THE AMERICAN OIL & GAS REPORTER®
APRIL 2008
The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

Lean Methods Can Boost Rig Supply

By Alan Orr
and Barry Blades

TULSA–With strong commodity prices spurring unprecedented drilling activity, rig manufacturers are increasing production capacity and refurbishing rigs that have long sat idle. In the quest to increase manufacturing efficiencies, rig builders and refurbishers are employing advanced business tools to drive productivity improvements, including principles such as lean manufacturing.

Although applicable to both manufacturing and service-oriented business processes, lean manufacturing techniques are often heralded as key to revitalizing American manufacturing. Spawned by American W. Edwards Deming and credited with the amazing resurgence of Japanese manufacturing after World War II, these principles are being applied today with remarkable results by thousands of American manufacturers.

American oil and gas-related manufacturing, however, has not been as quick to adopt lean techniques as some other industries. As a result, production costs can be unnecessarily high, delivery dates often are missed, supply chain communication and performance are hampered, and the industry's competitive edge can be lost. Successfully applying lean principles can eliminate cost overruns, ensure timely deliveries, and improve product quality. Together, these benefits will contribute to industry competitiveness in America and abroad.

The land drilling market, in particular, is a sector where the timely and cost-effective deployment of rigs to meet variable demand requirements is fundamental to success. At least one rig manufacturer and drilling services contractor has used lean principles to efficiently expand its rig building capacity.

In 2002, Helmerich & Payne International Drilling Co. doubled production from one to two rigs a month with the same floor space and personnel using lean techniques. Later, the company doubled production again, reaching four rigs each month with only modest increases in floor space and personnel. Achieving these goals demanded maximum productivity up and down the supply chain, calling for lean principles to eliminate non value-added activity. All this happened at the company's construction facility in southeast Houston.

Given the strong market demand for

In response to increased demand, Helmerich & Payne International Drilling Co. implemented lean manufacturing principles to increase plant efficiencies and expand production of its newest-generation FlexRigs™, including this FlexRig4 unit.

Helmerich & Payne's next-generation rigs and high utilization of its existing rigs, the faster production has paid off. The company has so far garnered multi-year contracts for 83 new rigs from 18 operators, including Williams Energy and ConocoPhillips.

To be sure, the company's manufacturing output did not reach four rigs a month as soon as planned. The 2005 hurricanes, certified welder labor shortages, and supply chain challenges caused delays. However, an output of four rigs a month was achieved beginning in the fourth quarter of 2006.

New Approach

The latest lean effort began in May 2005, when the manufacturer needed to design and lay out the process for producing its newest rigs. Before lean manufacturing, the process for building rigs consisted of unorchestrated individual efforts. With the end objective in mind, each individual proceeded down the path he thought was needed at that moment. Unfortunately, much of the activity did not add real value to the product. Looking for parts, walking for tools, searching for blueprints, and determining the next step to take consumed much of the workday.

Employees applied their crafts–welding, wiring, assembling, etc.–to resolve problems. If the component the supplier sent did not fit properly, they would turn it into what they needed. If a required part was missing, they would take a piece of raw metal and make one. This improvisation made each rig somewhat distinct from those fabricated before or after it.

This "process" has its disadvantages. Each rig was built in a different sequence and in a different way, using different tools, planning, scheduling and support. How long should building a rig take? How much should it cost? When will it be done? These were questions answered in hindsight when management had another question: Why did it take so long and what could be done to make the rig building process more cost effective?

To answer this question, the rig manufacturer hired a consulting firm to introduce employees to lean manufacturing and implement the culture necessary to make lean techniques effective.

Concepts And Tools

Lean manufacturing has two broad goals: minimizing the number of steps in each process, and reducing the variation in each step. The consultants teamed with company employees to develop a six-point road map for achieving these goals, which included focusing on:

- Value-stream, product-based thinking;
- Rate-based production;
- Value-adding activity;
- Reducing inventory levels and enhancing component part "staging" during manufacturing and assembly;
- Using visual cues to communicate information at a glance; and
- Continuous improvement.

