Oil and gas megaproject development

Project development to FID
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Introduction

Our 2015 Spotlight on oil and gas megaprojects report showed that industry-wide performance over the project development life cycle is poor, with 64% of projects over budget and 73% over schedule. Of course, budget and schedule overruns are not a new phenomenon for the oil and gas sector or other projects-based industries. But the trend and associated impact have been exacerbated in recent years by increasing project size, complexity of technical design, low oil prices, and geographical and political uncertainty.

Most critically, the current period of low oil prices has led to increased sensitivity around escalating development costs and called into question the commercial viability of many projects. As a response, project hurdle rates across the industry have been recalibrated to the market expectation of a lower-for-longer oil price outlook. In other words, to avoid being deferred or cancelled, projects must now be designed to be less costly to develop and with greater certainty over budget and schedule targets.

At the same time, corporate directives have driven dramatic cuts in project team capacity and increased pressure on suppliers to reduce their cost, often in a market where margins were already tight. This downward pressure on the supply chain (if not intelligently focused on true efficiency initiatives) risks reducing headcount and quality, rather than enhancing efficiency. While the market’s reaction is understandable, corporate and project leadership must now effectively balance the need to reduce cost with the need to maintain — and even build — workforce capability. Without this balance, there is a serious risk of long-term damage (as in previous oil price cycles) as resources leave the sector, potentially creating a resourcing crisis and ultimately resulting in increased labor costs if the market rebounds.

When selecting and approving projects in such a market, executives must be focused on the increased risk of optimism bias by project teams when setting targets. Project teams are under pressure to both maintain a project and production pipeline and to meet lower hurdle rates, but have had capacity and headcount reduced, are using the same technology, and are working with a supplier base that is under extreme financial pressure.

Our previous Megaprojects reports have empirically investigated the challenges of poor project performance, using our Megaprojects Database to qualify the scale of the problems that the industry faces. Despite the abundant challenges, the industry has many opportunities to improve performance and reduce waste, including the use of new technology to drive efficiency and standardization into project development and execution.

This report focuses on existing, but underutilized and leading practice improvement initiatives during the planning and engineering phases before the project final investment decision (FID).

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Market focus

Faced with historical performance challenges and a market that is extremely sensitive about investment risk, project leaders and corporate directors are increasingly challenging themselves as to whether they have sufficient oversight over, capability within or efficiency to develop, sanction and execute projects that meet both hurdle rates and production demand.

Oversight
How to deliver sufficient oversight over project targets and performance:
- Increase transparency over key decisions and project performance for stakeholders
- Improve operated and non-operated project performance through effective assurance
- Effectively govern project portfolios to manage risk and select optimum projects for investment

Capability
How to build and maintain appropriate capability to develop and execute projects:
- Create sufficient capacity and proficiency to manage front-end engineering design (FEED) and development contractors
- Meet man-hour requirements across the portfolio of development projects, creating effective development activities without prohibitive expense
- Maintain consistency in development of project plans (e.g., assumptions, P value assessments) in a market where the workforce is mobile and not retained

Efficiency
How to develop and execute projects as efficiently as possible:
- Reduce project development costs (while maintaining or improving quality) to meet increasingly stringent planning budgets and continue to drive cost efficiency over time
- Reduce inefficiency in interactions with key contractors and suppliers through effective collaboration in FEED work and detailed design
- Drive consistency of equipment and common units (e.g., trains, utilities) across projects to reduce time spent redesigning similar items
Pre-FID improvement initiatives

With many of the world’s projects currently in stasis, investors and corporate leadership are asking that projects, prior to receiving formal FID approval, improve their commercial position or forecast ROI, as well as to increase their certainty that FID estimates are achievable and accurate.

Pre-FID activities (typically concept through FEED) are critically important to project execution success. The decisions made during the early project phases often determine the project’s overall degree of success because this is the time where the least money is spent, but where the project team has the greatest influence. Acknowledging this disproportionate level of influence, it is critical that the industry seek to deliver intelligent cost reduction initiatives in the pre-FID phases focused on efficiency improvements, rather than purely headcount reductions.

