



Big Data = Big Questions for the Engineering and Construction Industry

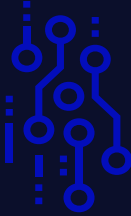
by Jay Snyder, Alyssa Menard and Natalie Spare

Engineering and construction companies that don't embrace the new norm of data-driven operations are likely to lose traction in the market and could become obsolete in the coming years. Is your organization ready to raise the bar and leverage big data and analytics in the future?



BIG DATA:

BIG QUESTIONS FOR THE E&C INDUSTRY



MISSED OPPORTUNITIES



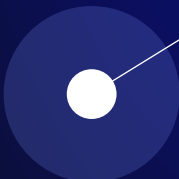
96% of all data goes unused in the E&C industry.



13% of working hours are spent looking for project data and information.



30% of E&C companies are using applications that don't integrate with one another.



8% of E&C firms have what they call real-time, full project management information systems that allow for dashboard reporting.



90% of data generated is unstructured. This includes tweets, photos, customer purchase history and even customer service call logs.

Sources:

vouchercloud
"Make it, or break it. Reimagining governance, people and technology in the construction industry." Global Construction Survey 2017. KPMG.
"Construction Disconnected. 2018 Industry Report." PlanGrid and FMI. 2018.

We're 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?).¹ 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.

Despite challenges associated with managing and implementing big data processes, companies that don't embrace the new norm of data-driven operations could lose traction in the market and become obsolete in the near future.

In this white paper, we break down some of the most challenging aspects of big data usage, explain the opportunities that present themselves when big data and analytics are properly implemented, and show the long-term power of utilizing big data as a business tool.

What Is Big Data?

The process of collecting large amounts of information and extracting useful insights through detailed analysis, big data in the E&C industry can be any information collected from sources such as:

- Sensors
- Drones
- Wearables
- Global positioning systems
- Email
- Transactions
- Financials
- Design plans
- Weather data
- The list goes on...

Consider this: Some of the largest infrastructure projects require an average of 130 million emails, 55 million documents and 12 million workflows.² 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.³

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

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

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

The good news is that big data can be captured and analyzed to reveal patterns or insights about an organization's processes, effectiveness, productivity, financials and other operational areas. 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. Using big data to gain insights about your organization comes with both challenges and opportunities. First, we'll explore the key challenges associated with big data:

Big Data Pain Points in the E&C Industry

Using big data effectively requires 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 data 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 (ROI). One new role to explore within the E&C industry is the "construction technologist." This professional 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, making effective data integration very challenging. Recent research showed that 30% of companies are using applications that don't integrate with one another.⁴ This happens when data is stored on different systems, including desktops,



What Is a Construction Technologist?

"Construction technologists carry a specialization in IT with additional interest and domain expertise in construction. The dual knowledge possessed by a construction technologist allows for technology management, research, adoption and implementation. The construction technologist also acts as a conduit to communicate the latest trends and vet technology to determine the most beneficial solution for each unique company."

Source: JBKnowledge

⁴ "2017 Construction Technology Report." JB Knowledge. 2017.



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 manually between applications. [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.

An abundance of data can be valuable, but mishandling that data—or not integrating your data sources—only leads to more data silos.⁵ Using multiple data sources is a great way to enrich your insights and create value for your organization; but it takes the skills to understand how to turn data into actionable insights.

For some E&C firms, current organizational processes simply can't accommodate advancements in data analytics. In an industry that is known for being behind the technology adaptation curve, some firms struggle with frontline managers and field staff who often don't understand how to implement analytical procedures. This can often make it difficult to get companywide participation in new data-driven processes, effectively slowing down the benefits of analytical tools within an organization. While some of the problem can be attributed to old-fashioned processes, long-standing cultures that are resistant to data-driven business models are also to blame. Recent research found that the biggest impediments to adapting new technology and advanced analytical tools are a reluctance from management or employees to change and budget restraints.⁶ However, in an industry where 35% of total costs can be attributed to waste and remedial work, using big data to reduce costs or increase productivity can have impactful gains on your organization.

