



The power of trust in analytics

**Part 1 of our Engineering & Construction
series – Understanding your data**

Our three-part series explores how engineering and construction executives can effectively leverage data and analytics to improve strategic decision making and gain a competitive advantage in their industry. In Part 1, we explore how to understand your data and the challenges of putting it to use.

Introduction

The engineering and construction (E&C) industry is being left in the dust of the digital revolution.

Technology is rapidly changing the world in which we live and how we work. Robotic systems, software and new technologies are replacing manual processes, human labor and antiquated machines causing the transformation of entire industries.

When it comes to the adoption of enterprise-wide digital vision and strategy, the E&C sector ranks near the bottom of the list, according to the 2017 Harvey Nash/KPMG CIO Survey. Without technology-driven efficiencies, E&C productivity lags far behind manufacturing and other sectors, and high-profile projects continue to fail or struggle to finish on-time or on-budget. Whether perception or reality, there is a stigma that the construction industry is archaic, inefficient, prone to corruption and unable to achieve budget and delivery goals.

As the rest of the world becomes accustomed to tech-driven efficiencies, companies are asking their construction teams to deliver more complex projects in smaller windows of time and for less money. One of the approaches that companies can use to meet changing customer demands and solve many of these issues is data and analytics—using computers and algorithms to mine large data sets for patterns and trends to help companies make quicker and better informed decisions that save time and money and ultimately drive better overall performance.

While many new and disruptive technologies are complex and difficult to implement, data and analytics offers E&C companies a quick and compelling way to improve productivity, compliance and overall performance, as well as differentiate themselves in the marketplace.

Armed with data they have already collected (and/or supplemented by additional data available externally), engineers and contractors can make strategic business decisions to successfully position themselves in a period of growing demand and competition.



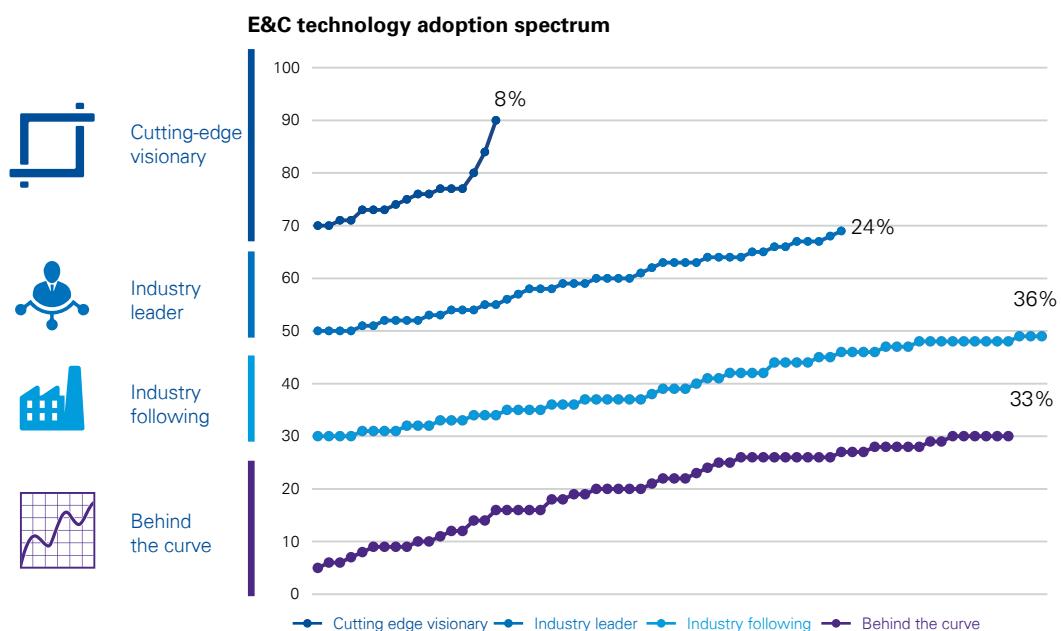
“Digital Darwinism is unkind to those who wait,” as the saying goes. So what are engineering and construction companies waiting for?

To start, many don’t see the value of hiring or dedicating staff for a data and analytics endeavor. Engineers, architects and contractors can be reticent to (in their minds) “waste time and money” sifting through years of data when they could be addressing current project needs or pursuing new work. As a result, just 36% of engineering and construction firms used advanced data analytics in addition to cost and schedule analytics, according KPMG’s 2016 Global Construction Survey. This bias against using

data and analytics in the construction industry leads to business decisions often driven by antiquated practices or beliefs instead of data-supported decisions and facts.

