KPMG

Power of trust in analytics

Part 2 – Leveraging existing data in the engineering and construction industry

Introduction

The engineering and construction industry is swimming in valuable data that simply isn't being put to good use.

What if you could accurately predict a likely safety-related accident three days before it might occur, or foresee potential budget or schedule overruns at the start of a 24-month project? Would this change how you managed projects or made decisions?

The answer is a resounding "yes." These scenarios are still fantasy for most engineering and construction (E&C) companies, but some organizations are piloting predictive analytics and starting to see real, positive results. While the journey to develop accurate and reliable data-driven predictive models is not quick and easy, E&C companies need to act now to stay competitive and avoid the risk of outsiders taking over and disrupting the ever-changing and competitive marketplace.
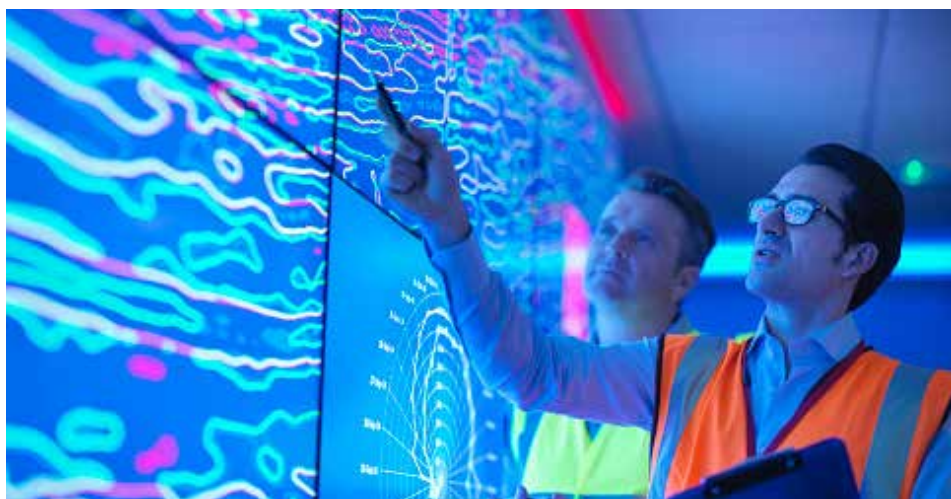
We previously discussed the different types and sources of data, methods of collection, and how companies can get started on their data analytics journey in Part 1 of the series.

But knowing what data to look for and where to find it is only the first step in a D&A program. An organization still must clearly define a methodology to ultimately drive positive results. It is time to start thinking about how to use data to its full potential.

Here we explore how engineering and construction companies can use analytics to drive business decisions, starting with a crucial first step: developing a robust approach to analyzing data within the organization.

Do we have the right talent for a D&A program?

Developing and conducting detailed analysis of project attributes and performance requires the right team. These individuals need to both understand the subject matter and have the analytical capability to extract, evaluate, summarize and interpret the data. E&C firms may need to make strategic hires or engage external subject matter experts to support the development of a D&A program.
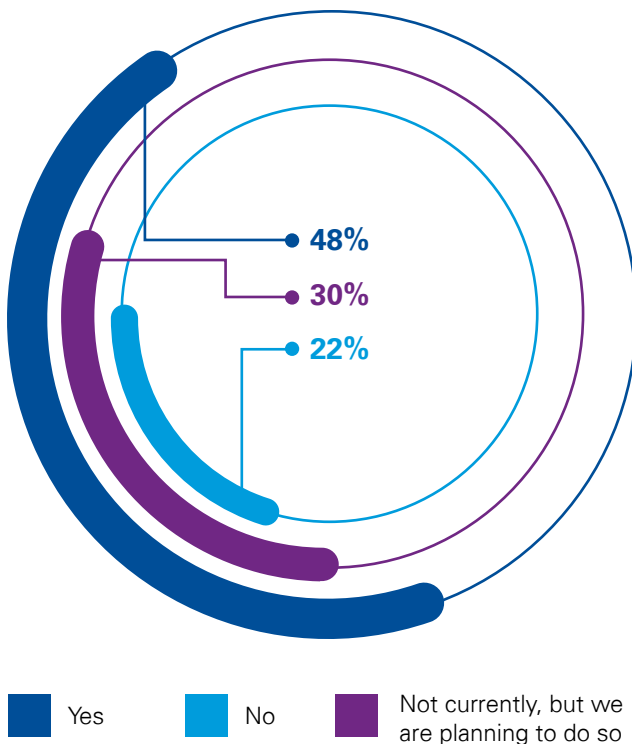
Developing an approach to data analytics

Almost half of chief information officers at E&C companies say that delivering business intelligence and analytics is a top issue for management, according to the Harvey Nash/KPMG CIO Survey 2017.

