The starting point for lean manufacturing:

Achieving basic stability

Art Smalley

Lean production has dramatically lifted the competitiveness of many manufacturing companies and the value they deliver to customers.

Encouraging news surfaces almost daily about firms embracing the central tenents of lean and driving them into nonproduction areas of the enterprise such as product development, purchasing, supplier chain management, and engineering for example.

Despite these triumphs, many firms I visit are stuck in first gear on their initial lean efforts. They are trying to create flow but can't somehow get traction. There are many reasons for this lack of progress. Insufficient leadership, resources, or commitment are a few of the most common. But an overlooked and recurring pitfall that I'm seeing more often is a lack of 'basic stability' in manufacturing operations. Quite simply, processes can't flow because key pieces of equipment are broken down.

Toyota's early struggles

Taiichi Ohno, the chief architect of lean manufacturing, developed its core elements at Toyota Motor Corporation in Japan in the period between 1950 and 1955. During this five-year learning period, Ohno conducted experiments in the machine intensive production shops that he managed. Key concepts such as takt time, process flow, standardised work, single minute exchange of die, and basic pull system mechanics were all tested and worked out under his supervision.

Unfortunately very little was written down about what Ohno did. Today we only hear of the success stories about lean and the impressive nature of the Toyota Production System. From interviews and conversations I've had with retired Toyota executives, I get a different perspective about how difficult it was to establish the basic

tenents of lean. These comments are typical reflections:

• "Our die changeover process was completely terrible, and took anywhere from one to two shifts to complete. Then the initial part quality was never any good;"
• "Our precision machine tools were all from Germany or the United States. Our uptime averaged 50-60% at best and we struggled with the foreign documentation and delivery of spare parts from overseas;"
• "We never had the production parts that we needed when we needed them. Materials were scarce and we always seemed to make too much of the wrong thing;"
• "Our employees wanted to only work one machine and work at their own pace. Virtual mountains of WIP existed between processes as machine speeds were not synchronised to customer demand (takt time) at all."

Lean implementers should draw encouragement from these early struggles by Toyota. No one ever said that making radical change and improvement was an easy process. What Toyota learned the hard way is that in the beginning of a transformation you need lots of basic stability, before you can succeed with the more sophisticated elements of lean.

Lean Implementation Sequence

Toyota has been reluctant to publish or even endorse what they consider to be the right way to implement lean. Their reluctance is well taken given our inherent human tendency to look for an easy way out or cut and paste answers from elsewhere. Toyota executives have always maintained that TPS/lean is a system of thinking and that practitioner's can best 'learn by doing'.

When pressed, however, veterans of Toyota comment that certain preconditions are needed for a lean implementation to proceed smoothly. These include relatively few problems in equipment uptime, available materials with few defects, and strong supervision at the production line level. And these are precisely the problems that I see manufacturers still struggling with today.

Obviously if we waited for all these problems to be solved, we'd never get started.

The act of implementing lean elements will eliminate some of these problems. Hence, we have an inherent sequential iteration problem — where do you begin?

Toyota UK

A clue comes from how Toyota works with new suppliers overseas. Toyota production consultants usually follow (but not dogmatically) an implementation framework of helping to establish basic stability, improving process flow, pacing work to takt time, developing pull systems, and levelling production. Actual implementation order depends upon the current state and Ohno's words from 50 years ago advising all to 'start from your greatest point of need'. For many manufacturers, this means more work in basic stability before trying to achieve the perfect flow.

Basic stability

So what is basic stability? In the simplest sense this implies general predictability and consistent availability in terms of manpower, machines, materials, and methods — the 4Ms. Under each of these basic building blocks of manufacturing, Toyota tries to establish a consistent and predictable process before getting too far down the road with the latter elements of flow and takt time.

The reason is simple. Without fundamental items like machine uptime or human resources in place you cannot run a production line and achieve perfect flow or pace to takt time. For example, producing to takt time and achieving perfect flow assumes a sufficient level of machine uptime is in place. The same is true for the rest of the 4Ms.

How do you know if you have enough stability in operations to proceed with flow? The answer depends upon your ability to meet a few key requirements:

• Do you have enough machine uptime to produce customer demand?
• Do you have enough material on hand every day to meet your production needs?
• Do you have enough trained employees on hand to handle the current processes?
• Do you have work methods defined such as basic work instructions or standards in place?

If the answer is emphatically 'no' to any of these questions, stop and fix the problem before proceeding. Attempting to flow product exactly to customer demand with untrained employees, poor supervision, or little inventory in place is a recipe for disaster.

Conversely, you should not fall into the trap of using these questions as excuses for not moving forward.

The paint shop

Lean is second nature to Toyota employees

Remember, you do not need perfect uptime in order to meet customer demand. If, for example, assembly takt time is 60 seconds and your upstream machine process cycle time is 30 seconds, then you only need some inventory to act as a buffer and slightly better than 50% uptime to begin establishing a better production flow paced to takt time. The same basic common sense applies to the other 4Ms as well. If the line needs eight people to run and you consistently only have six people trained to do the job, then you have a basic stability problem.

Achieving stability

To achieve basic stability, you should concentrate on four key elements corresponding to the 4Ms.

1. Manpower

Basic stability in lean starts with a well trained workforce. Fortunately employees tend to know their jobs very well or we would all be in serious trouble. However, Toyota in the 1950s learned some basic techniques about supervision in production and how to further improve the skills and capability of work teams. Specifically, they adopted an industrial training program that the US used during WWII called Training Within Industry (TWI). It has three specific job training components for production supervisors — job instruction, job methods, and job relations. Each component was a ten hour course that taught practical supervision skills.