“Like it or not, every construction company—and solutions provider—is now also in the data business. 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. 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. Solve the data problem and everything else falls into place.”

—Jon Fingland, General Manager,
Collaboration Solutions, Trimble

⁵ Ibid.

⁶ Ibid.

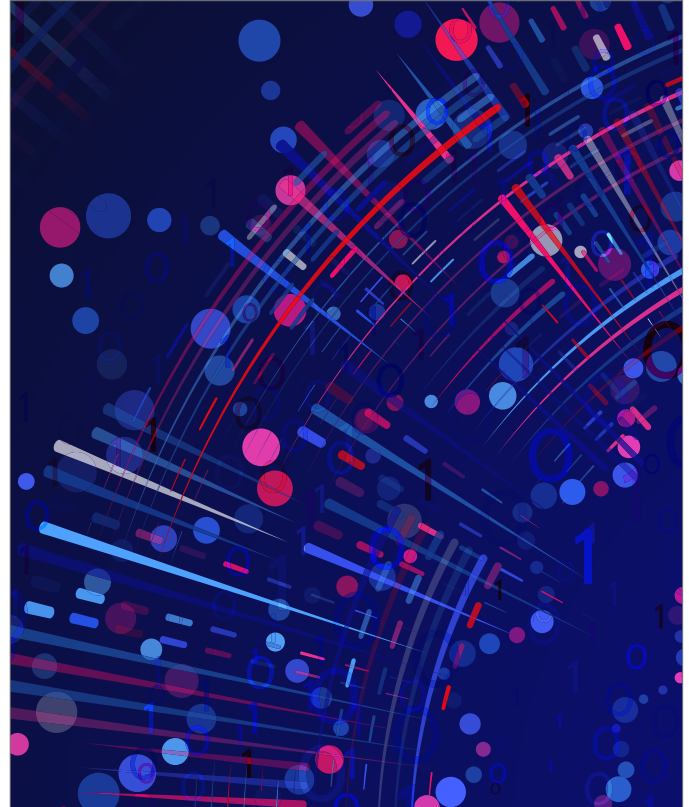
Finally, return on investment comes into play when using or implementing big data practices. In the E&C industry—on average—less than 1% of annual revenue is funneled into research and development or innovation. This makes guaranteeing a good ROI challenging for two reasons. For starters, without strategic planning, jumping onboard with a new technology platform may produce less than desirable results and poor companywide implementation. This is especially true for organizations that don't carefully consider the reasons (or "why") for which they are implementing the new processes or technology in the first place. Secondly, the organization must invest not only in technology but also in the right people to help guide it through these changes.

How E&C Firms Are Leveraging Big Data

Leaders in the E&C industry are already effectively using data to improve business outcomes, gain better visibility over their operations, and streamline their business processes. Building information modeling (BIM) is one example of how big data and data analytics are creating more productive and efficient processes.

Recently, JE Dunn's CIO partnered with Autodesk to build a real-time system that uses data-driven predictive modeling to create a custom visualization technology called LENS. This innovative tool speeds up the design process and reduces waste by allowing owners to see the project design, thus driving changes in the early design stages.

In the past, small changes contributed to major delays. Now changes are visible almost immediately. "Now you have a picture, the owner can see that concept model from our design partner and see the dollars tied to it," Jacobs explains. "You can say 'Show me what it would look like if we added another floor' or 'what if we made this part bigger?' Every element in the design is tied to our cost estimate. It is completely integrated so the solution changes visually, on the fly... That level of reliability is really changing the industry and effectiveness of our early pricing."



This predictive visualization software implementation is expected to save JE Dunn \$11 million on a \$60 million civic center construction project and reduce the project timeline by 12 weeks due to compression of the preconstruction phase.⁷

Skanska USA is another major E&C company that's leading by example. This global construction company leverages data to create better job sites and improve its project management practices. The company has embedded data usage into every corner of its business, including use of prefabrication methods, connected job sites, BIM, unmanned aircraft systems and virtual reality.