Yet fewer than half of the respondents to the 2017 KPMG Global Construction Survey say their company has a data/technology strategy or road map; just 30% are planning on developing one.

Ultimately, while many companies see the benefits of D&A, they have yet to put a plan in place to get started.

While methods, approaches and tools will differ from one organization to another, a road map with clearly defined objectives and methodology keeps all of the stakeholders aligned and provides a baseline for funding and reporting.

Less than half of E&C companies surveyed say they have a data/technology strategy or road map

48%

30%

22%

■ Yes   ■ No   ■ Not currently, but we are planning to do so

Source: Make it, or break it, 2017 Global Construction Survey, KPMG International

The approach to performing analytics

Below are key steps and basic examples that can be used as a launching point and resource for engineering and construction companies pursuing a data analytics program.

Repeat analysis or ongoing analytics
— Automated process developed
— KPIs identified and standardized
— Executive dashboards created

Summarize and present results
— Tools for presenting results selected
— Visualization created
— Stakeholder feedback addressed

Data analysis and validation
— Tools and methods for analysis identified
— Script or workflow for analysis created
— Results validated and outliers investigated

Data extraction, transformation and loading
— Extraction requirements understood
— Data prepped for analysis
— Data loaded into analysis software

Data assessment
— Data sources defined and mapped
— Population for analysis defined
— Key attributes selected

Goals & objectives
— Clearly defined problem or question
— Leadership buy-in

Additional details for each key step are summarized as follows:

🚀 Goals and objectives	Examples
The initial step is to clearly define the problems or questions that D&A plan to solve or answer. Avoid ambiguous or open-ended statements. Obtaining management stakeholder buy-in and gauging the level of effort are also crucial considerations in laying a platform for success.	*Example from a national construction management firm:* *The company was looking to use D&A to assess which geographical markets and industrial sectors have been the most profitable over the past five years*

📁 Data assessment	Examples
As discussed in Part 1 of our series, data is typically captured in multiple disparate systems in engineering and construction organizations. An initial data assessment should include the following: **a. Data source(s):** Organizations should assemble a data map that identifies all data sources, shows how those different sources interact, and details the format of the data. Once the available data is understood, identify the specific sources required for the analysis. **b. Data population:** In addition to identifying the source, establishing the population of data to be used in analysis helps to further refine the purpose of the analysis and narrow the focus. Document and obtain buy-in on how many projects, over what period, will be included in the analysis. Take into account data that may be considered incomplete or inaccurate in defining the population. **c. Data attributes:** After identifying and mapping the data sources, it is important to understand the specific data attributes that will be used in the analysis. Identify common fields (e.g., a unique ID) that can be found in multiple data sources to ease comparison of the various datasets. It's important to take the time to clearly understand the quality and source of the data. Failing to understand how different sets of data are interdependent on one another may lead an organization to move forward based on a faulty analysis that contains incomplete or inaccurate data.	*The data source was defined as the Job Cost Report download from the accounting system in Microsoft Excel format. Additional data to be used included summary-level project data including location, initial contract value, and final contract value from the project management information system.* *The analysis included all U.S.-based projects completed during the prior five fiscal years.* *Key attributes for analysis included project number, region, project start, project finish, baseline budget, approved budget changes, current budget, cost to date and profit margin. The unique ID across both the job cost report and project management information system is the eight-digit project number, to be used when transforming and normalizing data.*

🔦 Data extraction, transformation and loading	Examples
Once the data sources, population and attributes have been identified, qualified personnel should extract data from the existing systems and tools to help ensure the data is complete. Depending on whether the extracted data is structured or unstructured, there may be a requirement to normalize or transform the data to allow for consistency during the analysis, with the level of effort required highly dependent on the output.	*Relevant project information was pulled from the PMIS system, accounting system and company-standard project status reports.*