Job instruction (JI) taught supervisors how to plan for the correct resources they would need in production, how to break down jobs for instruction, and how to teach people safely, correctly, and conscientiously. Job methods (JM) taught supervisors how to analyse jobs and make simple improvements in their realm of control. Every activity was considered for improvement. Supervisors learned to question why an activity was done this way, and if it could be eliminated, combined with something else, rearranged, or simplified.

Job relations (JR) taught supervisors to treat people as individuals and solve basic human related problems in production rather than to ignore them.

Taken together these three courses help supervisors create a basic routine, discipline, and sense of fairness in work teams. Fifty years later, these same TWI courses and fundamental tenents constitute the basis for training supervisors and work teams in Toyota.

2. Machines

You do not need equipment with perfect uptime, but you must know your customer demand, the capacity of your process, and the actual average output.

Toyota uses a basic document called the process capacity sheet to measure the true output potential of a process during a typical shift.

If you have theoretical capacity as well as demonstrated capacity to meet customer demand, then there is no problem. It is only when you have no demonstrated capacity to meet demand that you have a basic machine stability problem. For example, if customer demand is 700 units per shift and your actual output is only 500 units despite having the capacity for 1,000, then you need more availability.

In cases such as these Ohno actually had people stand at the problem machine for the entire eight hour shift and record the production plan versus actual amount in small increments, such as 15 minutes to one hour. At the end of the shift, all the losses and the actual reasons why were identified in a Pareto chart. Simple and quick meetings were convened if necessary and improvement plans put into place. This is the quintessential respect for 'genba' (Japanese for actual work site) in Toyota.

3. Materials

In general the goal of lean is to reduce waste and shorten the timeline from when an order is received until the time it is produced. Normally this requires the reduction of inventory in the value stream. If you suffer from basic instability, however, you might need to increase inventory in the short term in some places or in some instances.

The reason is because with some processes you can flow production one by one or in very small amounts. For batch processes, however, some amount of inventory is required to cover for the time when other parts are running, or tools are being changed.

The amount of inventory you need is composed of what Toyota calls cycle stock (the amount of inventory to cover average demand and the lead time to replenish it), buffer stock (inventory to cover variations that might exist in your downstream or customer demand), and safety stock (inventory to cover the losses such as scrap or downtime that you currently have). Failure to account for this necessary buffer and safety stock in an unstable environment will actually harm the production line efficiency.

Two pieces of advice that I received in Toyota strike me on this topic. First, not all inventories are waste. Only inventory beyond what is needed to run the process is waste. Second, inventory often exists as a symptom of

The new Aygo from Toyota

2004 RAV4 model

a problem in the process. Solving the problem earns you the right to reduce the inventory.

3. Methods

Finally, achieving basic stability requires having standard methods for manufacturing. The key point here is the definition of a standard. The normal definition is that a standard is a rule or way to do things. The unintentional side effect is that people are not encouraged to question or change the rule. 'We do it this way because that is our company standard' is a phrase I often hear.

The definition of a standard in Toyota is slightly different. A standard is a 'rule or a basis for comparison.' A standard is nothing more than a tool to measure how we are doing something and refer to when we want to make a change. Lean thinking is about changing work methods in order to eliminate waste and make improvements. The standards are what we use to measure and compare our changes so that we know if the new way is better or not.

This improvement thinking is ingrained in all employees at Toyota from day one. Everyone is encouraged to make changes. However change is only implemented and maintained if it beats the old standard and, thus, is properly called Kaizen.

Summary

There are many other elements of basic stability in Toyota under each of these four headings. For instance, methods could be expanded to include Five S, visual control, the already famous standardised work chart, and other simple work management tools. And we could add a fifth M for metrics as well.

The final point is this: Like many of us today, Toyota once struggled mightily with establishing lean production. Along the way, it discovered that you often need a healthy dose of basic stability before you can advance to other elements of lean. Much like we need to crawl and walk before we can run, companies will often find that they need to improve their basic stability before perfecting flow and pull.

Land Cruiser

Glossary of terms

Takt time: *The desired time between units of production output, synchronised to customer demand.*
Process flow: *Relates to both material and information flows between customers and suppliers who work together in supply chains. Flow is aligning your speed to the customer takt.*
Standard work: *Where the method of doing the work has been planned and written in detail, and so performed the same each time.*
Single minute exchange of die (SMED): *The term used to represent the single minute exchange of die or setup time that can be counted in a single digit of minutes.*
Pull: *Make at the rate of customer demand, ie sell one make one.*
Kaizen: *Continuous improvement.*

Art Smalley is an expert specialising in the area of world class methods for operational improvement and has served numerous major companies around the world. Art was one of the first Americans to work for the Toyota Motor Corporation in Japan and spent nearly ten years both working and studying in Japan, learning lean manufacturing principles in the engine plant where Taiichi Ohno was the founding plant manager. During his time at Toyota, Art played an instrumental role in the development and transfer of both precision equipment and lean manufacturing methods to the company's overseas plants. In 2003 Art launched his own company Art of Lean, Inc and now divides his time serving a diverse base of manufacturing clients and many others in areas of operational performance improvement. In addition Art serves as senior faculty member and advisor to the Lean Enterprise Institute and its global affiliates delivering lectures to leading manufacturing executives around the world.

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