The value stream should be a continuous flow of goods or services to the customer. By mapping the value stream, management was able to focus its efforts on areas that have high potential for improvement and provide real value to the customer and the bottom line. This kept the company from optimizing one process at the expense of another and ensured that it met its final objective: providing customers with a quality product in a timely manner.

Employees at every level need to keep each other and the end user in mind. For example, when designing a product, engineers should use welds the fabrication shop can perform easily unless particular welds are required or make the product more appealing to the end user. Lean tools in this phase include process observation, business assessment, physical and logical process mapping and cellular manufacturing.

Rate-based production, a major step in implementing lean manufacturing, is the process by which manufacturing activities and objectives are identified and scheduled at a rate that supports customer needs. Toward that goal, Helmerich & Payne developed master schedules throughout the value stream and supply chain to ensure a consistent flow of information and material.

Lean tools for rate-based production include "takt" time analysis, process flow analysis, metrics tracking, and standardized work. Takt is derived from the German word "taktzeit", which translates to "clock cycle." When used in a production sense, takt means building at the proper speed to support a defined rate of demand. In this application, it sets the pace of production to match customers' demand for four rigs a month.

It is also important to keep the manufacturing focus strictly on value-adding activity. Organizations must continuously strive to remove activities that do not add value to the product, including motion, transportation, waiting, rework, correction

Lean principles use color and other visual cues to communicate information at a glance. At Helmerich & Payne's facility, this communications board with material pull flag is one of many visual controls that enable simple process execution and monitoring.

and inspection. Instead of accepting these unnecessary activities as unavoidable, lean manufacturing tries to squeeze them out of the processes. In the case of Helmerich & Payne, tools were "shadowed:" presented in a standard manner to minimize searching and handling. Standard work steps were developed and material and supplies pulled to the point-of-use to remove waste from the process. Tools here include time value mapping, setup time reduction, tool and part presentation, and standard work steps.

Lean manufacturing's cost savings come in part from reducing the amount of inventory and associated carrying costs, largely through two techniques. First, instead of manufacturing components in large batches, lean companies produce components only as they need them. For example, if a rig manufacturer needs eight skids in the next four weeks, it would make two to support that week's requirement, then reassign the skid makers to other components needed during that week. In addition to reducing inventory, this technique minimizes the impact of design changes or defects.

Second, lean companies produce components in the order best suited for the next stage in the process and only send those components forward when they are needed. At Helmerich & Payne, the rig-up yard instructs the component assembly facility when to send components, only in a given order and only to specified areas. This allows the rig-up yard to perform tasks in the most efficient order and proceed from one step to the next without moving as-yet-unneeded components. It also gives the assembly facility the information it needs to set priorities.

Tools for reducing inventory management costs include Kanban (an automatic component replenishment triggering mechanism originally developed by Toyota in the 1950s), visual controls, supplier-managed inventory, just-in-time systems, and point-of-use delivery.

Lean also calls for companies to use color and other visual cues to communicate information at a glance. This enables an individual to immediately recognize any deviations from the standard. At Helmerich & Payne, visual controls were employed that allowed for simple process execution and monitoring. For instance, workers raise a flag with a component's picture attached so the inventory group can quickly identify who needs a component and what components are needed. Tools for visual communication include "6S" (safety, sort, sweep, simplify, standardize and sustain); communication and signboards; color coding; and mistake proofing.

A six-point "road map" was developed to achieve the goals of minimizing the number of steps in each part of the rig manufacturing process at Helmerich & Payne's assembly facility, and reducing the variation in each step. As a result, the assembly facility experienced dramatic reductions in safety incidents, cycle time and labor cost.

Lean manufacturing is based on the theory that "our work is never done." Over time, a dedicated organization will find ways to improve even the most well designed processes. When one bottleneck is broken, a new one will appear and get attention as the organization continuously strives for leaner processes and shorter cycle times.