Data analysis and validation	Examples
The most time-consuming effort is typically spent on conducting the analysis and validating the results to help ensure the organization has developed complete and well-reasoned conclusions. The actual analysis of data can be performed using a variety of tools and methods, from simple Microsoft Excel analysis by average users, to a more robust analysis performed by qualified data scientists or professionals with significant experience in analyzing large data sets. The two key components necessary during this stage include: a. **Develop and conduct analysis:** When developing the analysis, it is important to consider which tools and methods to use. These will vary depending on the technical capabilities of the people conducting the analysis and the complexity of the initial objective. Organizations should also consider automating the analysis to allow for easier updates in the future. b. **Validate results:** After the analysis is complete, conduct a peer review to verify the initial results. Organizations should confirm the fidelity of the inputs and source data and investigate any significant outliers or anomalies. After the results have been validated, it may be necessary to perform the analysis again with corrected data.	*The company analyzed 230 projects over the last five fiscal years and identified variations in defined project attributes and combinations of project attributes for correlation to higher project profit margins.* *In one geographic region, the initial analysis indicated an average profit margin of 10% compared to the expectation that the region experienced an unusually high number of loss projects during the prior fiscal years. Upon further investigation into the results, the company determined that regions were incorrectly labeled in the accounting system, requiring a revision to the data set.*

Summarize and present results	Examples
An intuitive and clear visualization allows for complex analyses to be easily understood. For better results, consider specialty software packages developed specifically for visualizing large amounts of data. Additionally, visualization is an iterative process that allows for input from the end user or subject matter experts who best understand the data. Using the presentation as a brainstorming session to solicit input and alternative ideas on how to show the data may drive different or new conclusions.	*The organization created a visualization showing average profit margin by geographic region, which helped highlight that projects in one region consistently experienced solid profit margins of 3–5% with few loss projects. Upon further investigation, the projects won by that region were primarily low-risk contracts due to the nature of the industry in which they were performing work.*

Repeat analysis or ongoing analytics	Examples
Organizations may wish to regularly update or re-perform the analysis. When possible, consider automating the update process by linking existing data sources (e.g., ERP, PMIS) with analytic tools. By regularly performing analyses, organizations may be able to develop internal key performance indicators (KPIs) or benchmarks.	*A dashboard report was developed to analyze profit margin by region, office and project on a real-time basis, allowing executives to monitor ongoing and completed projects.*

While the methodology summarized above is illustrative, it contains some of the key elements of developing a robust analytical process as well as considerations for organizations beginning to analyze their existing project and program data. Every company will need to develop its own approach to conducting analytics and refine that approach through assessments.

Now that we've identified the steps for developing a D&A process, here we share a simple, real-world example of how industry leaders are leveraging existing information to better determine how to pursue and manage clients, deliver projects, enter into contracts, and make the many other decisions that impact their organizations, people and bottom line.

Case Study – Global EPC resource assessment

A major engineering, procurement and construction company was looking for opportunities to improve project performance and reduce costs by optimizing its global staffing. The company already realized that there were significant variances between how divisions and regions staffed major capital construction projects which impacted cost and schedule performance, and so it decided to assess recently completed major capital projects to analyze the existing staffing and resources models used to deliver those projects.

Key questions and concerns for the organization included:

— Are projects adequately staffed?

— Do specific project attributes (e.g., size, complexity, duration) drive our staffing model?

— Can we do a better job at planning how to staff projects?

— What factors should be considered when staffing projects, and how should they be addressed?

— Is there an opportunity to save costs on the existing staffing?

— Are sufficient resources in the right roles to reduce risk, control costs, manage schedule and ensure quality?

Upon establishing key goals and objectives for the analysis, the company undertook an extensive data assessment to gain a clear picture of the available and relevant information. This included looking across all program- and project-level systems and tools to determine the appropriate data sources.

At the completion of the assessment, the company decided to look at all projects completed over the prior five years that were in excess of $500 million. Key project attributes or factors that were considered in developing the resource analysis included the following:

— Project name

— Project number (unique ID)

— Staffing by job group/title

— Peak and average staffing

— Project type

— Project size

— Country

— Region

— City

— Total installed costs (TIC)

Data Sources:
— Project labor reports from Project Management Information Systems (PMIS)

— Project organization charts

— Project reports from PMIS

— Policies and procedures governing staffing models

Upon completion of the initial data assessment, the company held a meeting to validate the data sources, population and key attributes to be analyzed, and then turned to their IT personnel and external consultants to ensure a complete extraction of the relevant data. This included both structured data from their PMIS systems as well as unstructured data, such as organization charts that were inconsistent from project to project. Efforts were made to normalize the data to ensure consistency in comparing organizational roles for peer projects.

