Manufacturers Get Lean to Trim Waste

Those who advocate lean strategies tout the savings in labor, space, and time on the plant floor and beyond.

William Leventon

Manufacturers are increasingly turning to lean manufacturing in an attempt to cut waste from production time.

All manufacturers want to make products as efficiently as possible. But how good a job are they actually doing? "Everybody's trying to eliminate waste," notes Mark DeLuzio, a business consultant based in Glastonbury, CT. "But there's still an abundance of waste in the typical manufacturing organization."

The reason? "Most companies run on a very traditional 1970s business model," says DeLuzio, president of Lean Horizons LLC, a firm that teaches the principles of lean production, or simply "lean," as some proponents refer to it. Developed by Toyota after World War II, the lean concept offers companies a business model designed to eliminate waste in product manufacturing.

Many medical device firms vouch for the benefits of lean. In some cases, the benefits extend beyond the plant floor to all areas of the business—and even outside the company walls. But to get the most out of lean strategies, practitioners must avoid hazards that cause many to stumble on the endless journey toward waste-free manufacturing.

Lean Definitions

In order to grasp the concept of lean, manufacturers must understand the term work as defined in Lean Lexicon, a glossary of lean-related terms published by the Lean Enterprise Institute (LEI), a nonprofit training and research organization based in Brookline, MA. According to the Lexicon, work is the human activity involved in

production. Actions that constitute work can be divided into the following three categories:

• Value-creating tasks: Actions necessary for making products, such as welding or drilling.
• Incidental work: Actions necessary to make products, but that don't create value from the customer's standpoint. Such actions include reaching for a tool or clamping a fixture.
• Waste: Actions that (a) create no value from the customer's perspective and (b) can be eliminated from a process; e.g., walking to get tools that can be positioned within reach of a worker.
According to LEI, actions that create value as perceived by the customer are just a tiny fraction of the total activities in most enterprises (see Figure 1). So companies can reap significant benefits by eliminating wasteful activities.

How significant? Compared with conventional mass production, lean production usually requires only half the human effort, manufacturing space, and capital investment for a given amount of capacity, LEI claims. In addition, the organization notes, lean requires only a fraction of the development and lead time consumed by conventional production systems.
To this list of benefits, DeLuzio adds several others:

• At least a 50% improvement in quality per year, measured in parts-per-million defects or rejects.
• Dramatic improvement in on-time delivery in the first year.
• In the first two years, a 2% per month improvement in productivity.

Understanding Value

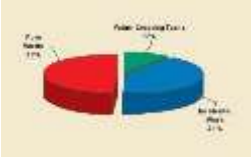

Figure 1. In a typical company, the greatest percentage of time is spent on tasks that are pure waste. Source: Lean Advisors Inc (click to enlarge).

To realize the benefits of lean, companies can apply a set of special tools. One of the most important of these tools springs from the concept of value, which Lean Lexicon defines as the inherent worth of a product as judged by the customer.

A product is the result of a combination of actions. Some create value as perceived by the customer; others do not. Taken together, all value-creating and non-value-creating activities constitute a value stream. LEI defines a value stream as all the actions in a process that take a product from concept to launch and from order to delivery. Included are actions to process information coming from the customer and actions to change the product on its way to the customer.

To see a value-stream in its entirety, companies create a value-stream map, which is a bidirectional flow diagram that maps the following two processes:

- How products flow from suppliers to the manufacturer to end customers.
- How information flows from end customers to the manufacturer to suppliers.

The product's current path to the customer is shown in a current-state value map. Manufacturers can also draw a future-state map that incorporates process improvements that result from studying a current-state map.

Value-stream mapping produces the greatest effect when it is done by a cross-functional group that includes representatives of all the departments that own a piece of the process, notes Larry Coté, president of **Lean Advisors Inc.** (Ottawa, ON, Canada), a business consulting firm. "These people get to see the entire system from start to finish—everything the customer is paying for to get a product or service," Coté says. "So they find out what their company actually does. Usually, people are amazed at what they see. You'll often hear the comment: 'I didn't know we did that.'"

In many cases, Coté says, people looking at value maps see that they're creating extra work for others before and after them in the process. Value maps also make it easy to spot convoluted processes that cause production bottlenecks, according to Jerry Bussell, global vice president of operations for **Medtronic Xomed** (Jacksonville, FL), which develops and manufactures surgical products used by ear, nose, and throat specialists.