As part of its commitment to constant improvement, Helmerich & Payne monitors, measures and analyzes its processes. This began with a focus on the assembly facility, then moved upstream to primary suppliers, and downstream to the rig-up yard and implementing lean practices in the field. Tools include "six sigma" (a set of statistical techniques for minimizing variation in a process), metrics, control charting, check sheets and brainstorming.

Culture

Although understanding the concepts and tools of lean manufacturing is vital, corporate culture is the most important factor influencing whether lean manufacturing will yield significant long-term effects for any organization. To benefit from lean, a company must believe a statement issued by former General Electric Chief Executive Officer Jack Welch in an annual report: "The desire and the ability of an organization to continuously learn from any source–and to rapidly convert this into action–is its ultimate competitive advantage."

One of the best sources of ideas for improving a process is the people who perform that process every day. Not every idea they suggest will work, but their familiarity with the process gives them insight that those at higher levels often lack.

Many employees resist lean manufacturing initially because they are used to traditional methods, which make some aspects of lean seem counterintuitive. For example, traditional manufacturing encourages companies to make as many units as they can in each batch on the theory that workers will get better at their assigned tasks the more they practice and produce more consistent results when they work uninterrupted. In contrast, lean calls for making only the items that will soon see use so the company spends less time and money managing inventory. This benefit outweighs those of large batches, as shown by Japanese automakers' success with lean manufacturing.

To overcome these obstacles and

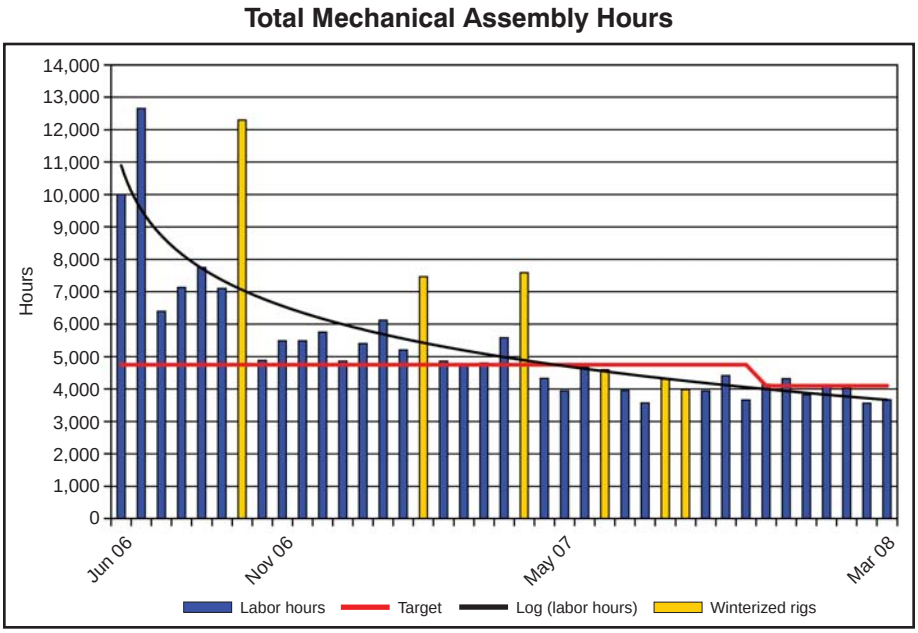
achieve profound change, an organization needs to promote learning and communication at all levels. While training is a good starting point, coaching, mentoring, teambuilding, and consistently "walking the walk" are necessary to turn doubters into believers. It is essential to get out on the floor where the action is, listen to employees and observe the process.

Helmerich & Payne's leadership knew one of its greatest challenges in implementing lean would be significantly changing the culture on the fabrication floor. Simple changes, such as renaming the "fab shop" the "assembly facility," relayed the message that the company was moving in a new direction.

The rig manufacturer was much like any other large organization when it came to change. There were opponents who were convinced that lean manufacturing would never work. There were also a number of supporters willing to give lean a shot, as well as "fence sitters" waiting to see which way the political winds would blow. With persistence and positive results, momentum took hold.

