



UTILIZING LEAN CONCEPTS IN E&P: THE TIME FOR LEAN IS NOW

Driving Performance Improvement



Many leading energy companies are recognizing the need to examine and manage operations more efficiently and effectively. With Lean tools and techniques, E&P companies can realize gains in productivity and reduce operating costs.

For many years, exploration and production (“E&P”) companies have focused on cost management during periods of rising drilling, completion and operating costs, periods of soft commodity prices or a combination. Historically, many E&P companies have had mixed results in attempts to manage costs and improve efficiency. Cost management has often been directed at suppliers and internal headcount. Instead of focusing improvement efforts on core operations, such as acreage acquisition, well planning, drilling and completions, and field operations, companies have streamlined their back-office functions, including procurement, accounting, IT and human resources. In recent years, many companies have implemented strategic sourcing or other supply chain initiatives with significant results, but in some cases, these initiatives have reached their limit. Consequently, many E&P companies are now recognizing the need to find new and innovative methods to manage costs and improve operations.

Some leading E&P companies are examining and proactively utilizing Lean tools to implement more efficient processes in operations now, while economic conditions demand improved cost structures and increased flexibility.

Lean tools and techniques have proven to be effective in delivering substantial gains in productivity and reducing capital and operating costs across a variety of industries, including pharmaceuticals, high tech, automotive, aerospace and banking. E&P companies are now turning to Lean to implement process improvements that reduce drilling and completion cycle times, increase production rates and enhance capital efficiency. By eliminating non-value added activities and time, Lean approaches can improve drilling, completion and operating performance, lower capital and operating costs, and yield higher production.

Lean is a process-centric improvement methodology aimed at accomplishing more with less. Lean process improvement focuses on elimination of waste and shortening production flows by benchmarking against theoretical maximum performance. Thus, Lean thinking puts an emphasis on value-added activities and overall system efficiency by eliminating steps that add to the time and cost of making a product or delivering a service, but do not add value from the customer's point of view.

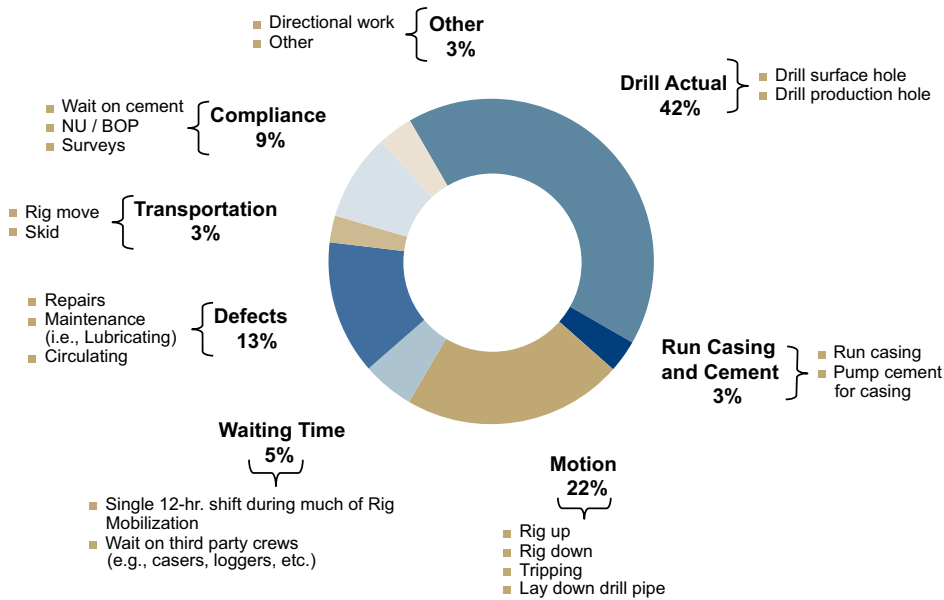
Successfully Applying Lean to E&P

Some leading North American E&P companies have looked to Lean to address challenges related to their cost structures. By applying Lean concepts, they have identified and eliminated costs and built foundations for profitable future growth. These leaders have tackled well planning, midstream activities, drilling and completion operations, procurement and finance issues through a series of focused Lean tool deployments. Successful Lean deployments have been scoped narrow and deep to drive significant results in a 10-15 week timeframe. With results in place, these leading companies have been able to methodically propagate solutions and results across geographic regions and business units.

Rig Mobilization Can Result in Sizable Benefits

Lean tools and techniques have been successfully applied to drilling and completion activities in multi-rig drilling programs, which closely resemble complex manufacturing operations. Initially, rig activities are observed and measured to establish a baseline and assess rig operations for improvement opportunities. Rig activities from spud to spud are measured and classified as either *value added* or *non-value added* — i.e.,

Figure 1: Breakdown of Rig Activities



“waste” (Figure 1). The resulting analyses reveal the percentage of actual drilling time is considerably less than expected, thus presenting an opportunity to improve rig mobilization, as well as to reduce time spent moving equipment, pipe and people around the rig site.