Based on the data downloaded and normalized across the five years of projects, the company was able to perform detailed analysis of the staffing levels across the population of projects. Two examples of analysis performed included the following:

Example 1– Project peak staffing vs. total installed costs

This analysis compared peak staffing to the total installed cost to assist in identifying potential outliers in the data sets or a causal relationship between the size of the project and peak staff levels. The company was able to identify specific outliers where peak staffing significantly exceeded their peers. Upon further investigation, the company determined key reasons for the increase in peak staffing and leveraged the available results to develop internal benchmarks and KPIs to be used in assessing staffing levels on future projects.

Facilities only Peak Staffing versus TIC curves (Phase 4)

Example 2 – Predictive modeling for project staff

Based on key project factors identified during the analysis, the company developed a predictive model for the anticipated number of personnel by job category (e.g., field engineering) based on key project attributes (e.g., size, region, phase, etc.). Based on the predictive model, the company was able to identify projects where the anticipated number of personnel by level or in total did not align with the developed model.

Once identified, senior management could perform further analysis and due diligence to assess whether the project was properly staffed. While there may have been project-specific or extenuating circumstances explaining the variances, the analysis provided management with the necessary information and data to investigate further.

Upon completion of the analysis, the company identified key trends in the data indicating why certain project staffing models were considered outliers compared to their peers. The analysis, in combination with input from project management, allowed the company to develop project staffing benchmarks for use on future projects.

In addition, the analytics developed for the initial population of projects was further enhanced and linked to the existing PMIS system to allow for the review of all projects in the oil and gas portfolio on a recurring basis, with minimal effort.

With so much readily available information, deciding exactly what to analyze can be a major challenge.

Quick wins in analyzing existing data

By tapping into program and project data currently available in their existing ERP systems, PMIS systems, schedules and homegrown databases and tools, companies can start to analyze projects to make them better positioned to pursue and win new contracts, control contracts, more efficiently deploy resources, and stay better informed about their business.

With so much readily available information, deciding exactly what to analyze can be a major challenge. The simplest way to begin the analytics journey is to focus on the following quick wins:

Pursue the right projects: Which types of markets and projects are the most profitable?

All businesses desire to be profitable, the construction industry is no different. Historical perspectives tell us that the greater the risk associated with the project or contract, the greater the potential profit will be—but has your organization analyzed the data behind this assumption? Conducting a detailed analysis of the historical drivers of profitability may assist in making go/no-go decisions on pursuing projects. Key factors to use in analyzing profitability include:

— Contract type

— Compensation

— Profit margin

— Competitive bid vs. sole source

— New client vs. existing client

— City

— Region

— Project complexity

— Regulatory requirements

— Union/non union

— Risk profile

— Competition

— Market conditions

A comprehensive analysis identifying the most profitable projects allows organizations to target their business development efforts while identifying risk factors for current projects or in-flight pursuits that may not achieve the desired level of profitability.

Focus on bidding and estimating: How accurately are we estimating and bidding on potential projects? Are we maximizing the use of our historical data to measure our performance?

Estimates are built on assumptions, and when those assumptions turn out to be wrong, it is important to evaluate if the failure occurred during estimating or during execution. Leveraging your company's existing estimating and bid data is the most common and single most effective way to analyze data.

Companies should maintain a comprehensive and easily accessible database of historical estimates, project bids, cost data, subcontractor bids and final project costs for use by project personnel across the globe. While most companies already have some tools and databases, there is still a long way to go to ensure the data is consistently captured, used and leveraged across the organization, as opposed to maintained in certain offices, systems or tolls. Historical databases also need to be constantly updated to reflect changing market realities.

An analysis of historical estimating performance will identify cost categories or other areas with the greatest variance between actual and budgeted performance. This allows for increased accuracy of future estimates and the implementation of mitigating actions on active projects.

Moving forward

It's likely your organization is already attempting to use some of your available data to improve business processes, identify risk and make more intelligent decisions about running the business. But if your company is like most E&C firms, current efforts are likely ad hoc with limited impact to the overall business.

As such, it is common at this level of maturity to question if the level of investment required is worth the cost and time. This is due to the lack of a vision, strategy and plan around using and analyzing data. Without a plan and a structured approach to achieve results, an organization is essentially blindly shooting arrows at a target and hoping to hit the bullseye.

