leads the development of new products and services designed to help mitigate those risks. He joined Zurich’s Risk Engineering unit in 2002 and has served in a variety of construction-related technical and management roles. Prior to Zurich, he had experience directing project supervision as a project manager and superintendent in commercial and industrial projects. James holds a bachelor’s degree in civil engineering and a civil engineering technology diploma from Lakehead University in Thunder Bay, Ontario. He holds the P.Eng. (professional engineer) designation from Professional Engineers Ontario and is a member of the Associated General Contractors of America (AGC) and the Construction Users Roundtable (CURT).

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A futuristic digital background featuring a glowing blue circuit board with intricate patterns and numerous small, warm orange-yellow lights. In the center, a dark, diamond-shaped chip is prominently displayed, emitting a bright blue glow from its base. The letters 'AI' are printed in a large, bold, light blue font on the top surface of this chip.

AI

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