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Becoming a Lean Enterprise

A Tale of Two Firms

Both an aircraft manufacturer and an oral surgeon are reaping efficiencies from following the principles of lean transformation.

by Tom Greenwood, Marianne Bradford, CPA, and Brad Greene

Over the past 15 years we've found one maxim to be true: Lean works! Not only are companies achieving productivity gains of 40% to 60% in targeted areas because of lean principles, but they're also obtaining inventory reductions worth millions of dollars. Is your company?

We aren't referring to just lean manufacturing techniques but rather to applying a specific lean enterprise technology. This technology is both a business model and a collection of tool sets designed to eliminate wasted activity throughout a company's product delivery system (PDS)—everything from the end customer, back through distribution, production, design, and supply channels. In other words, efficiently using all resources to deliver maximum value to customers.

Companies in a myriad of industries that have varied customer and supplier relationships, as well as different organizational structures, have successfully applied lean enterprise principles. We'll look at two—Cessna Aircraft Company and Adirondack Oral and Maxillofacial Surgery (AOMS). They began their lean transformation journey at roughly the same time and took remarkably similar paths.

Wichita, Kan.-based Cessna, the world's largest manufacturer of single-engine aircraft and business jets, employs some 12,000 people and produces revenues in the $3 billion range for its parent company, Textron. The service-based firm AOMS, a small oral surgery office with revenues of about $2.2 million, employs roughly 25 in Menands, N.Y. Although the differences are obvious, their experiences were strikingly similar, and from them come lessons relevant to all companies.

The Decision to Become Lean

Both companies had unique needs when they enrolled in the Lean Implementation System (LIS) sponsored by the University of Tennessee's Lean Enterprise Forum. Dr. Tom Greenwood, director of the Lean Forum, developed the LIS because of his experience implementing lean enterprise principles in more than 100 facilities worldwide. A structured, 75-step, 10-month process, LIS guides companies through the implementation experience by conducting workshops and on-site events that train the organization to achieve and sustain a

lean enterprise. Here's a look at the challenges both Cessna and AOMS had to overcome.

As the market leader, Cessna was striving to continually improve its operational performance, but, like many other manufacturers, the company found its customers demanding more customized products and shorter lead times, and it seemed the whole business environment was operating at a faster pace. Since lead-time reduction is one of the most publicized benefits of implementing lean principles, Cessna's decision to try the Lean Implementation System was an easy one.

The decision to implement lean wasn't so clear-cut for AOMS. Dr. Gary Wadhwa, principal owner of AOMS, became intrigued when he was completing his Physician's Executive MBA at the University of Tennessee (UT). At that time he decided to attend the Lean Enterprise Systems Design Institute, a one-week course through the Lean Enterprise Forum at UT's Center for Executive Education. Dr. Wadhwa caught the lean virus. His staff, however, was concerned that these principles would interfere with their work.

But Dr. Wadhwa had already benefited from business tools such as activity-based costing (ABC) and Six Sigma (variation reduction) techniques. He used ABC to determine that his highest-priced surgical procedure was actually less profitable than a much-lower-priced procedure. By applying Six Sigma techniques he reduced the average insurance payment cycle time from four weeks to four days.

What intrigued Gary Wadhwa about lean is that it provides an integrated approach to leverage the benefits of Six Sigma and ABC with another whole suite of business tools. The result would be even greater efficiencies. Interestingly, over the past five to 10 years many companies have struggled with the idea that these process-based tools work best in a complementary manner. By coupling these tools, he hoped to drastically reduce overhead and process times as well as take on new patients without increasing his workforce or office space.

Facing the Challenges of a Lean Implementation

Step One: Creating Buy-In

The first challenge for both firms was how to generate acceptance for lean. Cessna hired a consulting firm to create a set of lean awareness communication tools. Simple but effective videos explained why Cessna was pursuing lean and how each lean tool could improve everyone's work activities. In addition, individual information booklets explained the tools, what to expect when participating in lean events, and what it meant for the employees, the company, and, most important, the customer. Table 1 shows the lean production tools taught to Cessna employees.

