KPMG
cutting through complexity

ORACLE® | Platinum Partner

Digging into Data:
A Blueprint for
Mega-Project
Success

kpmg.com

Digging into Data: A Blueprint for Mega-Project Success

A multibillion-dollar budget. Hundreds of project employees. Dozens of contractors and subcontractors. Tens of thousands of activities. Intense public scrutiny. Five years of planning. Ten years to completion.

Many would call this fictional mega-project a recipe for disaster.

Here's the trouble: it's a common occurrence on a number of real projects managed by large Engineering, Procurement, and Construction (EPC) contractors.

As today's construction projects grow larger and more complex, a host of new challenges await project owners and the risk of failure increases exponentially. Amid this complexity, mega-projects can become like metaphorical quicksand: As owners and contractors get sucked deeper into them, failure becomes harder to avoid and the outcome of failure more ruinous. In fact, KPMG's 2015 Global Construction Survey found that in the past three years, the vast majority of projects failed to come in within 10 percent of their expected budget (69 percent) and deadline (75 percent).[1]

Why are many major construction projects so inefficient and error-prone? In part, because the construction industry has not kept pace with the rapid evolution of the surrounding technology landscape.

While technology advances are transforming other industries like retail, media, and auto manufacturing, the majority of construction companies operate much the same way as they did 20 years ago, relying on manual, disaggregated, and redundant processes for project planning and management. This slow adoption of innovation puts owners and contractors at great risk for cost overruns, missed deadlines, and other serious issues that stall mega-projects and—in worst-case scenarios—become cautionary tales (*see sidebar*).

But herein lies the opportunity: early technology adopters—construction firms which embrace cloud, mobile, and project management innovations that enable them to extract and capitalize on incredibly rich data insights about real-time and future project performance—will be positioned for mega-project success.

By rethinking how the enormous amount of data generated on a complex project is captured and utilized throughout the project life cycle, construction owners can achieve positive outcomes, including improved project performance, more effective resource plans, reduced risks, and lowered operational costs.

In the following pages, we plan to explore how the most innovative engineering and construction firms leverage emerging technologies to transform their processes and gain competitive advantage.

Project Failures Plague Construction Owners

- **69 percent** of projects fail to come in within 10 percent of their expected budget[1]

- **75 percent** of projects fail to come in within 10 percent of their expected deadline[2]

The Big Dig transportation project in Boston, completed a staggering nine years late and 190 percent over budget, is perhaps the most infamous example of a major project catastrophe.[3] Its story has been offered for the past decade as the industry example of the mistakes—and fates—to avoid. Yet current, ongoing mega-projects continue to be plagued with similar cost, scheduling, funding, and design problems. Take the controversial World Trade Center subway terminal project, delayed by 10 years and dubbed "the world's most expensive transportation hub" due to its massive cost for reconstruction.[4] Then there's Denver's sprawling rail system expansion, FasTracks, which—after massive postponements, ballooning costs, and budget shortages—was forced to turn to private funding sources to avoid pushing its completion date back by 25 years.[5]

[2] 2015 Global Construction Survey: Climbing the Curve
   Source: KPMG International (April 14, 2015)
[3] Big Dig's red ink engulfs state
   Source: *The Boston Globe*, Sean Murphy (July 17, 2008)
[4] New York's $4B shrine to government waste and idiocy
   Source: *New York Post*, Steve Cuozzo (August 2, 2014)
[5] RTD's Phil Washington, bound for big L.A. job, talks about Denver's next
   big challenge
   Source: *Denver Business Journal*, Cathy Proctor (April 10, 2015)

Improving project performance with cloud and mobile technology

Due in large part to the increasing complexity of project communication and project tracking, the volume of data being produced by major projects continues to grow at an exponential pace. As a result, project teams can become overwhelmed by the challenge of efficiently organizing and synthesizing project information to make real-time project decisions and course corrections.

That's why some pioneering project owners are leveraging both cloud and mobile technology to quickly analyze, assess, report, and act on project information.

