8 Answers to Your Lean Questions

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The phrase "lean manufacturing" is so ubiquitous, you might be embarrassed to ask what it really means. Let us ask the questions for you.

You've seen presentations on it. You've heard your peers talk about it and your customers push it. Your competitors have splashed it on their brochure and website, and you've probably Googled it. *Lean manufacturing*. It's the religion of the industrial sector—everyone has an opinion and a definition.

Put simply, lean manufacturing is a method of improving your processes so that you are creating more value with less work. "If you're not doing something to add value, you are creating waste," said Theodore Schorn, general manager of corporate quality, Enkei Corp., Columbus, Ind. "If you want to save money, you can benefit from lean manufacturing."

While "lean manufacturing" is really a generic term for improving the efficiency of a plant, engineers have developed distinct systems and tools that describe specific techniques for achieving better efficiency, each with their own labels, terminologies and measuring systems. Many in the industry agree that modern lean manufacturing philosophy is based on the Toyota Production System, which some argue was inspired by Henry Ford and his assembly line.

Various lean experts will point to value-stream mapping, 5-S initiatives, kaizen events, and other tools to achieve a lean company. But whatever the method, most will tell you the basic tenets are the same: eliminate waste and streamline product flow.

"You can do lean manufacturing without the jargon," said Frank Peters, associate professor of manufacturing/industrial engineering at Iowa State Univ., Ames, Iowa. "It just takes the effort of defining your facility's flow path and identifying where the delays are."

Use the following answers to frequently asked questions about lean, and take the mystery out of manufactu

1 Why would my plant want to go lean?

The benefits of lean manufacturing in high volume shops are relatively obvious because the tasks are repetitive. It can be more difficult to see why lean would be useful in metalcasting facilities that produce a variety of parts in low to medium volumes on any given day.

"In some businesses that have batch operations, it is hard to make an assembly line. It's not easy to connect all separate processes feeding into the main one," said Jay McCreary, partner at Flow Vision, Dillon, Colo., a lean consulting firm. "A lot of people in the metalcasting industry view metalcasting as a black art. But it's not a black art, it's just a manufacturing process with predictable causes and effects."

McCreary likened starting a lean program to metalcasters giving themselves their own stimulus check. One of the goals of lean is to eliminate inventory, which ties up cash flow. Inventory on your shop floor is an investment your company has made that won't be returned until the customer pays for its delivery. More inventory sitting in the shop means more money tied up in the process and less money available for regular operation costs or capital investments.

"If you had $20 million in inventory and eliminated $10 million of it, that's cash flow for the metalcasters's pocket," McCreary said. "Everybody's looking for a bailout right now. Well if you want cash, realize that you have it invested in your own factory. There's your bailout."

Applying lean initiatives to your facility also can help improve quality, safety, lead times and efficiency. Trimming the excess out of the metalcasting process reveals hiccups in your organization that routinely lead to errors and downtime. In a lean operation, members of your organization can investigate the root causes.

For example, say castings are piling up behind a trim press in a permanent mold facility. In a lean operation, this will be clear, whereas in a non-lean operation, the buildup of castings is assumed to be part of the proper work flow. Once the visual determination of a bottleneck has been made in a lean operation, management can begin asking why it has occurred.

2 What are signs that we need to lean our processes?

Piles of cores or castings and a constricted cash flow are two good signs that your company would benefit from lean manufacturing. Inventory is one of the primary waste products lean is meant to eliminate. Not only does excess inventory tie up cash flow, it also masks flaws in the process.

"Some look at inventory as a friend, but it may hide a lot of problems in the shop," said Paul Mikkola, retired president of Metal Casting Technologies, Milford, N.H. "Perhaps there are bottlenecks or a lack of preventive maintenance in the operation."