In the section which follows we highlight a series of project improvement initiatives that are aligned to our themes of Oversight, Capability and Efficiency. We do not intend this to be an exhaustive list, but rather an insight into known, but under-utilized and (in section 4), emerging digital opportunities with applicability across the industry.

1 Increasing oversight

i. Leading practice project governance and assurance

For some time now, project teams have seen effective project governance and assurance as a burdensome task with little reciprocal value. However, with the pressure those teams now face, effective project assurance and governance can and should be used to drive project performance and increase stakeholder confidence across all stages of a project life cycle.

Effective and thorough governance of and assurance over project targets and performance have never been more important, particularly prior to FID. Companies have aggressively reduced capital expenditures and the hurdle rates for project approvals, meaning project teams and major suppliers are under huge pressure to advance the project pipeline – but at fundamentally enhanced performance levels (e.g., accelerated

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schedules, with reduced budgets and greater efficiency). In this scenario, without appropriate assurance, there is a serious risk of both project and corporate optimism bias, in which the project cost and risk are underestimated, while corporate ability to deliver to target is overestimated. There is also a risk of deterioration in quality.

In addition to avoiding these parallel risks, our experience suggests that improved assurance over project governance and risk management, along with robust economic planning, can enhance whole life asset performance by 15% to 30%, while also improving company culture. As a result, companies are reassessing their in-house project management (as well as that of their supply chain) and establishing improved portfolio management and governance models capable of managing increasingly complex and changing portfolios.

Leading practice assurance and governance frameworks drive integrated team activities with common goals and a clear delineation of roles and responsibilities for all. Adding specified roles for independent review can help project leadership avoid optimism bias. Further, leading-class organizations are leveraging digital tools across the governance framework to reduce the reporting burden while increasing oversight, control and integration.

Executives across the industry are developing their understanding and control of increasingly diverse portfolios, enabling them to:

- Balance project economics with an increased consideration of risk
- Develop new governance techniques for innovative methods of production
- Manage the risk and reward equation to deliver consistent results
ii. JV relationship optimization

Faced with performance challenges, growing complexity and increased size, oil and gas companies are preferentially seeking to share risks and experience through project joint ventures (JVs), which are now the norm. In fact, our recent study showed as much as 71% of upstream investment is now spent through alliance or JV relationships.

When JVs are managed well, they have the potential to deliver greater value to stakeholders, significantly enhancing the value of portfolios and increasing access to diverse capabilities. This value and access to additional skills and experience is invaluable during the phases leading to FID, when key project design decisions are made and influence over the projects direction are greatest. However, when these relationships go wrong, they can be extremely disruptive, particularly to project schedules and key decision points.

At a high level, JV conflict typically arises due to:

- Distrust and poor working relationships as a result of poor communication and a lack of transparency of management information
- Cultural misalignment, potentially due to geopolitical or strategic differences
- Poor governance through the lack of an effective risk management framework and buy-in to the governance process by partners

Across the industry, the potential advantages of cooperation are well understood, but the management challenges involved in these often complex multiparty, cross-border and cross-cultural relationships are commonly overlooked. Increasing corporate understanding of the financial and operational root causes of JV failure can enable organizations to enhance the speed and impact of project decision-making, improve project team performance and ultimately increase the attractiveness of their projects to potential investors.

Critical to organizations improving JV performance is recognizing the need for robust, fair and transparent JV governance arrangements, including:

- Risk and internal control policy assurance
- Ethics and compliance
- Project commercial management
- Schedule and financial reporting.

Increasingly, organizations are using independent JV reviews to manage reporting and governance requirements across different JV partners. This increases the transparency of data sharing and reduces the need for multiple, single-party reviews that can be costly and disrupt the project. Collectively, these governance measures can help operators and non-operators monitor and enhance compliance, in turn developing a greater level of trust between JV partners and ultimately, improving JV operational effectiveness and project delivery performance.

Recognizing the increased complexity of projects and the increasing specialization of the industry, project leaders should seek to develop more dynamic, flexible JV’s that are able to align to specific project phases and access the diverse skills and expertise they require.

Additionally, projects should encourage the development more JVs within and with the supply chain. Whilst these relationships can be complex and challenging, the outsized potential value they deliver, together with the potential to have suppliers ‘fully invested’ in project success means they are worth the effort.