Consider how cloud and mobile technology can revolutionize the outdated pipeline construction inspection process and transform the role of the inspector from low-value "watcher" to a high-value quality controller and active risk manager.

Until recently, most owners' field inspectors maintained a "yellow book" that contained daily observations of the contractor's crew. The narrative would include the day's weather, work accomplished, and any issues identified or resolved—information that was rarely reviewed or used for any meaningful analysis.

Enabled by technology, today's field inspectors can capture this information—and much more—through cloud-based apps on their mobile devices, right from the work site. For example, they can input traditional yellow book data directly into a usable database from a hand-held tablet or smart-phone, as well as additional high-value information on crew personnel, station start/end points, equipment status, points of noncompliance with remediation actions, and more.

With data from field inspectors at multiple sites easily accessible in a centralized cloud system, the owner's or contractor's home office can analyze and track performance over time at the portfolio level, project level, and contractor level. This analysis can help senior management pinpoint trends that indicate the root causes of pipeline construction problems, so they can quickly correct them and prevent them from recurring.

Moreover, senior management can conduct error validation routines on complete data files to identify gaps, inaccuracies, and inefficiencies in the data *during* the pipe installation, helping to avoid postconstruction reporting and records management issues. By more easily and accurately validating and documenting data related to risk management, they can also enhance oversight diligence to regulators.

In the field: Data-driven project management

Oracle® customers implementing enterprise project management systems have been able to integrate risk registers with their baseline project schedules as well as leverage mobile technologies for real-time updating. By implementing these types of technology-enabled enhancements, they have been able to reduce average project durations by 10 percent and reduce claims by up to 16 percent.

Source: Oracle

Enhancing people resources with project workload tracking tools

A precise estimate of a project's people needs is one of the most important weapons in a construction owner's arsenal. It helps the owner calculate ROI and risks, as well as guides strategic execution throughout the project life cycle.

However, when the development phase of a project is accelerated, or when long project time lines create economic uncertainty, it can become extremely difficult to produce accurate forecasts of people needs. This is especially the case for massive projects involving a large number of workers— an increasingly common trend. Today, 62 percent of the largest project owners (greater than $5 billion turnover) have more than 100 employees planning and managing capital construction projects. That does not include the full- and part-time contractors and subcontractors who comprise the bulk of the workforce.[6]

In this complex environment, project managers' ballpark estimates of staffing projections and personnel availability are both inefficient and ineffective at determining the level and type of people resources required at each phase of a major project. On the other hand, optimizing how they staff projects and utilize people is a significant opportunity for project owners to differentiate themselves, given the severe talent gap in the industry as other sectors compete not only for laborers, but also for project planners and project management professionals.

Engineering and construction firms can seize this opportunity and improve real-time talent forecasting and decision-making by leveraging powerful project tracking tools that collect valuable project data on staffing and workload. When integrated into their planning processes, structured project data can help organizations better manage and forecast people resources to align with project and organizational goals.

Project tracking technologies depend on a standardized project taxonomy, which is used to track and report data on staffing and workload throughout a project's entire life cycle. The taxonomy allows project team members, coded by function, to track time by project phase and activity, enabling project owners to evaluate and benchmark valuable project metrics (*see sidebar*).

High-Value Staffing and Workload Project Metrics

Workload Capacity

- $/Full-Time Equivalent (FTE) (per year)
- FTEs/Project (by project type per $100 million)

Staffing Ratios

- Vendor: % AE, % Contractor, % Subcontractor (by project delivery method, region, and/or project type)
- Owner %, Vendor % (by project delivery method, region, and/or project type)
- Peak HC vs. Average HC by phase (by project delivery method, region, and/or project type)
- Functional: % Engineering, % Project Management, % Administration, % Project Controls

Workload Breakdown

- % of Project Hours by Phase (i.e., planning, design, construction, commission, closeout)
- Average Hours by Project Activity (by project delivery method, region, and/or project type)

These metrics help owners rationalize staffing requests and project estimates and evaluate staffing curves. Ultimately, owners and contractors can use insights from the metrics to significantly optimize their projects, such as by decreasing average project duration, reducing the average number of employees on a project, and freeing up resources to increase overall throughput.