McCreary suggested that companies look at their inventory turns, or how many times their investment is turned over per amount of goods sold. Plants with an inventory turn of less than 10 can benefit from a lean initiative. For example, a company with $150 million in revenue may have $100 million invested in cost of goods sold, including all the material, labor, and overhead costs related to production. If there is $25 million inventory, divide that into $100 million cost of goods sold. This is the number of times the inventory turns over per amount of goods sold in a year (four times). The inventory in this shop, therefore, is equal to three months of production.

"A lot of inventory means there is a lot of opportunity to lean a factory out," McCreary said.

Your shop's typical lead time is a second area to examine when deciding whether to implement lean techniques. "Normal lead times are weeks, but if you look at the amount of labor hours that actually go into a product, it's only several hours up to a day," McCreary said. "The rest of the time the product is just sitting around waiting for someone else to do something." According to McCreary, lead times that are more than three times labor hours signal a need for a lean intervention.

Poor productivity rates, or productivity rates that don't improve year to year, are another sign of a wasteful operation. Peters pointed to incentive systems that are based on production per month as a neon sign announcing that productivity is miscalculated at the shop. "Incentivizing based on tons per month goes against the whole idea of trimming out waste," he said. "If you must incentivize, do it based on castings needed today rather than tons per month."

A casting facility with piles of work-in-progress cores and castings behind machines and in walkways is crying out for an organization initiative based on product flow. Peters pointed out that in nobake facilities, the cope and drag parts of the mold often are built in one area of the shop while the cores—produced in the same process—are built in a separate part of the building. "Cores should be considered another mold piece and made in the same room as the cope and drag," Peters said. "Alienating the coreroom turns into inventory build-up. [It's like making] a whole bunch

Resources: Your Peers

Once you start, you're never done implementing lean manufacturing into your plant's operations. Likewise, you'll probably never learn all there is to know about lean manufacturing. Join the conversation about lean currently in progress among the Foundry and Diecaster Network on LinkedIn.com. To link, go to our website www.modern-casting.com.

3 How do we start leaning our operation?

You may know that your shop could use some lean initiatives, but the piles of cores and castings, labyrinth of departments and building additions, and burden of finding the time to make changes can be overwhelming. One of the hardest parts of a lean program is actually starting it. Following are some tips to launching your lean masterpiece.

Plot the flow of product, from when it is ordered to when it is delivered. Keep track of how much time it takes to move through every step of the process. "Any time a part sits idle, that's a waste," Mikkola said.

Determine how much inventory is on the plant floor. McCreary suggested calculating your inventory turns, which is how many times your investment in inventory is turned over per amount of goods sold. This tells you how many months of production on your shop floor have not been paid for yet. "Inventory is all up front investment by the metalcasting facility," McCreary said.

Pick a place to start. Eliminating the biggest pile of inventory usually is where you will see your biggest return on investment. "Go to where the money is," McCreary said. "Grinding areas are places where castings tend to pile up. That's the process closest to the customer. Big picture, you want to work backwards from the customer, without leaving a big hole in the flow in the middle of the plant."

Establish a goal and revisit. Goals can be tracked by productivity, lead times, equipment efficiency, etc. The important thing is to set a goal and, once it is met, raise the bar a little higher for continuous improvement.

Implement changes quickly. For immediate impact, establish the new system using lean tools within three, six or nine months, according to McCreary. "If you don't do it fast, people start getting defensive about the changes," he said. "Don't give them time to fight it."

Resources: Books

Paul Mikkola, retired president of Metal Casting Technologies, recommends reading the business novel *The*

- *Goal: A Process of Ongoing Development* by Eliyahu M. Goldratt for lean inspiration.

Other books:

- *The Toyota Way* by Jeffrey Liker
- *Going Lean* by Stephen Ruffa
- *Lean Manufacturing Systems and Cell Design* by J.T. Black and Steve Hunter.

4 Who should manage the leaning of our operation?

So you know you want to go lean, but you're not sure which direction to take. Do you hire a lean consultant to guide you through the process, or do you designate someone in-house to lead the charge? Both options have their advantages and disadvantages.