In 2016, for example, Skanska began using sensors to track employee, equipment and material movement. It found that workers on-site were walking up to six miles a day to procure equipment and materials. By using movement data and tracking worker location and comparing that information against worker activity data, the company configured the construction site to optimize tools and resources as well as positioning of the workers. This cut the movement and walking of on-site workers by one-third, thus boosting productivity by nearly an hour a day.

Along with the labor movement data, Skanska coupled geolocation and movement data that was collected via wearables plus information that workers provided about their daily activities. Analysts and software experts crunched the numbers and came up with an optimized solution centered on the ideal physical placement of objects within a spatial environment where things are almost always moving.⁸

⁷ Marr, Bernard. "How big data and analytics are transforming the construction industry." Forbes. 2016.

⁸ Wood, Chris. "Betting on Big Data: How Construction Firms are Leveraging Digitized Job Sites." Construction Dive. 2016.



Increased Collaboration and Efficiency

A big challenge for E&C firms, productivity lags can also be effectively addressed by using big data. By increasing collaboration with big data, for instance, firms can increase productivity and profitability, while simultaneously reducing risk and breaking down barriers. Some ways that disparate storing of information contributes to the notorious productivity challenge include:

- Data silos can affect many parts of your organization, such as finances/budgeting, information technology, human resources, etc.
- Data silos can slow down your company—silos create an incomplete picture, making it more challenging for leaders to make informed decisions.
- Data silos limit communication and collaboration within and outside of your organization.
- Data silos decrease quality and credibility of your data—isolated data can quickly become obsolete or inaccurate.
- Data silos reduce efficiency and storage.⁹

If these inefficiencies persist, they will greatly impact E&C firms' bottom lines and productivity rates. This is particularly critical in light of increasing project complexity and growing demand for new E&C projects. These realities are driving the need to break down silos across the industry and find ways to increase collaboration, consistency and efficiency on E&C projects. As most executives already know, siloed information can slow down processes, impede the flow of information and decrease productivity. When those silos are "flattened" out, those challenges begin to fade. Using big data to create automated workflows between stakeholders on a project, for example, can keep all parties informed with real-time information to create a more effective process. This, in turn, helps reduce delays and ensures that all parties have access to up-to-date information on a 24/7/365 basis.

"Integrating smart technology into construction is the only reliable way to meet the productivity demands. It's what we call the intersection of infrastructure and technology. This is the point where construction, surveying and engineering professionals find advantages and know-how to be at the forefront of technological innovation—to increase productivity and profitability—for growing infrastructure needs."

—W. Scott Langbein,
Topcon Positioning Group

Big data also does wonders for worker productivity. A [recent study](#) conducted by PlanGrid and FMI found that over 13% of construction teams' working hours were spent looking for project data and information—this equates to over five hours a week per person. In 2018 alone, U.S. companies will spend \$177 billion on nonoptimal labor activities.¹⁰ This illustrates the opportunity costs associated with creating streamlined processes and data workflows that can benefit stakeholders across the board.

⁹ "How to Break Down Data Silos: Problems and Solutions." Status. 2018.

¹⁰ "Construction Disconnected. 2018 Industry Report." PlanGrid and FMI. 2018.



Data as a Strategic Business Advantage

With various home and field offices and project teams all requiring access to the same data, it's easy to unintentionally compartmentalize data—that is, if the right data strategy isn't in place. With multiple departments using business data for different purposes and at different frequencies, processes will be unnecessarily repeated across groups and within teams. This becomes a real problem when data is downloaded and analyzed on an ad hoc basis, with copies being made and saved locally. New data entries are added manually, and the most up-to-date documents only exist as localized copies. In this scenario, version control quickly becomes an issue. When multiple versions of the same documents exist simultaneously, team members won't know which versions are the most current. The root cause of all of these problems? Data silos.