Standard rig mobilization processes are established through a series of Kaizen Events, which analyze existing work processes and focus on driving out non-productive time. Rig move activity cycle times are measured and tracked against targets using visual controls to minimize variation. In turn, effective communication and planning significantly eliminate non-productive

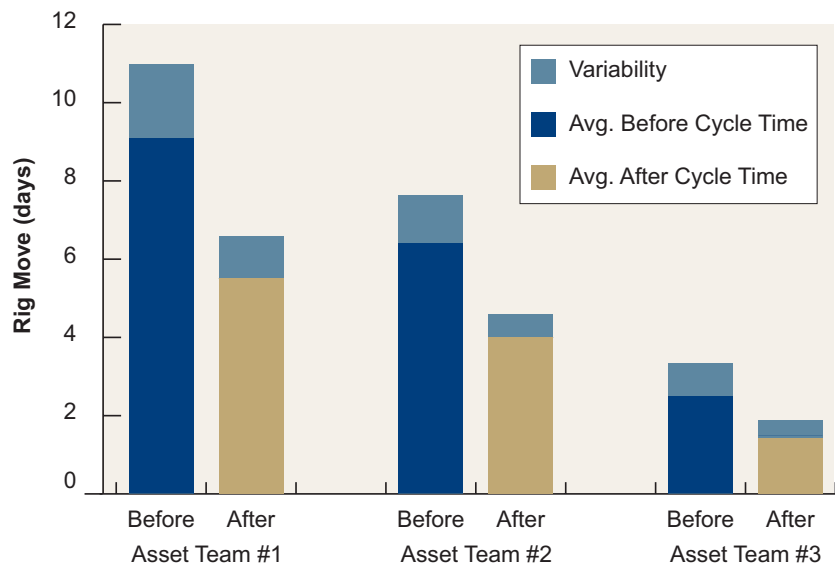
time — such as waiting on third-party moving crews or equipment at the new location. Rig-move cycle times are typically reduced by 35-50 percent, resulting in savings of up to \$120,000 per move, depending on daily rig rates and move distance. Rig-mobilization Lean efforts have been replicated across multiple organizations and asset teams to prove applicability to long- and short-cycle time rig moves (Figure 2).

Improving Well Planning Provides Available-to-Drill Wells

Time is critical when it comes to drilling and completing new wells, connecting wells to gathering lines and pipelines, and recompleting existing wells to enhance production. To complicate matters, lead times are increasing for everything from drilling permits to hydraulic fracturing crews. Maintaining an accurate drill schedule has been hindered by significant variability from title attorneys and regulatory agencies. In many E&P organizations, the drill schedule changes weekly and the well planning team must work diligently to chase the changing priorities. This unpredictability forces teams to increase the number of planned wells in order to find a few locations that can actually be drilled.

Implementing Lean tools has enabled several well planning teams to reduce lead times, decrease the number of wells being planned at a given time, and increase the number of well concepts that actually spud. The well planning process, which is traditionally viewed as unique to each individual

Figure 2: Rig Mobilization Results



well, is redesigned to look like a structured, repeatable manufacturing process, while continuing to provide a flexible drilling program (Figure 3). Breaking down the process allows teams to focus on discrete tasks, which can be planned, scheduled, analyzed and improved. Utilizing a *demand-pull system*, wells are now planned according to the pace drilling rigs spud new wells. Size-based *kanbans* are used to determine how many wells should be “planned” or “available-to-drill” at any time. These teams also develop simple *visual controls* to monitor the current status of the number of available-to-drill locations against the target.

Each kanban is sized to cover for demand variability (spud-to-spud cycle-time variation), supply variability (planning lead-time variation), supply process capability (wells planned, but never drilled), as well as demand over replenishment time using historical data. The days of constructing locations based on guesses of which wells *could* be drilled are long gone.

These custom-tailored Lean solutions are developed by cross-functional teams from land, geology, drilling, reservoir engineering and regulatory. Results consistently show 40-50 percent well planning cycle time reductions, from well concept to spud. At the same time, the number of “cut” wells significantly diminishes and constructed locations are actually drilled.

Streamlining Revenue Accounting Eliminated Rework

Several E&P firms have deployed Lean tools to accelerate the revenue accounting process. Unsatisfied with the magnitude of rework in the process, their goal is to expedite the monthly close process and provide more accurate revenue accounting.

These efforts begin by delivering current state value stream maps, which identify potential areas for subsequent Lean activities and educate participants from revenue accounting, midstream accounting and land administration on the entire revenue accounting cycle. In most cases, no individual fully understands how the process works from beginning to end (e.g., steps, hand-offs, individuals involved). As a result of initial analyses, immediate improvements are identified and executed. Examples of

immediate improvements realized include elimination of unused accounting reports, simplified price deck maintenance activities and standardized deduction nomenclature across pricing areas.