At the facilities of **The Tech Group Inc.** (Scottsdale, AZ), an injection molding and contract manufacturing firm, value maps help workers rearrange molding and assembly equipment on the shop floor to minimize transportation and wasted motion. The maps also help workers spot non-value-adding items such as inspection loops and inventory queues, according to Tom McLean, the company's manager of process improvement.

Waste-Fighting Tools

Besides value-stream maps, lean practitioners have many other waste-fighting tools at their disposal. One is called 5S, which comprises a set of techniques for removing waste from the workplace through better organization, cleanliness, and visual communication. The five Ss are sort, set in order, shine, standardize, and sustain.

At contract manufacturer **Plexus Corp.** (Neenah, WI), plant personnel conduct regular 5S audits, reports Scott Theune, the company's director of manufacturing process and technology. As they go through the production area, Theune and his colleagues refer to an audit check sheet, which prompts questions such as: Does everything on the production floor need to be there? Is it in the right place? Is it clean? Is it identified? "The audit helps us stay clean and organized," says Theune, who credits lean for cutting lead time by more than 75% and space utilization by more than 25% at Plexus facilities. For a list of sample metrics, see Table I.

Another popular lean tool is standardized work, defined in Lean Lexicon as the establishment of exact procedures for each job in a manufacturing process. Benefits of standardized work include easier operator training, process documentation for all shifts, reductions in variability and injuries, and a baseline for improvement efforts.

At Medtronic Xomed, the standardized work initiative has produced written instructions telling people exactly how to do their jobs. "You find the best way to do something and make sure people repeat it that way, no matter who's doing the job," Bussell says. Though it sounds simple enough, he adds that standardized work is "a hard thing to do, because human nature is to change things a little, twist the wrench a little bit different."

Several lean tools relate to the concept of just-in-time production, defined in Lean Lexicon as making and delivering just what's needed, just when it's needed, and in just the amount needed by the downstream process. One of these tools is "pull production," a system in which nothing is produced by the upstream "supplier" until the downstream "customer" signals a need for it.

Manufacturers establish pull production to eliminate waste caused by conventional push production, in which large batches of items are made at a maximum rate based on forecasted demand and moved to the next downstream process, regardless of the actual needs downstream, according to Lean Lexicon. Push production makes it almost impossible to produce the smooth work flow characteristic of lean production, Lexicon notes.

At **MedSource Technologies Inc.** (Minneapolis), a contract manufacturer that serves the medical industry, plants have established pull systems with customers and suppliers. According to Chuck Foster, the firm's director of value-chain velocity, the process starts when customers pull product from a MedSource plant. To replenish that inventory, MedSource pulls product through its own plant and from suppliers. Replenishment activities commence when inventories hit a "trigger point," Foster explains. In some cases, MedSource and its manufacturing partners share inventory data on-line using special Web pages.

Beyond the Shop Floor

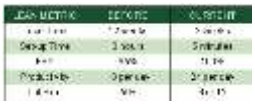

Table I. An example of possible metrics for improvement. Source: edSource Technologies (click to enlarge).

In the past, lean initiatives were aimed solely at process improvement on a company's shop floor. Recently, though, lean has spread beyond the manufacturing process to attack waste in all parts of an enterprise. Therefore, advanced lean thinkers no longer use the term lean manufacturing, Coté notes. "When you add manufacturing to the description of lean, you restrict your way of thinking about it," he says. "Lean is much bigger than the one piece called manufacturing."

So today, lean thinkers are focusing on new areas such as product development. In a traditional design process, engineers are left to their own devices when doing design work, "so if you have 10 engineers, you may have 10 different processes for designing a product," DeLuzio explains.

When working with clients, DeLuzio tries to inject a healthy dose of standardization into design processes. His standardized design process includes a series of "tollgates." Each tollgate is a checkpoint with a checklist of items that should have been addressed by that point in the process. The checklist includes standardization of components, design for manufacturability, and other items consistent with lean thinking.
The design process is a logical lean target because most of a product's cost is "baked in" during design, DeLuzio says. But in many cases, engineers design products without an understanding of how they will be manufactured or the costs of specified components and materials. To fill such crucial voids in education and experience, many successful companies rotate their design and manufacturing engineers, DeLuzio notes.