See detailed joint ventures in oil and gas capital projects article here.

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2 Enhancing capability

i. Project relationship efficiency

The oil and gas industry has seen the cost of major projects increase dramatically in the past 10 years, with productivity deteriorating over the same period. The current period of low oil prices has increased the pressure on project teams, engineering, procurement and construction (EPC) companies and the wider supply chain to reduce project costs. So far, this reduction has been achieved largely through headcount reductions, but this relatively crude tool rarely leads to substantial improvements in productivity or resolves cost escalation in the longer term.

Beyond headcount, experience and research suggest that there is significant opportunity for project leadership to enhance the working relationships between the major suppliers, EPCs and operators to collaboratively improve practices and processes across the project development cycle, reducing inefficiency and ultimately lowering project cost.

Regrettably, the abundance of projects that have overrun budget and schedule estimates, coupled with current low oil prices and the prevailing incentive mechanism within key contracts, has led to adversarial rather than collaborative relationships between operators and EPCs. These strained relationships mean that most cost reduction initiatives are still targeted largely within the operator’s own project organization, which makes up a relatively small proportion of the total project cost. Initiatives across the wider project ecosystem are commonly overlooked, misunderstood or considered too difficult to tackle despite their out-sized potential value. Consequently, the majority of total improvement opportunity on projects remains unrealized.

Future project cost reduction initiatives must be collaborative in nature to move discussions away from protectionist thinking and empower EPCs, who hold the key to the greatest cost reduction opportunity, to propose improvement initiatives. Critical to successfully making this change is a mutual understanding of the other’s default position and motivation – operators focusing on delivering projects to budgetary targets, and EPCs trying to maintain or maximize profits in a contractual system that actually incentivizes them to maintain (or indeed grow) contract scope at all costs to maintain overall profitability in a market where margins are increasingly squeezed.

Under most EPC contracts, the contractual mechanism means that when scope or contract value decreases, EPC profit also decreases (as profit is typically aligned to man-hours or days). To motivate EPCs to drive real efficiency, operators must redouble their efforts to ensure that EPCs and major suppliers are part of a fully integrated project team. Critically EPCs and the supply chain should be able to share in the commercial benefits of clear, transparent improvement initiatives; benefits that outweigh the costs to them of a decrease in their total contract value.

Fortunately, the investment and prioritization of such initiatives is gaining momentum across the industry, with a growing recognition of the impact that greater collaboration across the project teams (both internal and external) can have on costs, schedules and working relationships between operators and EPC companies.

See detailed project efficiency article here.

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6 Wages and salaries, employment and productivity, by industry, Table 09174. Statistics Norway.
ii. Intelligent client and outsourcing

Challenging market conditions mean that organizations across the industry have sought headcount reductions aligning to and often going further than their capex reductions. At the same time, companies have reported that over the past decade they have seen significant decreases in workforce productivity.

The industry is challenged by the impact of increasing project size on peak man-hour requirements, which skew demand and increase the need for large numbers of temporary workers. This issue is accompanied by the need to adapt the traditional engineering skills base to accept new and emerging technology solutions.

While it is unquestionably cheaper to have temporary workers meet peak demand instead of permanent staff who are underutilized, there is a balance to be struck – and a real risk that wage escalation will occur when the project development pipeline increases, as in Australia during the LNG boom.\(^7\) The increase in temporary workers has been linked to inconsistent application of project management methods and is thought to lead to a more transactional relationship between workers and the projects they transit through. As a result, corporations feel less inclined to invest in training personnel. This in turn exacerbates the decline in productivity and has serious implications for the industry’s future skills mix.

Faced with these challenges, intelligent outsourcing of non-critical project skills offers a potential solution. The outsourcing of functions such as IT, logistics and facilities management are now common across the industry, yet there are many other project management components that should be considered for outsourcing. In many cases, the required proficiency could be delivered more cheaply

through the supply chain and exists in greater abundance within supplier, rather than operator, organizations. Operators should question what skills they will require in the longer term as advanced technology solutions become increasingly prevalent on projects. They also should consider whether to retain talent in-house or outsource, and if so, how to set up contracts to build the trust and transparency that is required.