Lean consultants have the experience and training to implement lean techniques. A few even have specific experience working with metalcasting facilities. However, they can be expensive and aren't in the facility day after day to oversee projects.

"Every company is different," McCreary said. "Some can drive the changes required to implement lean on their own. Others need a lean consultant as a partner to get the maximum benefit for the least cost."

Mikkola suggested trying to implement lean on your own before hiring a consulting firm. "Start on your own with the basic principles and see what barriers you run into," he said. "If you find you need a more sophisticated way to measure your productivity or process flow, then you might consider involving a lean consultant."

Peters said he knows some companies have found success with lean consultants but suggested considering another route toward lean manufacturing—hiring a manufacturing engineer full-time who can direct the organization of the plant's operations for less money.

"Manufacturing engineers can use their educational background and experience in improving process and product flow and apply it to the metalcasting facility," Peters said. "It might not necessarily be termed 'lean,' but the common sense of flow manufacturing behind it is the same. Hiring someone on staff means the person in charge of lean is there 52 weeks out of the year, rather than every six weeks or so."

No matter whether you are using a lean consultant or someone on staff, full company-wide support is imperative in making the changes work. Management will have to fully support the lean leader or "champion" in lean projects, and employees will have to be convinced to implement the changes wholeheartedly.

"Shop floor personnel like having mountains of work in from of them and get really nervous when you take that pile from them," McCreary said. "One of the major steps will be to convert them to the lean idea of having only one piece in front of you to finish, trusting that once that is done, another piece will be waiting."

5 What are some examples of successful lean projects?

Lean manufacturing is an ongoing process, but everyone has to start somewhere. Following is a look at successful lean projects implemented by two U.S. metalcasters.

Eagle Alloy Inc.

John Workman, Eagle Alloy Inc., Muskegon, Mich., would rather talk about his company's organization-wide leaning methods than a single project, but when pressed, he started at the end.

"In lean techniques, you typically start at the back end. If you expedite that, you can start pulling from the other departments," he said. "If you started at the beginning, you'd be pushing too hard."

So that's what Eagle did, first leaning its inspection and packing processes. Previously, the company would place its castings in a container after blast, inspect them, then sort them according to which parts needed to be weld repaired and which could be sent off as is. Welded parts then were placed in another container for a separate operator to pencil grind the welds. The castings would then be put in a final container for shipping.

To better the work flow, Eagle installed an inspection cell with the help of lean manufacturing consultant CQD Consulting Lean Systems. Now, the parts are inspected, placed on a conveyor, welded or ground if necessary and placed in a shipping container when the process is completed.

"It's a one stop process, whereas before it was four stops," Workman said.

The way Workman described it, the project was relatively simple, requiring only the installation of a conveyor belt with welding and grinding booths and inspection stations around it. The real leap was buying into lean manufacturing company-wide.

"Our philosophy here at Eagle was to create the best service in the industry," Workman said. "We felt we could compete with low-cost countries in service and lead time, whereas it was difficult on price. Our goal was to have the lowest lead times in the industry."

After finishing the inspection room lean project, Eagle has continued backward through its processes to the cleaning room and molding and core making. All together, the projects have allowed the company to offer lead times of no more than five weeks, and it can produce a finished casting in three or four days if absolutely necessary.

"Our productivity improved by 15% throughout the shop," Workman said.

Buck Co.

The ferrous castings at green sand job shop Buck Co., Quarryville, Pa., were piled up so high in the finishing room, no one could tell how many were still works in progress.

The facility was moving its castings through the plant in batches; after they came out of shakeout, they were placed in a bin and taken to the finishing room, where they sat and awaited further operations. Each employee would then remove the castings one by one, perform their prescribed operation and return them to a bin to be moved to the next operation. This resulted in excess handling and made it difficult to determine visually whether the workers were in compliance with their goals.

To improve operations, Buck engaged in value stream mapping, a process of tracking the product flow through the facility and finding bottlenecks and other areas of improvement, or "kaizen bursts."