Table 1: BASIC LEAN TOOLS

LEAN TOOL	DEFINITION
5s	Maintaining a clean, organized work area.
Setup Reduction	Techniques used to reduce the time it takes to change over machines from one product to the next.
Production to Takt Time	Takt time is the rate that each product should be produced such that it will equal the rate of the customer demand for that product.
Standard Work	A specified set of tasks for operators to balance their work patterns as close to takt time as possible.
Pull Execution Using Kanban	A production method in which each of the upstream processes produces based on a signal (Kanban card) from a downstream process. Thus ultimately the customer pulls the product.
Method Sheets	Visual work instructions and quality control checks.
Mistake Proofing	Tools, fixtures, and engineering designs that prevent quality defects from occurring by assuring that they can't occur (e.g., fasteners only fasten one way).
Flow Production Cell Design	Grouping machines or operations together around the flow requirements of product families rather than by departmental functions. The emphasis is on dramatically shortening the flow time to produce a finished product.
Point-of-Use Material Storage	Raw material and subassembly storage in close proximity to the assembly area as opposed to a central storage area.
Visual Controls	Use of color coding, shapes, empty spaces, and other visual cues to communicate production status as opposed to paper reporting.
Cross-Training	Training operators to perform multiple jobs so that work can be distributed according to demand fluctuations.
Total Productive Maintenance	Technique in which operators learn to perform certain daily preventive maintenance tasks on equipment in order to free up maintenance personnel to perform more technically based maintenance activities.
Quality Assurance	Use of quality methods that assures defects aren't passed on from one workstation to the next.

For AOMS, the main impediment was lack of time to execute the implementation since the office was already operating at full capacity, which meant the implementation would require overtime or lost revenue. In the end, overtime was the answer. The reason? An investment of overtime to improve the office's overall operation would increase the system's capacity without additional investment in overhead or added employees. As it turned out, they used a little overtime, and the productivity came.

Step Two: Adopting Standard Work

Another factor was the mind-set of the two workforces. Cessna's employees worked under an operational metric known as standard-hour attainment, which is developed around the traditional standard costing idea that production areas are cost centers. This approach dictates a process of absorbing overhead costs through attaining standard hours of production. The metric is intended to measure the department or work center's productivity. Developed by industrial engineers who performed time studies on each job, the metric is the ratio of actual production time as compared to the job standard.

But this traditional metric is plagued with problems. First, the operator knows the most about how to perform the job but doesn't determine the best method to do the work. Second, the operators, who are being observed as the time standards are set, may be concerned that the resulting standards may be too tight to allow adequate time to react later if there's a problem or defect while performing the task. These concerns can lead to padding so don't reflect the actual work content accurately. Third, the standards may become incorrect over time if they aren't adjusted or reset when process improvements are made. Over time, these standards have a high degree of variation from actual times that creates issues related to capacity and manpower requirements used in the production planning process.

In a lean enterprise, however, the operators own the process and define the best method or "standard work" for each task by eliminating unnecessary steps, motions, and sources of delays. Reaching this point requires a fundamental paradigm shift in the way companies do business. So how do you make the shift?

Standard work requires teaching operators how to improve their work by breaking down each activity to its most elementary tasks, with the objective being to identify and eliminate any nonvalue-added tasks and to develop the best work patterns. Matt Kraft, Cessna's director of lean, says, "The operators have learned this tool and are driving improvements. Through standard work, they have the skills to identify and reduce process variation. We're beginning to see operators achieve initial productivity gains of 20%-30% as they establish standard work patterns."

Case in point: Enough nonvalue-added tasks were eliminated on the Citation X business jet line that line move rate, the time an aircraft stays at a particular station, decreased from 56 to 48 hours. This translates into adding three new Citation X aircraft to the annual production schedule with no additional resources—and approximately $55 million in additional revenue to the business plan. Pure growth!

In the interim period before full deployment, some workstations completed their work cycles in the 48-hour window. But the planes couldn't move on a faster cycle until the adjacent workstations were converted to the new work cycle. Here's where the traditional efficiency measures became a barrier to improvement. Because the assembly teams in the lean workstations finished their work cycle within the new 48-hour cycle but the line move rate was still 56 hours, the traditional incentive would have encouraged the team to overproduce. One of the principles of lean is to only make what's necessary to meet the immediate demand. Overproduction wastes or misallocates capacity because it results in unnecessary inventory.

The team proposed the solution: After standard work patterns were established at a given workstation and the work cycle was adjusted to the new line rate (48 hours), a clock could be placed at the workstation to indicate when the 48-hour cycle time had expired. After this time the operators would clean up the work area and then flex into other workstations to help out those operators. This process would continue until the standard work process was established across the entire line.