In today's project environment, with increased complexity, risks and expectations of perfect performance, an organization cannot afford to sit back and hope it all works out. To stay competitive and grow, leaders need to evaluate any opportunity that will drive business results, and applying analytics to available data is one of those options.
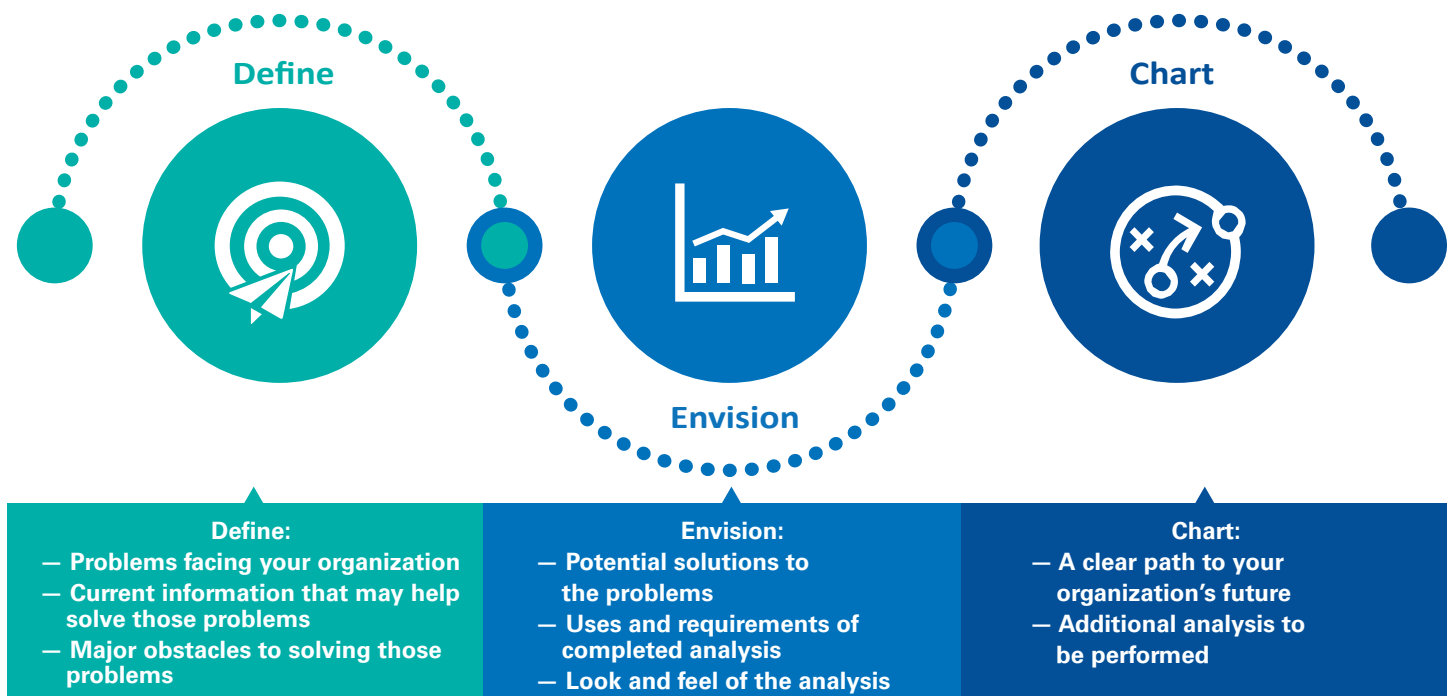
How and when your organization takes the next step to streamline the analytics process and incorporate it into all aspects of your business will be crucial in maintaining a competitive

advantage over your peers. As outlined in this paper, developing a robust and consistent approach to capturing, analyzing and reporting on program and project data will be a differentiator in the coming years.

If you don't have a plan in place today, your organization is already behind the industry leaders. The best time to start is now, and the best steps to tackle first are summarized below.

1. ***Understand your organization & business needs -*** Get started by defining the problems facing your organization. What data does your organization currently have that would help answer those problems? What needs to be done to prepare that data for analysis?

2. ***Envision what you want from the data -*** What insights can you draw from that analysis?

3. ***Chart a clear path -*** Above all, consider developing a clearly defined methodology to answer the simple questions and problems facing your company. You'll be surprised by the insights you will find hidden in the data and how it can benefit your business.

Moving forward in a clear direction

Define:
— **Problems facing your organization**
— **Current information that may help solve those problems**
— **Major obstacles to solving those problems**

Envision:
— **Potential solutions to the problems**
— **Uses and requirements of completed analysis**
— **Look and feel of the analysis**

Chart:
— **A clear path to your organization's future**
— **Additional analysis to be performed**

🖋 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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What to read next

Part 3 of our series will help engineering and construction companies envision the future of data analytics in the industry and understand how predictive and prescriptive analytics can be used to drive improved results. Check our site for the latest installment at "The Power of trust in analytics".

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