The nature of supplier portfolios means they are often better able to manage their workforce size to smooth peak demand and maximize productivity, and they often have greater total proficiency in managing projects than the operators funding them. Greater collaboration between operators and key skills providers could drive standardized training of personnel, improving quality and reducing the impact of turnover on project performance.

In order to embrace this opportunity, companies need to effectively assess the work and roles they require in-house vs. those that can be outsourced. In the event that sufficient external capability does not yet exist, where beneficial, companies should work collaboratively to develop long-term agreements that give service providers the confidence to invest and the operators, sufficient certainty that the supply chain can deliver.

Companies also should encourage new entrants to the market where skills align. Not all project roles require an engineering or project background, so working with nontraditional providers has the potential to free up existing teams to focus on critical tasks. And, of course, positive lessons can be learned from other industries.
Driving efficiency

i. Lean project development

A key factor behind the decrease in oil and gas project efficiency is the ingrained and often accepted process inefficiency that exists across the project development cycle.

The industry has been slow to leverage the collective learning from past projects to develop a standardized process management framework. As a result, project teams often lack an understanding of end-to-end processes, lean principles or leading practices from other industries, making key decisions with little appreciation for their implications at a macro project level.

The increased prevalence of JVs and the growing number of suppliers on projects means that despite greater technology systems capability, making decisions and completing tasks are hampered by conflicting project priorities or a misunderstanding of project goals. This misalignment often manifests as:

- Unnecessary waste
- Economically disadvantageous decisions
- Long consensus-building process
- Frequent scope changes
- Silo-driven behaviors

Oil and gas companies require a dramatic shift in their approach to how capital projects are run and managed. Too often projects adapt a “just in time” approach to process adoption — as a result, they rarely anticipate the protracted nature of implementation or the impact of not having an adequate process architecture in place.

Early in the development process, projects must identify critical processes, set up a process architecture, establish a project-wide governance model and instill a rigorous change management culture. Starting with a baseline of core project processes not only creates a stable working position, but also means that subsequent requirements for process change, as the project moves through the development cycle, can be better assessed and more quickly implemented.

Early identification of critical processes is essential, as they are not all equal in their impact on a construction project. Once identified, focus should switch to identifying and eliminating waste activities through a combination of traditional improvement techniques, such as lean management, and innovative digital solutions, such as robotic process automation.

The real opportunity — and skill in implementation — lies in applying these concepts in a unified way to capital projects. This requires a deep understanding of the effect that change in one area will have elsewhere, balancing macro-level project dynamics with micro-level work stream priorities.
ii. Standardization

The oil and gas industry lags behind other asset-based industries in adopting standardization. By treating each project as being largely unique, the industry misses opportunities to develop a common project management template or standards for equipment and components. This approach has led companies to develop expensive designs for new oilfields rather than identifying opportunities to replicate existing solutions.

Consequently, unnecessary complexity and duplication are widespread in the industry, and field development continues to face challenges related to long lead times for critical components, deteriorating workforce productivity, budget overruns and schedule delays.

In an era of volatile oil prices and extreme pressure on cost, the industry must embrace greater standardization as a tool to improve project development economics. This should include standardization of not only equipment and technology, but also:

- Project management practices
- Engineering and design approaches
- Data and monitoring methodologies

Industry standardization can develop standard project design templates and project management methodologies around which teaching and new technology can be aligned to reduce variance in delivery performance, improve the efficiency of maintenance and modification works, and, simultaneously, reduce the cost of equipment and technology.

Companies can achieve significant improvements through internal standardization initiatives. In fact, Wood Mackenzie report that, standardization has the potential to structurally remove 10% to 20% of project costs. But to fully realize the industry's potential, companies need to work harder to collaboratively develop new standards. Sporadic instances of such collaboration exist – in July 2014, FMC Technologies announced a joint industry program with Anadarko, BP, Shell and ConocoPhillips – but to achieve meaningful scale, the industry needs to expand these initiatives much further.