Begin Near the Customer. Another key point is to begin at the most downstream portion of the process (nearest the customer) and to work upstream. It's like breaking ice on a frozen river. You start to establish flow downstream and work upstream, thus creating a pull to break up the upstream bottlenecks and let the materials flow. You certainly wouldn't start breaking ice at the head of the river! It's ironic how many companies do just that because they want to first create flow in the areas that they perceive to be the greatest bottlenecks in the process. Often, when they're successful in fixing the bottlenecks, they find themselves gridlocked from a flow perspective until they can also fix the downstream activities. If it takes too long to establish flow downstream, the team may get frustrated, and some of the initial gains may be

lost over time as the focus areas settle back into the slower work pace determined by the downstream condition.

The organizational dynamics of a surgical environment such as AOMS are similar to a typical manufacturing organization. For example, a distinct hierarchy of doctors to nurses to staff workers exists within AOMS, with each level tending to blame the level below for the inefficiencies of the overall system. So a major mind-set change was to move from a “people-blaming” culture to a “process-oriented” culture. In a lean enterprise, the process becomes the target for improvement as opposed to the people.
The application of standard work at AOMS emphasized this result. They first analyzed the administrative areas, and any job that was repeated on a consistent basis was a target to study. The staff members learned to map their processes and eliminate any nonvalue-added activities, which resulted in fewer mistakes and shorter wait time for patients.

One distinction of a surgery clinic that’s different from a manufacturing organization lies in the roles of the doctors. On the one hand, the doctor is a highly skilled operator and the most expensive resource, but, on the other hand, the doctors often own the business. Similar to a player-manager in the golden era of baseball, the doctor is a fundamental part of the system but is also the designer of the system. The doctors pushed back when it came time to analyze the surgical procedures and establish standard procedures because they were very protective of “their method” of performing surgery. The root of the problem: They see themselves as craftsmen rather than technicians, and, as the owners, the doctors wanted to fix the system, but they were torn when it came time to fix “their” part of the system.

The problems prior to developing standard work manifested themselves in many ways. Different surgical methods, techniques, and setup requirements translated into much variation in the time it took to do any one procedure. This variation presented a scheduling nightmare, and capacity was wasted, but by establishing standard setups and procedures for similar surgeries, the doctors could add three additional surgery slots per day.

For some examples of the challenges both companies faced, see Table 2.

Table 2: IMPLEMENTATION CHALLENGES

	IMPLEMENTATION CHALLENGE	
Creating Buy-in	Large companies have difficulty diffusing lean awareness.	Oasana adopted a comprehensive internal communication strategy: u Standard training materials, u Promotional video.
	Small companies have difficulty allocating resources for improvement activities.	AOMS used overtime with the justification that improved capacity translated into increased business.
Adopting Standard Work	Workforce Mind-set: u Standard-hour attainment metric.	Oasana operators developed standard work, and other metrics began to replace standard-hour attainment.
	Workforce Mind-set: u Doctor-to-nurse-to-staff hierarchy, u People-blaming culture.	AOMS changed to process-oriented culture through process-flow analysis and development of standard work for all (doctors included).

Step 3: Implementing Pull Systems

Both companies also attained significant gains in productivity by employing kanban, a Japanese term meaning visual signal. It's a method of pull scheduling in which parts or products are made only in response to the consumption of parts or products in a downstream operation. This material replenishment system differs from traditional ones that often use MRP-driven schedules. MRP stands for materials requirements planning. Though it's a valuable tool for planning future material requirements based on a forecast or master schedule, many traditional plants use MRP to also execute the materials plan by releasing orders to internal and external suppliers. These orders are to deliver components and raw materials to meet future production schedules. The problem is that the MRP system is an order-driven push system that relies on forecasts of future demand rather than a kanban pull system that's based on actual demand via a visual consumption-replenishment signal.

Using a kanban system, pull scheduling smoothes the flow of materials across a factory floor because production signals are generated real-time for components as work-in-process inventories are consumed in downstream workstations. The result is usually a significant reduction in inventory as companies adopt kanban pull methods. This differs from MRP-driven orders, which are based on what was supposed to happen according to the schedule rather than what really happens.

In its assembly areas, Cessna's work-in-process inventories dropped by over $5 million in the last year, and airplanes are now flowing through final assembly in a much more predictable manner without material delays. According to Matt Kraft, "The [kanban] system forced us to actually study the lead times and capacities of internal suppliers and to integrate them with the line schedule. This is in stark contrast to the old method of just releasing all the orders on the MRP and trying to manage with schedule due dates and shortage lists. The old system never really took internal supplier capacities into consideration. With kanban, Cessna has found the additional benefit that demand for individual parts is more consistent on a week-to-week basis. This enables both internal and external suppliers to respond more quickly."