---

[6] 2015 Global Construction Survey: Climbing the Curve
Source: KPMG International (April 14, 2015)

Although data analytics is a mainstay in business operations, organizations have been slower to embrace this approach for managing talent, where uses include:

- Predictive modeling to more accurately forecast future people needs

- Retention algorithms to predict which employees are most likely to leave or retire

- Valuing top performers: calculating the (potentially significant) difference between average and exceptional employees, to justify recruitment strategies and acknowledge individual contributions.

In the field: Data-driven scheduling

Unless contractually mandated, most contractors do not resource-load project schedules. In cases where schedules are resource-loaded, it is often done outside of the core schedule via added tools. Contractor personnel are typically only required to input time into their Enterprise Resource Planning (ERP) system, as that is the system of record for employee payment.

The challenge is that the ERP system is not a field tool. Resource-loading schedules and integrating schedule data to the ERP is difficult and requires of up-front investment.

Oracle has found that clients that have implemented integrated project management information systems (PMIS) and are using practices such as cost/resource loaded schedules have been able to reduce project and program FTEs by up to 23 percent and reduce project reporting FTEs by up to 70 percent.

Source: Oracle

Reducing project risks and operating costs with a PMIS

A PMIS is designed to improve project planning, scheduling, monitoring, and controlling, in order to raise the quality of decision-making in each phase of the project life cycle. It enables engineers and project managers to communicate project status swiftly and accurately with functional departments, while also keeping senior management up to speed on all the projects in the organization's portfolio.

Prevalence of PMISs

- 50 percent of project owners use a PMIS

- 32 percent of those that use a PMIS have yet to integrate it with their accounting and procurement software[7]

[7] 2015 Global Construction Survey: Climbing the Curve
Source: KPMG International (April 14, 2015)

Engineering and construction owners are increasingly using PMIS technology to enhance a number of crucial functions:

Data collection for claims management
Historically, claim resolution favors the organization that can provide the greatest volume of project documentation to support its stated position and associated cost impacts. Identifying and unwinding the costs and schedule impacts associated with a large claim can be a monumental postmortem effort, riddled with assumptions and exclusions. As a result, an organization's position is inevitably weaker than if cost tracking had been performed from the start.

Organizations that successfully manage claims management understand the importance of having a thorough and systematic approach to capturing claim data up front, and organizing it so it can be easily analyzed and evaluated.

Both owners and contractors use data from their PMISs to effectively present and defend against complex construction claims. PMIS technology has been established as invaluable in claim management support, including:

- Systematic categorization of claim-related costs and time;

- Real-time monitoring of cost and schedule impacts;

- Using claim data analytics estimates-to-complete, ancillary impacts, and schedule reliability.

Leading industry practice is to establish your organization's claims management process in connection with the capabilities of your PMIS. The work breakdown and cost structure integrated into the PMIS should allow for claim account codes to be established and utilized once a potential claim is identified.

Audit and contract compliance
Another advantage of using an integrated PMIS is to reduce or prevent contract compliance disputes.

PMIS tools can be configured at the start of a project to incorporate key contract terms and conditions to help minimize or prevent deviation from compliance. For example, organizations that prepopulate labor rates, equipment rates, allowable burdens, and more into their PMIS cost-tracking modules can help ensure alignment with the contract terms and help minimize exposure to manual reconciliations and adjustments.

Additionally, companies can take advantage of task and schedule modules in their PMIS to set reminders, triggers, and work streams to meet obligations during performance of the work (e.g., reporting updates, stakeholder notifications, and change management protocols).

PMIS modules that support contract compliance

- Schedule: Populate integrated schedules with any contractual obligations to be performed over the course of the project.