In addition, executives are often overwhelmed by the amount and dispersion of data their company already collects, let alone tackling how to organize it and put it to use. Launching a data and analytics initiative is easier to get started than many think and, if structured right, can help to create immediate value through improved project performance, efficient use of resources, compliance, and risk management.

Only 8% of engineering and construction firms consider themselves cutting-edge visionaries on the technology adoption spectrum, according to KPMG’s 2016 global construction survey.



Source based upon responses to level of adoption of a number of different technologies



Why does leveraging data and analytics seem so difficult?

Most engineers and construction firms are already using data in many aspects of their business. Although data collection may not currently be a targeted initiative, businesses still rely on information gathered over a span of projects to govern decision-making. Examples of this include building a schedule to determine the level of manpower needed to manage a project, or using daily reports from past projects in a region to determine how many weather days should be accounted for in order to complete exterior work.

Identification of data is just half of the battle. Most companies do not have a centralized or integrated project management information system (PMIS) in place; therefore, project data is scattered across multiple systems, programs and databases. Making matters worse, the information most often is not automatically populated or even routinely updated. Tracking and managing data is cumbersome and viewed as additional, unnecessary work.

Organizations that can integrate their systems and leverage data in new ways to drive productivity and performance will quickly differentiate themselves from the competition.



Becoming a more data-driven organization is a top-five strategic initiative for global CEOs over the next three years. And yet, CEOs also identify optimizing the use of data analytics and predictive technologies as a top-five technology challenge.

— 2017 KPMG Global CEO Outlook*







Current data sources

The following table summarizes typical industry data, where it's captured, and how it's used by engineering and construction firms.

Project Management Information Systems (PMIS)	
Examples: <ul style="list-style-type: none">— Unifier— Primavera Contract Manager— Prolog— Constructware— Procorre, etc.	Typical Uses: <ul style="list-style-type: none">— Document management / controls (RFIs, submittals, meeting minutes)— Subcontractor contract management— Daily reports— Quality management— Safety reporting
Data Inputs: <ul style="list-style-type: none">— Project staffing requirements— Weather impacts— Subcontractor financial performance— Safety incidents— RFI frequency and review periods— Submittal review periods	Data Outputs: <ul style="list-style-type: none">— Project staffing optimization Reports— Project schedule analysis— Project performance dashboards

CPM Scheduling or Schedule Analysis Tools	
Examples: <ul style="list-style-type: none">— Primavera P6— Microsoft Project— Acumen Fuse	Typical Uses: <ul style="list-style-type: none">— Project scheduling— Schedule quality analysis— Schedule impact analysis
Data Inputs: <ul style="list-style-type: none">— Daily reports— Earned value	Data Outputs: <ul style="list-style-type: none">— Schedule quality metrics— Schedule performance data by trade package or subcontractor



Estimating Software

Examples:

- RS Means
- Timberline

Data Inputs:

- Historical pricing data
- Contractor and subcontractor bids
- Project specific information

Typical Uses:

- Estimating
- Bid management/coordination

Data Outputs:

- Historical bid data
- Subcontractor quotes



Enterprise Resource Planning (ERP) system

Examples:

- SAP
- Deltek
- PeopleSoft
- Workday
- JD Edwards

Typical Uses:

- Document management / controls (RFIs, sumittals, meeting minutes)
- Subcontractor contract management
- Daily reports
- Quality management
- Safety reporting

Data Inputs:

- Enterprise governance requirements
- Human resource data
- Project requirements

Data Outputs:

- Enterprise financial data
- Project financial data
- Historical procurement costs
- Employee compensation data
- Subcontractor procurement results



Unlocking data's potential

Engineering and construction executives continually face difficult decisions regarding resource allocation.

Which projects should we pursue?

What industries are most profitable?

Do we really need that extra project engineer requested by the project manager?

Can we start demobilizing that project to cut our supervision costs and get a jumpstart on the next project?

These are just a small fraction of the questions asked throughout the project lifecycle.

When implemented to its full potential, analytics allows companies to answer these difficult questions and more, while finding potential strategic advantages that result in higher productivity and better business results. Beyond its use for business development, up-to-the-minute data on project performance allows management to rapidly respond to the ever-changing demands of projects.

The ability to know when or how to size manpower, or how to use resource-loaded schedules to keep ahead of procurement, is important to ensuring that projects meet schedules and, in turn, foster repeat clients. In fact, today's owners and customers are getting smarter in looking for underlying data and supporting analysis to back up a contractor's historical performance or claims they will meet budget and schedule.