Indeed, a leading independent oil and gas company was able to fast-track the engineering and construction of the floating production systems for two of its fields by standardizing topside facilities. This approach allowed the operator to:

- Accelerate time to first oil
- Leverage learnings from one platform to the other
- Save manpower
- Reduce procurement lead times
- Lower fabrication costs

Similarly, a leading operator in Norway was able to reduce project cost by around 20% and start production a few months ahead of the schedule partly by using a standard subsea template.

Realizing the full standardization opportunity within individual organizations and across the wider industry will take time, with greater work needed to drive collaboration and identify where to focus effort. However, standardization has the potential to drive a significant change in project economics, system reliability and lead times, and it should be considered as a measurable criterion of success for project teams as they progress towards FID.

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Machine learning to drive project planning

The energy industry as a whole has fallen behind other industries in the adoption of data collection and the use of advanced analytics for decision-making. This is a particular problem for large capital projects where analysis is almost entirely reactive rather than predictive.

Despite the cost and schedule overruns we see in oil and gas capital projects, a fundamental constraint to the successful delivery of such projects remains unaddressed: how do you take the facts and lessons learned from the past and accurately and comprehensively incorporate them into predicting the future, so we can pre-emptively manage what is to come, rather than reactively managing what has already happened?

Oil and gas companies have access to large amounts of data collected, aggregated and disseminated through a variety of enterprise resource platforms, cost management systems and project management systems. However, such collection occurs in disparate pockets and is driven more for tracking and reporting purposes than for gaining data-driven insight. In fact, our experience suggests that none of the approaches currently used in the industry are able to adaptively and consistently predict project outcomes.

The industry needs to shift its approach toward data-driven project planning for successful delivery of capital projects. Instead of only collecting historical performance data, the industry needs to adopt a learning-based pattern recognition approach. Such an approach to construction cost estimation could offer substantial help in predicting, and hence pre-empting, the potential cost overruns and schedule delays that result from inaccurate initial and FID estimates. Indeed, research into large software development projects showed that by using a Bayesian model-driven approach to cost modeling, cost certainty was significantly enhanced. Similar machine learning based approaches to construction cost, schedule estimation and risk management could offer substantial improvements in the predictability of early estimates and therefore could reduce cost overruns and schedule delays.

Achieving such theoretical results is by no means easy, as desired results can sometimes take years to realize. However, a robust understanding of the key success factors and potential traps can help an organization stay on target. It’s important to consider the following:

- **Process:** why, where, when, how, how much and who collects, wrangles and consumes the data will require life cycle-based re-engineering with the goal of achieving maximum impact on the organization
- **Organization:** an elite team of evangelists and technologists supported by a small team of data scientists, data engineers and analysts needs to be formed under an executive-sponsored mandate that combines vision, creativity and hands-on knowledge of its business needs, project execution and data science

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10. Data and Analysis Impact Index, 2015, Forbes Insight and EY.
Technology: big data analytics and machine learning are constant evolving realms. Staying on top of leading research, data science languages and techniques, cloud and on-premise solutions, and hardware capabilities is essential to the quality of insights developed and the speed at which they can be generated.

In order to drive a comprehensive change in the understanding of data, better predict performance and identify transformational improvement opportunities, the industry needs to find ways to share data for the broader benefits of improving overall predictability, and ultimately, profitability. Equally, the industry should move away from using data solely for proving the existing, marginal improvement hypothesis, and instead begin to leverage the power of big data and machine learning to identify emerging or unseen improvement opportunities.

Engineering visualization

As projects increase in size and complexity, developing certainty over initial and even FID estimates has become increasingly challenging. This is in part due to the increasing complexity of engineering design and the increase in unplanned rework. In fact, some estimates within the real estate construction industry suggest that rework could be worth 30% of total project cost. While this percentage is likely to be lower on oil and gas projects, due to the high cost of materials and equipment, it is still expected to account for considerable cost.

An opportunity exists for the oil and gas industry to learn from other project-based industries where new technologies, including building information modeling (BIM), is developing quickly to increase the transparency of design and reduce mistakes. There are now emerging examples of visualization and gaming technology being used to create interactive 3-D engineering environments that allow users to virtually navigate their sites and even operating assets prior to beginning construction or procuring major equipment.