But successful products require more than just design and manufacturing expertise. "Many times, a marketing guy will look at a product after it's designed and say, 'We can't sell that. That's not what the customer wants,'" DeLuzio says. "Then it's back to the drawing board to design the product all over again."

DeLuzio tries to prevent such fiascoes by stressing the importance of a cross-functional design approach that includes input from marketing, finance, and other departments besides manufacturing and design engineering. The additional input can prevent design mistakes and save time, he says.

At Medtronic Xomed, value maps of product development processes and subprocesses have revealed bottlenecks and other waste that can be eliminated. In the development of handheld surgical instruments, lean initiatives have cut non-value-added steps, standardized subprocesses, and improved handoffs between departments. As a result, time to market has been reduced 40–80%, Bussell reports.

A Recent Revelation

Besides eliminating waste from existing systems, lean is also being used to plan efficient new processes. Aiding lean practitioners in this task is a tool called the Production Preparation Process, or 3P. A method for designing a lean production process, 3P is one of the more recent revelations from the legendary Toyota Production System.

The key to 3P is upfront planning that right-sizes equipment and establishes key lean processes such as pull production from the beginning. "You do all the things you would want to do if you were starting with a clean sheet of paper," Hafer explains, adding that this approach is more efficient than trying to adapt batch-oriented equipment and processes to lean principles.

According to Hafer, 3P still isn't widely known at this point. But he and his colleagues have already helped establish the practice at many firms. The results include substantial savings in process development, faster new product introductions, and better product quality. "It's been a tremendous boost for many of our clients, especially the medical device companies," he reports.

Another boost for lean-minded medical firms comes from software, notes Joseph Vinhaus, vice president of regulatory compliance for **Camstar Systems Inc.** (Campbell, CA). Camstar's InSite manufacturing execution system software helps companies control and optimize production processes that are spread out in multiple

locations. For lean practitioners, InSite offers features such as "electronic kanban" for more-efficient signaling of production needs (see Figure 2).

In addition, InSite includes Web Modeler, a Web-based tool that allows detailed mapping of production processes. The resulting maps show processes at a "granular" level, Vinhaus says, making it easy for users to spot duplicative steps and other wasteful activities. InSite also puts controls in place that prevent these activities from reappearing in the process.

More lean help is available from eMPower, a manufacturing process management software product from Tecnomatix Technologies Ltd. (Herzlia, Israel). eMPower features a central process repository (CPR) of all processes in a company's facilities. The CPR helps companies standardize processes and spread lean-related best practices throughout a multisite manufacturing operation, notes Ron Yosefi, manager of the software developer's U.S. electronics business unit.

To help factory personnel evaluate possible lean modifications before they're actually made, eMPower also includes a simulation tool for testing different production scenarios (see Figure 3). Although manufacturers have other options for performing simulations and additional lean-related functions, Yosefi maintains that the software simplifies lean implementation by integrating a number of different process management tools into a single package.

Regulations and Lean

Figure 2. Software often provides features such as kanban to optimize production processes. Source: Camstar Systems Inc.

Once a tool like eMPower identifies waste, it must be rooted out of the system. This part of the lean journey can often trip up medical device manufacturers, according to Hafer. As a result of device regulations, he points out, tasks may have to remain in a process even though they add no value and would otherwise be eliminated.

The regulatory compliance should have no effect on lean as applied to a new production process, McLean says. But compliance can make it harder to apply lean to a process already validated. In such situations, waste-reducing changes may require a manufacturer to repeat the validation process for the new system. According to McLean, the prospect of revalidation can be enough to kill a lean-related alteration of the production line. "Whether because of the cost or because we can't afford the downtime in production, I think there are cases where it just wouldn't make sense to do it," he says.

However, Bussell thinks lean and regulatory compliance can reinforce each other. "The last principle of lean is to strive for perfection," he notes. "I think that fits in

very well in the medical device industry, because we always have to try to do everything perfectly." In addition, he says, compliance requires validations and standard procedures that can give a boost to lean initiatives.

Why Lean Fails

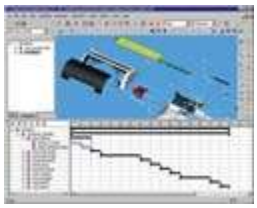

Figure 3. Software can provide a 3-D-based definition of a sequence of events to help optimize the assembly process. Source: Tecnomatix Technologies Ltd.