At the same time, organizations can analyze costs against controls and other data for any red flags as part of risk and compliance efforts. Construction companies had among the highest annual median losses related to fraud relative to other sectors, according to the 2016 Global Fraud Study from The Association of Certified Fraud Examiners, with corruption and billing fraud identified as the most frequent schemes in the industry.

Industry challenges and data-driven solutions

The following table summarizes typical construction industry challenges and example analytics or solutions that can assist in making key decisions.

Challenges	Typical Data Sources	Potential Solutions
Pursuit Analysis: <ul style="list-style-type: none"> — Should we pursue opportunities in markets of historical strength or enter new industries? — Is this pursuit the most cost-effective use of the organization's time and money? 	<ul style="list-style-type: none"> — ERP System: Project financial records — Estimating Software: Historical bid results 	Model that determines most profitable opportunities based on an organization's specific inputs
Bid Optimization: <ul style="list-style-type: none"> — How have we performed against our as-sold budgets? — Which subcontractors or trade packages have been our best performers? Worst performers? 	<ul style="list-style-type: none"> — Estimating Software: Historical bids — ERP System: Project financial reports 	Analysis of budget performance by cost category and trade package for consideration in future bids
Subcontractor Selection: <ul style="list-style-type: none"> — Which subcontractor is 'right' for this project? — How has this subcontractor performed on previous similar projects? 	<ul style="list-style-type: none"> — ERP System: Enterprise financial records, project financial records — CPM Scheduling Software: Schedule historical performance — PMIS: Quality control reports 	Subcontractor selection that considers historical cost, schedule, and quality performance in addition to project-specific requirements
Project Staffing Optimization: <ul style="list-style-type: none"> — What is the optimal level of project management staff on a project? — Do we have the appropriate manpower to manage our full backlog? — When can we demobilize our project management staff with minimum project impact? 	<ul style="list-style-type: none"> — ERP System: HR records, project financial reports — PMIS: Project daily reports 	Optimized time-phased project staffing models Resource planning projections
Scheduling: <ul style="list-style-type: none"> — What trades have historically been the best and worst performers compared to the baseline schedule? — Are we adequately forecasting weather impacts on our projects? 	<ul style="list-style-type: none"> — CPM Schedule Software: Schedule historical performance — PMIS: Daily reports 	Analysis of schedule durations for standard activities and establishment of key performance benchmarks
Financial Metrics: <ul style="list-style-type: none"> — What project attributes have the highest correlation to profitability? — What contract financial terms have the greatest impact on overall project profitability? — Which project attributes have the greatest impact on working capital and other metrics? 	<ul style="list-style-type: none"> — PMIS: Project status reports, project performance data — ERP System: Contract metrics, project financial results — CPM Schedule Software: Schedule historical performance 	Analysis of project attributes and overall project profitability
Compliance and Monitoring: <ul style="list-style-type: none"> — Do we have the right fraud controls in place? — Are there Foreign Corrupt Practices Act (FCPA) risks we are not aware of? 	<ul style="list-style-type: none"> — ERP System: Project financial results 	Analysis of financial transactions by location, vendor, employee to identify potential fraud risks



Key considerations, challenges and risks

Nearly one third of IT leaders say their organizations have not been effective in facilitating the use of data and analytics, according to the 2017 Harvey Nash/KPMG CIO Survey. There are a handful of common issues facing engineering and construction companies looking to implement a data and analytics initiative.

Establishing a centralized system

The problem that many companies face as they collect data is how to use the disparate systems to streamline information and produce results. Most companies track costs, procurement, schedule, weather reports, punchlist, etc. in many different software applications using differing methods across the company. The issue then becomes how to take this vast amount of information and turn it into a useful tool to help executives make critical decisions.

One challenge associated with data and analytics is creating a system that will last—one that is easy to update, modify, and can continually produce results.

Consistency remains an issue facing all engineers, architects, contractors and owners. New teams and combinations of personnel are formed with each new project, resulting in slightly different means and methods applied to how a project is managed and tracked. Projects also range in size and complexity, making it difficult to apply a standard methodology across all projects in a portfolio. Pulling information from many different projects that all use different systems can create hurdles that obstruct producing clean data results.

Determining the true value of a D&A initiative

Data and analytics has the potential to help all businesses prepare themselves for the future, but choosing to invest the time and resources to analyze this information may not always be the right financial decision for every company. Performing a cost/benefit analysis of whether investing in data and analytics will generate the results and returns desired sounds like the obvious first step, but in many cases, it is not that simple. Much of the information needed to develop a strong business case takes years to collect in order to forecast benefits and weigh costs and risks.