- Cost: Populate approved rates, mark-up percentages, discounts, and more into the cost module to apply against units, hours, and quantities as incurred. Review the format and structure of cost reporting with the owner prior to proceeding with setup.

- Change: Develop a workflow for change management and approval that aligns with contract terms. Have appropriate owner/stakeholder approval built into the workflow to help ensure contract terms have been met before proceeding with a change.

- Reporting: Establish and integrate reporting templates that align with contract requirements. Set automatic generation to meet the agreed-upon schedule for issuance.

Change order management

Whether arising from an unforeseen circumstance, an error or omission, or simply an owner's request, change orders are inevitable on most construction projects and can be highly disruptive, causing rushed work or inaccurate material and labor estimates.

These impacts are expected to lessen as data mining—enabled by PMIS tools—becomes a leading practice in the construction industry. The structured data and powerful analytics of PMIS tools give owners and contractors greater insight into the cost, schedule, quality, and safety performance of their projects and programs. Additionally, data captured within 3-D *Building Information Modeling* (BIM) systems—used by a growing number of architects, engineers, and design consultants—allow cost estimators to prepare accurate quantity take-offs and develop change order pricing in a fraction of the time taken in the past.

Through historical patterns from data collected on previous projects, contractors and owners can more accurately track and forecast the amount of resources required for a particular scope, ensuring that materials and labor are budgeted and scheduled efficiently. When coupled with an adaptive, resource-loaded schedule, the disruptive and inefficient change orders of previous generations will become obsolete.

While PMIS programs will never completely eliminate the need for change orders, a skilled project team with the knowledge and ability to harness emerging project data can reduce the number of change orders needed for project completion. Also, predictive analytics made possible by PMIS systems help project owners improve visibility into the impact of change orders on future performance.

In the field: Data-driven change orders

Change is inevitable in the field of construction but it's the speed of how you deal with changes that makes the difference. Change can start from anywhere, but it's the ability to have flexible and configurable business processes that defines how to handle the change in the most expeditious manner, from identification through review and validation all the way through reporting, tracking and closeout. The speed in which all of these activities take place can have major impacts on a project.

Oracle has found that clients that implemented integrated PMIS systems have been able to reduce the annual cost of change orders by up to 49 percent as well as reduce annual compliance violations by up to 30 percent.

Source: Oracle

Digging into data

While the engineering and construction industry has not taken full advantage of technological advances, it is clear that the sector is poised for a transformation. From mobile apps to cloud systems to project tracking tools to PMIS programs, managing today's major construction projects requires a deep understanding of the increasingly sophisticated technology supporting each project phase.

Companies that have implemented, refined, and integrated their project data and analytics strategies are in a prime position to improve processes, decision making, and performance—and to seize competitive advantage.

To get started, project owners and contractors should ask themselves the following questions:

- How will we capture and utilize data on each project?
- How will we use an integrated PMIS—i.e., to track, manage, report, share, and archive project documents and records?

- Can we leverage a common data taxonomy, project coding and work breakdown structure across the entire portfolio project?
- How will we use data from past projects to build a predictive model that proactively alerts us when performance is likely to be impacted?
- How will contractors and subcontractors use and share technology requirements and model results?
- How can we introduce transformational methods cost effectively and in a timely manner?
- How will remote users access project documents?
- What level of security protocols will we employ?

About us

When engineering and construction leaders turn to KPMG LLP for advice, they do so because we understand the industry on a local, national, and global level. For decades, we have provided services tailored specifically to meet the needs of the engineering and construction 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.

Our engineering and construction 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 2,000+ professionals in more than 40 countries worldwide.

Contact us

For more information on how KPMG LLP's engineering and construction professionals can help your organization, please contact:

Clay Gilge
Principal, Major Projects Advisory
T: 206-913-4670
E: cgilge@kpmg.com

Geno Armstrong
Principal, International Sector Leader
Engineering & Construction
T: 415-963-7301
E: garmstrong@kpmg.com

kpmg.com