Though Bussell touts lean as easy to understand and apply, lean initiatives don't always succeed. When companies fail at lean, it's usually because they start by trying to master individual lean tools, according to DeLuzio. Instead, he says, firms should begin their lean journey by developing an overall strategy for their business. If companies don't have a strategy, their customers won't see the benefits of lean initiatives. "You'll have a lot of good war stories to tell, but your customers will say, 'You guys still stink,'" DeLuzio says. "And if your customers don't see benefits, the whole thing doesn't make any sense."

Coté agrees, citing the pitfalls of what his firm calls exciting chaos—people turned loose to eliminate waste in their own departments or processes without a plan for the entire organization. People involved in exciting chaos "feel like they're doing something good for the company," he says. Instead, they may simply be wasting time—for example, reducing waste in a process that will ultimately be eliminated. Worse, Coté says, they may be jamming up the next system in the production line. So exciting chaos can actually result in slower service and higher costs for the customer.

According to Coté, exciting chaos and its unintended consequences can be averted if individual lean initiatives are linked to a detailed future-state plan. With such a plan as a guide, he says, people know what to change, how to change it, and the proper sequence for changes to be made in order for the organization to achieve its goals.

Another pitfall in implementing lean is the failure to engage all the people in an organization. For starters, DeLuzio stresses, the CEO must be actively involved in the process. "In order to do lean, you have to drastically change the business and how you think about doing business," he says. Therefore, lean initiatives "must be led from the top, not the middle." But many CEOs, seeing lean as one of many ongoing company programs, delegate implementation to lower-level people who lack the power to make the necessary changes.

When lean leadership is lacking, some companies look outside their walls for the right people. These companies can get help from executive search firms like Phoenix-

based TowerHunter. According to the firm's managing partner Terry Hindmarch, TowerHunter can match companies up with "subject-matter experts" who are well equipped to implement lean initiatives and executives who aren't lean experts but will effectively support and champion lean activities.

Today, some universities and institutes offer lean training and certification. But when the job requires lean expertise, Hindmarch advises companies to hire executives who have lean-related accomplishments to go along with their training.

In some cases, lean executive searches can lead companies outside the medical device field. When the leadership team already includes enough industry-specific expertise, "you can hire people who are experts in the kind of change you want to implement rather than experts in your industry," Hindmarch explains.

Not Getting It

At all levels of the corporate hierarchy, many people new to lean will view it as simply the latest in a never-ending stream of new business improvement ideas. According to McLean, workers sometimes dismiss these ideas as "flavors of the month."

Bussell has encountered the flavor-of-the-month attitude among workers. "People think [lean] is just the latest program, and it's going to go away," he says. "This isn't a program. It's a journey. And there's no end to it, because you're striving for perfection."

But some workers "are never going to get it," Bussell concedes. Called "anchor draggers" or "concrete heads" in the lean vernacular, these people either don't understand lean or don't want to make the changes it requires. Instead of firing talented anchor draggers, Medtronic Xomed moves them to positions that won't affect the company's lean initiatives.

Talented employees who are resistant to change can be the biggest impediments to establishing lean, according to DeLuzio. Thus, he notes, Toyota estimates that companies will have to change 10% of their workforce—including people in senior management—to implement lean effectively. "But companies typically don't do that," he says. "So these people end up staying around and jeopardizing the whole process."

Tracking Wasteful Activity

At some companies, however, many workers may no longer be required after the arrival of lean, which often reduces the amount of activity needed to manufacture a certain amount of products. Just ask Jeff Hamelink, who sought a way to slash the amount of non-value-adding activity at Stealth Manufacturing Inc. (Savage, MN), a contract manufacturing firm that works with medical device companies.

According to Hamelink, the firm's owner, the first step was tracking the amount of time plant employees spent on activities other than part manufacturing. Industrial scoreboards provided such data, but only in the form of hard-copy reports. Hamelink wasn't interested in such "after-the-fact" data. "I want to know what's happening today and what I can do to fix it today," he says.

Working with an industrial sign manufacturer, Hamelink came up with a device he calls the Scoreboard. Measuring 18 in. high by 42 in. wide, the Scoreboard displays the accumulated downtime of a machine or line during the course of a day. During production, the Scoreboard builds a library of optimum cycle times for different jobs. Using these data, software developed by Hamelink determines accumulated downtime by calculating the difference between the normal cycle time and total elapsed time during the workday.