Building trust in the data

Finally, companies must be able to trust the available data enough to drive business decisions, and that can be a difficult transition for many companies.

It is important for companies to develop processes and controls that ensure the collection of accurate and reliable data. Companies need to develop systems, tools, processes and training for their people to ensure data is collected in a consistent manner across the organization. The good news is that many companies have standard protocols and project management systems that already allow for analytics. An example is a company deciding to bid on certain work based on historical success rates with specific clients, industries or geography.

Relying on existing systems and tools to build trust in the data to make critical choices may seem like a big step, but the industry has been leveraging data for years. The real change is the process and speed at which information is analyzed, and the quality and greater depth of insight it can provide. A successful data and analytics program allows engineering and construction companies to more consistently rely on their data to make the right decisions.





56% of CEOs are concerned about the integrity of the data on which they base decisions.

— 2017 KPMG Global CEO Outlook*

Getting started

The key to getting the most out of your data is clearly defining the goals and objectives and laying out a plan to achieve those goals. The size of your business and the intended use of the information will steer the data collection needed. Is your goal to bid on higher-margin jobs? Grow the volume of work and increase margins? Allocate manpower more consistently to prevent ebbs and flows? Determining the end game before investing time and money will allow the greatest return on that investment.

Start developing a plan to use analytics by performing a thorough initial assessment of your data analytic capabilities and goals for developing a program. Key steps in getting started with an initial assessment include:



Initial Assessment - Key Considerations

- Establish goals and objectives for program
- Understand existing enterprise framework
- Identify existing data sources and uses
- Compare organizations within the business
- Examine existing tools and systems capabilities and usage
- Clearly define KPIs and benchmarks for use by organization
- Develop a roadmap with defined timeline for implementation



Start developing a plan to use analytics by performing a thorough initial assessment of your data analytic capabilities and goals.



Conclusion

The construction industry often suffers from the perception that it's slow to change and archaic. Yet, engineering and construction companies are already collecting copious amounts of data to leverage in meaningful ways to keep up with the growing demands of clients to delivering complex, fast-paced projects. Gone are the days of collecting data year after year with no real purpose other than documentation or the off chance it is needed for litigation. Now more than ever, companies must find new ways to structure and analyze data in order to improve productivity and overall performance, as well as differentiate themselves in the marketplace.

E&C companies should perform a realistic analysis of their current abilities to collect and analyze critical information. By performing an initial assessment, they can make the appropriate changes to identify the new sets of data that need to be collected now in order to produce the future results they desire. By using data to help steer business decisions, the construction industry will continue to thrive in the tech-savvy modern era.

What to read next

Part 2 of our series will identify tips for engineering and construction companies to leverage data that's currently being captured, with a focus on basic analytics to help identify profitable markets and clients and make better decisions on planned or ongoing projects. Part 3 will explain how to develop a roadmap for organizations to build world-class data and analytics capabilities.

You can access our series on D&A in engineering and construction, as well as thought leadership, surveys and other helpful content, on our website at <https://home.kpmg.com/us/en/home/industries/building-construction-real-estate.html>.





About the authors

When engineering and construction leaders turn to KPMG for advice, they do so because KPMG firms understand the industry on a local, national, and global level. For decades, we have provided services tailored specifically to meet the needs of the E&C industry. To do this, we have created a diverse practice that includes certified public accountants, professional engineers, architects, project managers, owner representatives, contract and procurement specialists, finance and tax professionals, business valuation specialists, cost estimators and specialists, certified fraud examiners, and forensic technology specialists. KPMG's E&C professionals provide strategic insights and relevant guidance wherever our clients operate. KPMG services are delivered through the global network of KPMG International member firms by over 2,000 professionals in more than 40 countries worldwide.



Clay Gilge, Principal, leads KPMG's Major Projects Advisory practice and has more than 20 years of practical experience and research. He has been at the forefront of KPMG's efforts to advance industry-leading methods and tools to objectively benchmark project controls, and he is on the cutting edge of applying advanced data and analytics to improve transparency and leverage the vast data sets associated with major construction projects.



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Stephen Andrews is a Director in KPMG's Major Projects Advisory practice specializing in cost and compliance auditing, project cost evaluations, project controls and forensic investigations in the real estate and construction industry. He is a CPA with more than 15 years of experience in auditing and construction accounting across industries and, prior to joining KPMG, was an Accounting Manager for a large regional general contractor.

*The 2017 KPMG Global CEO Outlook is based on a survey of 1,261 CEOs from global companies conducted between February 21 and April 11, 2017



When engineering and construction leaders turn to KPMG for advice, they do so because KPMG firms understand the industry on a local, national, and global level.



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