To date, Cessna has more than 5,000 parts on kanban execution. "It has resulted in reduced lead times and significant improvements in internal schedule performance," Kraft says. "But most importantly, the operators have come to realize that those kanban cards mean something to them. It means that they will have the parts they need when they need them."

Cessna's metal bond department, for example, supplies the final assembly area with parts that require a special metal-bonding process. When the lean implementation began in September 1999, they videotaped parts of the implementation process. The video crew returned to the department three months later. They expected an inventory reduction, but the unexpected result was a dramatic difference in morale, which Kraft attributes to the more stable work environment created by the kanban implementation. Here's why.

Operators often feel as if they have more control over the system when using kanban. When parts aren't available, the problem is usually very evident, and the operator can quickly get to the root cause because the kanban card serves as a direct link to the person or machine that's supplying parts to the operator's work area. In conventional MRP execution systems, the operator receives a master production schedule, and someone else (often in another area of the facility) makes sure that the proper materials are available. When problems arise and materials aren't available or are defective, the operator has very little control over his or her situation. Often the necessary parts were produced in a batch mode, weeks or months earlier, making root cause analysis impossible.

A kanban system is also alive and well at AOMS. This surgical firm placed its suppliers on a fixed-cycle reorder system in which they contact the suppliers to replenish what has been

used, and, fortunately, its major suppliers were already set up to supply in this manner. Traditionally, for a service organization, material issues aren't the major issues. The only criterion was that there's enough on hand at any given time, which led to a mind-set that more is better, so now the size of inventory was actually rationalized. The result: a large inventory reduction in the first couple of months. Previously, the inventory was bought in bulk quantity discounts and stored for a long time, but now materials are bought on an as-needed basis in kanban quantities. Spending on supplies has been reduced by approximately 35%. (See Table 3 for more results.)

Table 3: LEAN TOOLS AND RESULTS

LEAN TOOL		
Standard Work	Cessna u 56- to 48-hour move time. u Increased capacity to three additional planes per year. u 15% reduction in lead time.	AOMS u Decreased wait time for patients by approximately 30%. u 1-3 additional surgery slots per day.
Kanban	u Reduced work-in-process inventory by $5 million. u Reduced time waiting for parts, which led to improved flow time for planes. u Improved morale due to sense of increased control felt by operators.	u 35% reduction in inventory of supplied materials.

Looking Toward the Future

Neither company is a fully mature lean enterprise. In a company as large as Cessna, it takes time to change all segments of the product delivery system. According to Kraft, "In the first year we got started. In the second year we began seeing real results, and in the third year we expect to really experience the 'wow' level of impact." Cessna is now truly realizing that lean works! They've realized productivity gains of 40% to 60% in targeted areas that have resulted in annualized productivity savings of more than $70 million. With the use of kanbans, the company has experienced millions of dollars of inventory reductions, and inventory turnover (sales/inventory) has improved dramatically.

Cessna is now creating a strategy that involves "leveraging lean across the enterprise" by combining lean tool sets with a company-wide, process-based management initiative. This initiative looks at integrating a new "lean" product delivery (order fulfillment) process with new order acquisition, product development, and supply chain processes. The goal is to continue to build highly customized aircraft using configured and modular designs that meet every customer's mission profile but to do so with dramatically shorter lead times and at very competitive price points.

For Cessna, the first phase of implementation wasn't easy, and the learning curve was steep. But Kraft is confident that, with each new product line, it will be easier to undergo the lean transformation. Cessna's workforce is developing a proficiency in the tool sets as well as a fundamental awareness of how lean enables a new business strategy. As other product lines follow the same structured approach, Cessna will continue to reap productivity gains. It will also see enterprise-level benefits as they extend the principles and tool sets upstream into the supply chain and to the customer through greater design and delivery flexibility.

AOMS is on its own journey toward a lean transformation and truly blazing a trail for other medical practices to follow. As Dr. Wadhwa says, “Did we ever imagine that we would use the term ‘supply chain management’ in the medical world?” The challenges for Dr. Wadhwa are to continue to institutionalize these principles within his own organization without a huge training budget or the time to do it. To sustain and improve upon its early successes, AOMS must continue to develop a formal approach. And finally, Dr. Wadhwa plans to extend these ideas up the value stream to the dentists’ offices and dental labs that serve as his suppliers of patients and services.

These are just two examples of lean implementations. By following lean’s prescriptive process, any company can change its business model and redesign its product or service delivery system. As you can see from these two examples, lean principles are universal and can create tremendous efficiencies for the companies that adopt them. Regardless of company size, industry, or culture, lean principles are the key to unlocking the value in your business.

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