The benefit of such detailed systems is clear, as structural issues that need to be adjusted can be spotted as engineers explore the virtual site, prior to materials being ordered or construction beginning. Estimates from engineering projects where this has been implemented suggest that as much as 40% of engineering billable time can be eliminated – not to mention the cost of supplier rework. There are also significant benefits to team members and suppliers, who are often in different offices or fabrication yards around the globe, collaborating in real time to align disparate components and optimize the overall design.

In this area, the oil and gas industry has significant potential to embrace visualization and other new technologies to improve project engineering accuracy and ultimately the likelihood of delivery to FID estimates.
Potential for digital labor and digitization

With the exception of exploration, the oil and gas industry has been slow to adopt new digital technologies. The prolonged period of high oil prices has largely coincided with the digital revolution, and the lack of pressure on price appears to have stymied digital investment, particularly in large capital projects, which are often considered too customized to offer potential for digitization.

However, there is now movement to suggest the industry is seeking to close the gap. For example in robotics, where the technology has the potential to significantly reduce the cost of manual, high-volume, highly repetitive, multistep, rule-based tasks – as it has already within the banking industry.

The recent growth of projects into mega and gigaprojects has led to increased spending on back-office and support services. These are typically consistent from one project to the next and are therefore ripe for consideration for robotics intervention. For example, in the HR and logistics functions, considerable time and money is spent booking repeat flights and accommodation for the flow of people and equipment onto and off site. In this example, by using robotics to automate the booking process, there is significant potential to reduce HR headcount cost; reduce the frequency of out-of-policy actions; and improve personnel movements so that they are aligned to project demand, transportation, accommodation costs and availability.

Many other examples exist, including EY’s digital field ticketing approach that seeks to optimize the approval and tracking process to reduce man-hours and cycle time. In addition, multiple service providers offer mobile and GPS data for use by project management to more effectively manage the movement and productivity of site personnel. Similarly, and with overlapping data needs, digital site security systems using iris or other biometric data have the potential to decrease the cost and increase the accuracy of site security.

Companies need to embrace potential robotics opportunities to help reduce cost and improve efficiency and HSE. The key challenge for project leaders is the speed of technological change. Because many of these technologies are new or emerging, development teams need to keep their options open before adopting solutions on major projects with long life cycles.

See EY digital page here.
The oil and gas industry faces a conundrum:

- Project size and cost have increased, making megaprojects the new normal. Project performance to schedule and budget targets is consistently poor, with the average cost overrun now 59%.

- These delivery challenges are now deemed unacceptable, and in a low oil price environment, companies are unable to sanction many of the projects within their development pipelines.

- At the same time, in order to maintain position within the market, oil and gas organizations need to maintain and develop a pipeline of projects. However, to be approved, many of these projects must significantly reduce cost and increase the certainty with which they are able to meet FID targets whilst using the same technology, supplier base and workforce.

As the industry grapples with these challenges in delivering capital projects, there is unlikely to be a silver bullet near-term solution to transform performance. As in other industries that have demonstrated significant efficiency improvements, oil and gas organizations need to look to the cumulative effect of many smaller, additive efficiency opportunities to improve existing processes and behaviors. While new technologies, such as 3-D printing, robotics and digitization, offer huge potential to drive improved performance, there is greater near-term opportunity in eradicating the significant inefficiency that exists within the development of capital projects.

Conclusions
In addition, the oil and gas industry needs to see significant cultural change in how organizations interact with their suppliers and competitors alike. There is enormous potential for increased collaboration within the industry to reduce inefficiency, but this can only happen when major suppliers, EPCs and operators overcome the long-standing barrier of mistrust. By working together, these players also could realize huge potential for standardization across the industry, which has yet to gain meaningful momentum despite considerable rhetoric.

At EY, our global capital projects teams offer independence, understanding of project development and demonstrable knowledge across the project life cycle. They can help oil and gas companies:

- Improve their **oversight** over the development of and delivery to performance targets
- Develop appropriate internal and supply chain **capability** to plan and execute
- Drive project **efficiency** through innovation, as EY supports the planning, sanction and execution of projects in the continuing era of depressed oil prices
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