"[Value stream mapping] ends the kamikaze approach to lean, which means you shotgun kaizen processes all over the plant without seeing the overall effect on the bottom line," Sullivan said.

Buck's first value stream was the ferrous casting side of the operation. The map showed various areas of possible improvement in the finishing room. In order to lean the areas, the company arranged the room in a cellular format and now maintains flow by balancing the the work content performed on each metal casting.

"We identify the work content in the parts and supply them to the cell [intermittently] so they flow efficiently," said Jeff Barr, the company's lean manufacturer manager. "Each cell is built around [several] operations. When a supervisor gets one part, if he sees one operation that is behind, say regrinding, he's not going to put a part through that will require that same operation."

Since completing all of the opportunities for improvement on the first value stream map, Buck's ferrous finishing department has reduced lead times from 14.5 to 5.5 days and reduced labor hours per ton of castings processed by more than 35%. It now has created a new map and will go through the process again, with the goal of improving productivity b

Resources: *MODERN CASTING* Articles

The following articles highlight methods for lean manufacturing in metalcasting facilities.

- "Bucking Up to Go Lean,"October 2006, p. 18.
- "American Aerospace Catches Fire," July 2008, p. 16.
- "Best Cleaning and Finishing Operations—2001," January 2001, p. 32.

Buck Co. arranged its ferrous finishing room in cells to increase throughput.

6 What is 5-S and what does it have to do with lean?

Some engineers in the industry believe 5S should be the first thing done when implementing lean in a manufacturing plant. Others disagree and believe that 5-S is only one tool in the lean manufacturing toolbox. Whatever your belief, 5-S projects can be helpful when leaning your operations, and they're not that difficult to perform. If you can clean out your garage, you can perform a 5-S project. Following are the steps (although the original s-words were Japanese, various English equivalents have been developed):

Sort—The first step is to go through your plant and remove all of the items you don't need. Ted Schorn, general manager of corporate quality, Enkei Corp., Columbus, Ind., said this is more difficult than it sounds. While it seems as simple as throwing out old stuff, plant managers tend to hang onto things on the slight chance they might have a need for them down the road.

Streamline—Organize the remaining items in the plant after you have eliminated everything that's superfluous. Tools should be given a specific place at each workstation. Many lean engineers suggest painting silhouettes where the tools should be hanging, resulting in what looks like a crime scene after a mass murder of wrenches.

Scrub—Clean up the area. Again, Schorn said this is a common sense aspect of lean manufacturing that continues to be neglected for the wrong reasons. The metalcasting industry has long been considered a dirty, disorganized black art, and a certain machismo persists that keeps plants from cleaning up all the sand around their workstations.

A manufacturing process that is left to its own devices will move away from being lean.

Standardize—Every action in the manufacturing process should be repeatable and operated on a repeating schedule. Once a worker's space is clear of excess materials, the needed materials are organized and the area is clean, he or she should have a set order of operations that can be performed over and over in a given period of time.

Sustain—Lean manufacturing never ends. One project does not a lean operation make. By definition, a manufacturing process that is left to its own devices will move away from being lean. Schorn said it takes a management philosophy that is committed to lean operations to make it work.

7 What do all these strange terms mean?

The terminology associated with lean manufacturing can sometimes sound like a foreign language. In some cases, the terminology is a foreign language. Use the following glossary to translate lean speak.

Andon: a system to notify management, maintenance and other workers of a quality or process problem.

Fixed Repeating Schedule: a production schedule which is unchanging and repeated daily or over a longer period, such as two weeks or a month. If the schedule can be implemented, then economies of repetition start to become evident and suppliers and customers can be assured in their own activity scheduling.

Genchi Genbutsu: a Japanese term meaning "go and see for yourself." The notion is that rather than simply hear or read about a problem and make a suggestion for improvement, one should go to its direct location and experience the situation firsthand.