Luckily, data silos can be broken down and avoided altogether by creating a central repository and set of rules or “standards” that govern data storage (i.e., how and where it's stored, who has access to it, and how often it's updated).

“While the value of data has evolved tremendously over the past 20 years—and business users recognize it—few companies have adjusted their approaches to capturing, sharing and managing corporate data assets,” cloud software provider SAS points out. “Organizations need to create data strategies that match today's realities. To build such a comprehensive data strategy, they need to account for current business and technology commitments while also addressing new goals and objectives.”¹¹

A strong data strategy also:

- Establishes good practices.
- Is essential in allowing a firm to fully utilize its data.
- Codifies processes and procedures.
- Creates shared resources.
- Eliminates duplicate efforts.
- Standardizes data formatting and naming conventions.
- Increases accessibility for all users.
- Guarantees that data is consistent across the organization.
- Ensures that data is treated and managed as an asset and tool (instead of simply as a byproduct of other business processes).

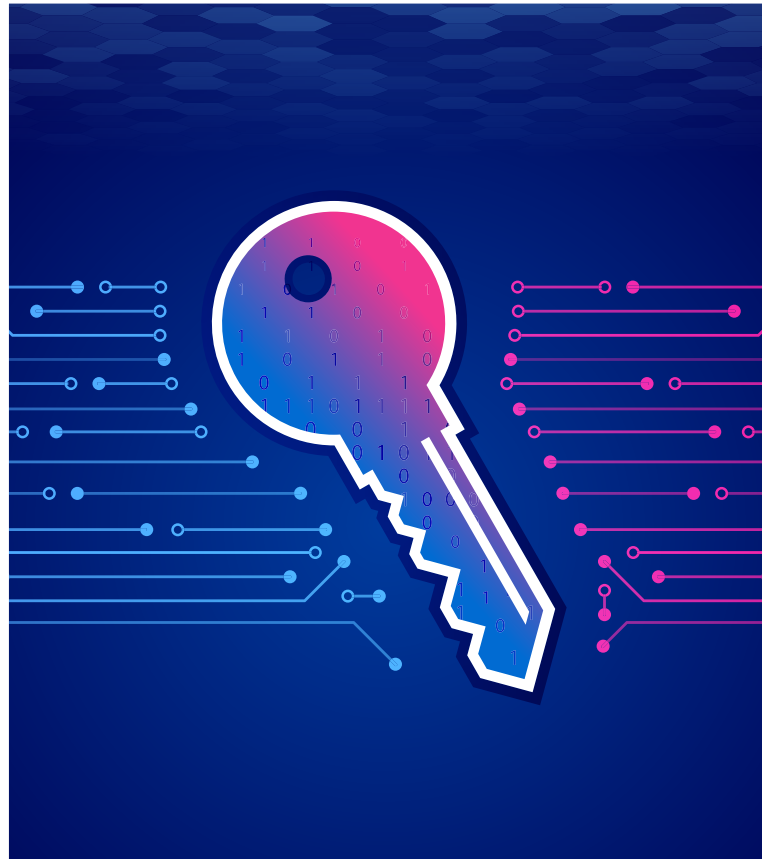
A well-designed data strategy should account for all of your data sources and repositories, including the third-party software vendors and point solutions that are in your firm's technology stack. Customer relationship management (CRM) systems like Salesforce and Cosentia—and enterprise resource planning (ERP) platforms like CMiC, Oracle, Sage or Viewpoint—should be evaluated and defined in your data strategy.

When developing your data strategy, it's important that you know which systems integrate with one another (and which don't). Interoperability among systems is crucial to optimize organizationwide data flows. If two pieces of the stack don't communicate with one another and don't allow data to transfer between them, your company won't be able to efficiently process and use its own data. When systems can't talk to each other, duplicate data entry is required. This slows down workflows and decreases efficiency. In a fully optimized system, the same information should never need to be entered more than once.

¹¹ “The 5 Essential Components of a Data Strategy,” SAS. 2018.