One of the most significant findings is the rework inherent in the revenue accounting cycle in the form of reverse and rebook activities. In severe cases, more than 20 percent of all revenue accounting postings is reversed and rebooked. By conducting thorough root-cause analysis, one team determined that 64 percent of the reverse and rebook activity was related to changes in division of interest (DOI) decks — primarily the use of estimated DOI decks. A stage gate process was tied closely to the aforementioned E&P well planning process so that the use of estimated decks was greatly reduced by ensuring the timely creation of complete DOI decks.

Lean Has Been Applied to Other Areas

Many E&P companies are experiencing similar issues with speed, flexibility and costs throughout other parts of their business as well. Lean tools and techniques have delivered results across portfolio planning, well planning, drilling, completions, production, well connect, facilities construction, marketing, supply chain and finance / accounting processes (Figure 4).

Change Management Challenges in E&P

E&P management teams face significant challenges in attempting to drive sustainable transformational changes. A lack of new talent entering the industry over the past two decades has resulted in few young professionals who possess the leadership experience needed to drive organizational change. To compound matters, most E&P companies are organized functionally, which results in a lack of holistic understanding of business processes and problems among core employees. Additionally, long project cycle times associated with some E&P areas means benefits realization can take longer than expected.

While the change is significant in Lean initiatives, these challenges can be successfully managed. By mobilizing cross-functional teams and developing integrated operations teams centered on core business processes, employees

Figure 3: Well Planning Process Divided into Discrete Manageable Activities



Figure 4: Lean Applied Across the Value Chain

	Portfolio Planning	Well Planning	Drilling	Completion	Production
Kaizen Events	<ul style="list-style-type: none"> Business Planning Land Management 	<ul style="list-style-type: none"> Well-Planning Stage Gate Drill Schedule Permitting 	<ul style="list-style-type: none"> Rig Mobilization Drilling Parameter Optimization Drilling Process Controls SimOps 	<ul style="list-style-type: none"> Water Schedule Frac Stage Schedule Perf Stage Schedule SimOps 	<ul style="list-style-type: none"> Well Optimization Well-Production Lifestyle Planning SimOps
Representative Benefits	<ul style="list-style-type: none"> Improve Concept-to-Spud Yield by 10-25% Reduce Concept-to-Spud Cycle Time by 30-50% 		<ul style="list-style-type: none"> Reduce Rig Move Time / Costs by 30-50% Accelerate D&C Cost Reductions Up to 3x Reduce Spud to 1st Sales by 20-50+% 		<ul style="list-style-type: none"> Improve Production Performance up to 10% by Eliminating Downtime and Optimizing Production Increase Personnel Productivity Through Route Optimization
	Midstream	Facilities Construction	Marketing	Supply Chain	Finance / Accounting
Kaizen Events	<ul style="list-style-type: none"> Gathering System Strategic Planning Financial Forecasting and Cost Controls Permitting SimOps 	<ul style="list-style-type: none"> Facilities Consolidation Cycle Time Controls SimOps Standard Pad Layout 	<ul style="list-style-type: none"> Risk Management 	<ul style="list-style-type: none"> Parts Supplier Program Compressor Procurement Strategy 	<ul style="list-style-type: none"> Business Planning Revenue Accounting Flash Reporting and Accruals Division of Interest
Representative Benefits	<ul style="list-style-type: none"> Reduce Overtime by up to 50% Increase AFE Budget Adherence 	<ul style="list-style-type: none"> Reduce Pad Costs per Well by 30-40% Reduce Pad Footprint (sq. ft. / well) by 50-75% 	<ul style="list-style-type: none"> Provide Real-time Visibility to Risk Exposure Reduce Reporting Time Lag from 24 to 2 hours 	<ul style="list-style-type: none"> Reduce Lead Times by 30-50% Increase Inventory Turns by up to 40% Reduce Material Expediting 	<ul style="list-style-type: none"> Reduce Reverse / Rebook Transactions by 30% Elimination of Unnecessary Reporting Activities Improve Productivity by up to 20%

gain a better understanding of how their work affects those outside their functional areas. Measuring and visually tracking metrics related to E&P success is also a useful method in creating a comprehensive view for core employees. Communicating direction and vision clearly to the organization, and establishing a constant presence of visible executive support will help employees maintain a focus on desired behaviors when benefits realization may be extended.

Conclusion

Implementing Lean tools may seem intuitive and straightforward, but it requires discipline, focus and time. Resources must be dedicated to support the efforts and the organization must be committed to effectively managing and implementing change. However, the step change results that can be achieved will dramatically shift the way the business operates and impact bottom-line performance. By leveraging Lean tools and methodologies, E&P organizations stand to compress cycle times from 30-50 percent, yielding accelerated production, lowered cost per barrel and increased resource recovery.

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