Just-In-Time: an inventory strategy implemented to improve the return on investment of a business by reducing in-process inventory and its associated carrying costs.

Kaizen: a Japanese philosophy that focuses on continuous improvement throughout all aspects of life. When applied to the workplace, kaizen activities continually improve all functions of a business, from manufacturing to management and from the CEO to the shop floor workers.

Kanban: a signaling system to trigger action in just-in-time manufacturing. Kanban traditionally uses cards to signal the need for an item.

Muda: a general Japanese term for activity that is wasteful and doesn't add value or is unproductive.

Mura: a general Japanese term for unevenness, inconsistency in physical matter or human spiritual condition.

Muri: a Japanese term for overburden, unreasonableness or absurdity.

Single Minute Exchange of Die: provides a rapid and efficient way of converting a manufacturing process from the current product to the next product. This rapid changeover is key to reducing production lot sizes and thereby improving flow.

Takt Time: the rate at which a part needs to be completed in order to meet customer demand.

Value-Stream Mapping: a visual method of charting your facility's inventories. Management should go out into the plant, see how

castings are in each work area and time how long it takes them to move to the next area.

Work Cell: a clustered arrangement of resources in a manufacturing environment to improve the quality, speed and cost of the process.

5-S: a method for organizing a workplace and keeping it organized. The key targets of 5-S are workplace morale, safety and efficiency.

5 Whys: a question-asking method that requires continually asking why a given answer to a defect or problem is so until the root cause is determined. A sixth, seventh or eigth question can be asked if needed. Example: Castings are piling up behind a trim press. Why? Because some parts need to be run through the press a second time to remove all the flashing. Why? Because the machine's blades aren't that sharp. Why? They haven't been replaced or reconditioned. Why not? It isn't part of the regular preventive maintenance plan. Solution: replace the blades and set a schedule for regularly maintaining that machine.

8 What are the wastes to eliminate?

The phrase lean manufacturing in its simplest sense is self-explanatory. (That may be part of the problem—everyone has decided to explain it to him or herself.)

A lean operation is one that has trimmed away its fat, which in most circles is called waste. Lean gurus attempt to pinpoint the different types of waste that one finds in a manufacturing facility so that they may eliminate them, or trim them away. Some cite seven types of waste, some believe there are eight. Following is a look at seven wastes that you might look to eliminate in your facility to become a leaner operation.

Overproduction—According to Fred Sanders, Intermet Corp., Fort Worth, Texas, overproduction is the most critical of the wastes lean manufacturing tries to eliminate. Manufacturers make extra product as a cushion, but in reality the excess merely hides process shortcomings.

Motion—Every movement your floor workers make takes time and energy. Creating cellular workspaces with repeatable activity schedules allows employees to economize those motions.

Correction—Errors upstream create more work downstream in the form of necessary corrections. Fixing these problems before they start is more efficient than fixing them after the fact. For example, your molding room might be able to eliminate a finishing step by doing its job better.

Waiting—Employee waiting, be it due to a down machine or another process in the facility lagging behind, constitutes a waste that must be eliminated. One way to eliminate waiting is to cross-train employees. If one worker is burying someone downstream from him/her, adequate cross-training allows them to step away from their work station and assist in the other activity. Proper preventive maintenance can reduce waiting due to down equipment.

Inventory—Inventory can be hiding throughout your processes, not just in the shipping department. Excess cores and castings in process constitute inventory, as well, and should be minimized in order to lean operations.

Transportation—Like employee motion, taking parts from point A to point B requires additional time and effort, which leads to increased costs and more works-in-process. Cellular and linear plant layout can minimize wasted transportation.

Extra Processing—Like correction, extra processing can be eliminated upstream from its actual occurrence. Sanders asked why permanent mold facilities assume they have to put their castings on a trim press to remove the flash. "Why not just eliminate the flash during production?" he asked.

Grinding beyond that which is required by the customer requirements is also a waste of extra processing. This waste is often related to the poor job of visual inspection in determining if a castir