Besides using the Scoreboard in his own plant, Hamelink is offering it to other companies. At one plant, he notes, accumulated downtime readings and the resulting analysis of shop-floor operations helped reduce non-value-adding time so successfully that the user believes the firm can complete in a four-day work week the production that used to take five full days.

At Stealth Manufacturing, meanwhile, Hamelink says the Scoreboard and other lean initiatives have reduced the number of shop-floor employees from 36 to 11, while output has remained about the same. This may sound good to some corporate executives, but DeLuzio sees a danger in viewing lean as a downsizing exercise. "Once your people know you want to do lean just to take heads out, you get no buy-in at all," he cautions. In fact, he adds, one of his clients is failing in implementation because management sees lean simply as a method for reducing the firm's head count.

Instead, DeLuzio tells clients to view and sell lean as a process for producing profitable growth. Coté agrees, stressing that companies need a growth strategy that employs the time, people, machinery, and floor space freed up by a lean transformation. "Since you're going to have excess capacity, your sales and marketing people have to get out there and start selling," he says.

Lean Outside Your Walls

As envisioned by proponents like Coté, a lean transformation should encompass all the companies that share the value stream for a particular product. But according to McLean, The Tech Group has had trouble establishing lean partnerships with customers and suppliers. What's more, McLean says he has heard the same story from other contract manufacturers.

What's the problem? McLean notes that most businesses are set up with a traditional ordering system. But pull production requires sophisticated communications tools such as on-line electronic systems. "We haven't seen too many customers that are anxious to jump into that arena," McLean says. "It typically means a pretty big change to their systems, and they don't see enough benefit to make radical changes to accommodate it."

Moreover, some customers probably want upstream companies to carry extra inventory that can be quickly tapped to help meet unexpected surges in demand. "They'd like to have inventory sitting here at our cost," McLean says. "And to be honest, we're probably no better with our suppliers."

So how do you sell lean to your value-stream partners? Show them how lean will benefit them, Coté advises. For example, tell customers that some of the savings from a pull system will be passed on to them in the form of lower prices. Eager to share in such savings, Medtronic Xomed has established pull systems with more than

50 suppliers. These suppliers produce and send products based on spreadsheets from Medtronic that show what's being sold and consumed at the company, Bussell explains.

Impressed by the on-time delivery record and product quality of its lean suppliers, Medtronic Xomed is encouraging more suppliers to adopt the practice. In some cases, the company brings in the presidents of supplier firms to show off the benefits of running a lean operation.

On the supplier side, meanwhile, Parker Hannifin Corp. has developed pull systems with a number of OEMs. Larger OEMs have considerable lean experience, so they understand the value of a pull relationship with their supplier community, says Jan Santerre, Parker Hannifin's vice president of quality and lean enterprise.

On the other hand, some of the supplier's smaller customers still have a more traditional view of manufacturing. "They'll say, 'Yeah, we understand. But we still want you to keep three weeks of material on your shop floor,'" says Santerre. To these companies, Parker Hannifin stresses that minimizing inventory lowers costs, resulting in less-expensive products for its customers.

Besides reducing Parker Hannifin's inventory by about 20%, lean has helped the company maintain greater than 90% on-time delivery by slashing lead times. "If the customer wants something tomorrow, shorter lead times give us a much better chance to provide that [product] when the customer wants it," Santerre says.

Impressive Results

At Medtronic Xomed, the benefits have been impressive. According to Bussell, some of the results of the company's lean efforts between 2000 and 2003 have included:

- A reduction in total production lead time in the Jacksonville facility of from 253 days to 129 days.
- An improvement in on-time delivery of from 85 to 96%.
- A 38% reduction in cost of shipped product.
- A 40% increase in productivity per employee based on annual sales.
- A 40% reduction in defective parts per million received by customers.
- A 50% reduction in plant floor space.
- A 57% reduction in rework.
- A 85% reduction in scrap.
- A 97% reduction in manufacturing cycle time.

Despite these results, the company has no plans to rest on its laurels. "As you get deeper into lean, you have to maintain a healthy dissatisfaction with where you are," Bussell explains.

But that's not the attitude at all firms. Ignoring lean's kaizen principle of continuous improvement, some companies conclude that they've "done lean" after seeing some initial improvements, according to DeLuzio. "They get that first 40% [improvement], but don't challenge themselves and say, 'How can I make that 400%?' So they leave a lot [of opportunities] on the table."