One initially skeptical foreman summarizes lean's benefits from his perspective in the assembly facility, noting, "My job has changed. I am no longer a 'fire fighter.' I can actually manage the shop like I am supposed to."

FIGURE 1



ALAN ORR

Alan Orr is executive vice president of engineering and development at Helmerich & Payne, responsible for developing all engineering, technology, new rig construction and upgrade projects. He has worked at H&P for 32 years, previously serving for 14 years as vice president and chief engineer. Orr has worked in H&P's U.S. and international divisions in both field and engineering assignments, including roughneck, driller, tool pusher, superintendent and division operations manager, as well as drilling engineer, project engineer and chief engineer. He was the recipient of the 2005 International Association of Drilling Contractors' Contractor of the Year Award. Orr holds a B.S. in general engineering from the United States Military Academy.

BARRY BLADES

Barry Blades is chief executive officer and president of Wichita, Ks.-based SixthSenze, Inc. He also has served as lean/six sigma champion at Raytheon Aircraft in Wichita and as executive in charge of manufacturing and chief information officer of Charles Machine Works, the manufacturer of Ditch Witch® construction equipment in Perry, Ok. Prior to that, Blades worked for 12 years as a consultant in the manufacturing industry. He is certified in production and inventory management and integrated resource management. He holds a B.S. in marketing and an M.B.A. from Oklahoma State University.

The Results

Over 32 weeks during the initial program for the manufacturer's FlexRig3®, the assembly facility experienced dramatic reductions in safety incidents, cycle time and labor hour cost. Similar results can be seen in its newest build program. Work areas stay clean and uncluttered, material is delivered when needed, and employees take the initiative to improve their areas. Examples of initiatives include:

- Employees began painting their workstation communication boards different colors. They then painted their tools and fixtures to match, ensuring what they needed remained at their workstations.
- Employees designed and built special fixtures to simplify roller installation, minimizing handling during assembly.
- A vocal adversary at the beginning of the project became a vocal advocate, ensuring lean practices were employed and standard work steps were followed before releasing components from the assembly facility to the rig-up yard.

Helmerich & Payne's lean effort did not stop at the gates of its assembly facility. Once the effort there showed tangible results, the company began working up the supply chain, with a primary supplier.

The supplier, a heavy steel fabricator, was having difficulty making the defined schedule. While the steel fabricator was linked to the rig manufacturer's schedule and knew supply delivery dates, in-

ternally it had difficulty gauging where it was in the process. Any unexpected delay would cause the supplier to miss a delivery.

The rig manufacturer and the steel supplier found several solutions. First, workstations were developed to make seven key elements immediately available for employees: information, parts, fasteners, supplies, hand tools, power tools and jigs/fixtures. Second, internal schedules and work steps were developed, allowing management to monitor progress and adjust for delays before impacting delivery. Finally, material was delivered to the point-of-use. The supplier managed to recover the schedule, and in so doing, learned a great deal about organizing and improving its overall business processes and profitability.

With management commitment, teamwork, persistence and a proven lean methodology, Helmerich & Payne's Houston assembly facility has achieved remarkable gains in production efficiency, cycle time reductions and improved product quality (Figure 1).

The experience with lean techniques in the rig fabrication and assembly process points toward many value-adding possibilities with the well construction process, especially in applications where customer development plans require multiple similar wells. These possibilities include rig moving; rig up and rig down; blowout preventer testing, installation and removal; delivery of operator-furnished equipment to well sites; casing running; and preemptive change-outs of equipment/components (e.g., rotary hoses, blowout preventors, triplex pump fluid end modules, etc.). More opportunities for continuous improvement!

Lean techniques can yield equally dramatic reductions in cycle times and greater quality far outside manufacturing. For one manufacturer, applying lean techniques in the office reduced the order cycle 80 percent. For an insurance company, applying lean principles to the bid-and-proposal process lowered the time needed to put a new customer into the system from weeks to days. Health care record keepers have also benefited from lean. With such wide applicability, lean principles can help companies throughout the oil and gas industry. ❐