For this reason, when you are adopting new technologies into your company's stack, it's important to choose software that utilizes an open Application Programming Interface (API). These interfaces allow one piece of software to interact and communicate with other pieces of software. When an API is "open," it means that the software is designed in such a way that the information can be easily extracted from the backend. This makes the raw data accessible for use in things like business intelligence dashboards and internally developed, proprietary applications. This kind of access becomes incredibly important when your company wants to start employing higher-level data analytics techniques, including dashboards and predictive modeling.

Software companies that lack open APIs often require customers to operate on closed systems, which means that the data entered into the system is self-contained and can only be extracted via reporting tools and spreadsheet exports. Along with requiring duplicate data entries, these systems can't accept data directly from other applications. That makes it difficult to directly compare data from across your company. With this setup, the only viable way to compare all of your data is to download it yourself from each application and then visually match the results by hand in a spreadsheet application.



Some companies build pre-existing integrations with systems for their customers to interact with. For example, PlanGrid, one of the leading document-sharing and collaboration tools in the construction industry, has existing integrations with CMiC, HoloBuilder, Kahua and others. These integrations allow data from those applications to be pulled into PlanGrid and used in its system. A user can then extract information about a project housed in CMiC and use the same project details in PlanGrid—all without having to re-enter information in the latter. This level of interoperability plays an essential role in any data strategy and allows a company to be more data-driven in its decision-making.

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.

Creating Value and Actionable Insights

With good data practices and a solid data strategy in place, E&C companies can raise the bar and implement more sophisticated analytics. This foundation opens the door for a company to start using business intelligence (BI) tools like dashboards that take all stored, well-defined data and pull it into a centralized location where it can be displayed in a visual format for easier consumption. These dashboards allow you to aggregate separate data streams and compare the information within them in a single place.

A powerful business operations tool, a dashboard allows you to monitor your firm's performance in real time. The key measurable metrics include (but aren't limited to):

- Basic existing business data (e.g., finances).
- Custom, business-specific key performance indicators (KPIs) that utilize multiple data sources to paint a more intricate picture of your company's health.
- Information from public data sources that can be viewed in comparison to your company's data (for a snapshot of your firm's performance relative to the broader market).

Once you've established a solid data strategy, other analytical techniques, such as machine learning (ML) and artificial intelligence (AI), can help you gain insight from your data. These are two different types of data analysis that allow you to:

- Make predictions
- Discover relationships between data points
- Identify customer or market segments more intelligently
- Learn patterns from large and unwieldy data sets

Both machine learning and artificial intelligence require large amounts of data in order to be accurate. This is why it's so important to put a data strategy in place before using these methods. These technologies are already being used for drone and satellite image classification, real-time quality inspection and progress updates, immediate notification of code noncompliance, calculation and recalculation of a project's critical path, and prediction of safety issues before they happen. Both ML and AI represent the future of E&C. Companies that lay the groundwork of a comprehensive data strategy now will be better-equipped to adopt these new technologies and evolve with the industry in the future.

Big Data Is the New Oil

Intimidating for many companies—and especially those that are just beginning to wake up 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 white paper, 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.



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About FMI

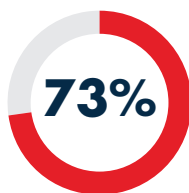
For over 65 years, FMI has been the leading **management consulting and investment banking** firm dedicated exclusively to **engineering and construction, infrastructure and the built environment**.

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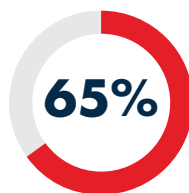
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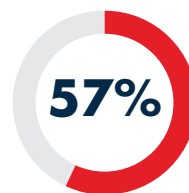
FMI Client Highlights



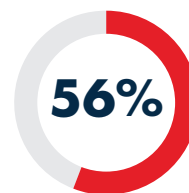
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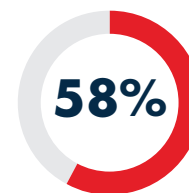
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