Lost in Translation? LEAN for High-Speed Manufacturing

Is LEAN another quality management fad whose time has come and gone? We don't think so. But in a high-speed manufacturing environment, a misguided application of LEAN principles can lead to disastrous results. In order to apply LEAN principles to high-speed manufacturing systems, special care must be used in the management of buffers, downtime and changeovers.

Introduction

Industry Week recently reported that fewer than half of executives are satisfied with their LEAN programs and only two percent of those who are seriously engaged in LEAN/Six Sigma are achieving world-class results.

While LEAN principles have produced truly impressive results in some manufacturing environments, their concepts are not universally applicable. High speed, continuous motion manufacturing systems respond differently to these concepts than do lower speed, more discrete operations. And not always in a positive way.

This paper explains how to adjust LEAN principles for optimal performance in your high-speed manufacturing environment.

LEAN: Not Made for You and Me

Manufacturing is a tough business. Assuming you're fortunate enough to develop a product people will actually pay for, you're confronted with all kinds of decisions in the maintenance and expansion of your product line. Underlying these critical decisions are the realities of the manufacturing processes. Labor, raw materials, machines, production schedules, automation and material flow must all be coordinated into a fluid system.

Once you've accomplished this herculean feat you may realize that you're not making enough money. "How is it that I am working so hard just to break even?" Your business has turned into a high performance sports car with its parking brake firmly engaged – lots of smoke and noise, but not much speed.

The problem is that most people don't achieve anything close to the results they wanted.

Getting better is more difficult still. The leaders of Toyota understood this and began developing a system to encourage process improvement in order to best use their finite resources and expand their limited market share. The Toyota Production System (TPS) is now, justifiably, famous in the automobile industry.

Other industry professionals took notice and began attempting to emulate Toyota's methods in the hopes of mirroring their success. Over time, TPS received more and more attention. In the late 1980's, quality engineer John Krafcik wrote an article for the Sloan Management Review entitled "*Triumph of the Lean Production System*", and in so doing, sparked a revolution.

Almost overnight terms like "value stream mapping" and *kanban* or "pull systems" became part of the new manufacturing vernacular.

Toyota continued its march to eliminate all forms of *mura* (unevenness), *muri* (overburden), and muda (waste). In contrast to other automakers' focus on big batch production, Toyota began to focus on improving the *system* of making cars. They rightfully proposed that if automobiles are manufactured with a minimum of customized effort from the workers and a minimum amount of waste in the process, the natural result will be a high quality vehicle produced at a very competitive price – higher quality does not necessarily cost more money.

These Lean principles can be extremely attractive to manufacturing professionals who are on the hunt for world-class results. The problem is that most people don't achieve anything close to the results they wanted.

LEAN, Culture & The Engineer's "Tools" Fixation

A leading reason for the poor results is that Lean is difficult to implement regardless of the speed of your line. Lean Manufacturing requires a cultural change. Most managers find affecting their company's culture extremely difficult because culture is collectively driven from many different sources. There is no cultural change machine to purchase. Because of the difficulty in "projectizing" cultural change, many companies break Lean Principles into discrete projects with independent "Lean Experts" who employ a single Lean Principle on a subsystem within the plant in the hopes of achieving holistic improvement. Sounds silly when you say it like that, doesn't it?

During a visit to any "Lean" facility you will see evidence of their efforts. Painted lines on the production floor, charts of key metrics on walls, and graphics indicating the location of tools will be visible. However, these visual cues do not always indicate that worker effort has been reduced, quality has been increased, or waste has been eliminated.

Lean manufacturing is an outcome, and while there will be visual indicators, the true indicators of Lean will be in the safety, quality, employee morale, customer satisfaction, and profitability of the line. Unfortunately, the inherent difficulty of creating a cultural shift isn't the only reason that most Lean efforts fail to deliver the desired results. It's just as critical to understand the differences between a high-speed manufacturing environment and the environment in which Lean was developed.

CASE STUDY

"Cereal" Killer - Understanding "Waste" of Movement

The first break from the tenets of classic Lean is the idea of designing out stops in the manufacturing process. The highly variable materials used in high speed manufacturing make it impossible to completely eliminate these stops.

Unlike the steel, glass, and rigid polymers used by automakers, high-speed manufacturers wrestle with corrugate, shrink wrap, and thin plastic. Even at six sigma levels, a stoppage will occur approximately every five hours. And with multiple failure modes for each machine in a system, it is unrealistic to expect to eradicate stoppages entirely.

The solution for the high-speed manufacturer is the utilization of a buffer. An analysis of the line will determine both the correct size of the buffer and its proper location in the manufacturing process.

For, example, a cereal manufacturer was implementing a new production system with Lean concepts. The intent was to get from raw material to finished product to a truck in approximately one hour versus the previous standard of almost eight hours. Based on their understanding of LEAN concepts, the project team hypothesized that the entire buffer between processing and packaging should be eliminated – the most significant delay in the system.

> Using the traditional definitions of waste can lead to non-lean results. A common form of waste is unnecessary movement of product. Distinguishing between a "good" buffer and unnecessary movement becomes the critical task.

All of the engineers around the room had a pained look on their faces as they considered this possibility. They knew it would not work, but needed to articulate this to the management team. With no buffer the process and packaging systems would be locked together. A problem of any type in either system would immediately be transmitted to the other. Waste would inescapably increase, and production would surely suffer.

The correct question for the project team was not "Do we need a buffer?" but rather "How much buffer do we need?" Any high speed manufacturer knows that material variance will inevitably lead to production stoppages.

Fortunately, the experience of the engineers prevented adopting a zero-buffer solution. Considerable gains were still made after detailed analysis of the process and packaging relationship. The buffer was designed to the right size, and the waste of the old design was significantly reduced.

CASE STUDY

Cars and Liquids Don't Mix

More important than an understanding of material variance is the application of product flow in a high-speed environment. It's possible to create a high-speed line that is too lean.

For low speed manufacturers such as Toyota, the product on the manufacturing line moves like a train. The natural result is that when a stoppage occurs, all the machines on the line must stop at the same time. This condition is used to identify the root cause of the problem in order to eliminate it.

However, for a high-speed manufacturer the root cause of most stoppages is known – highly variable materials. Forcing the entire line to stop every ten minutes to point this out will only hurt production.

As an example, a juice manufacturer was struggling with line performance. By happenstance, the manufacturer had ready access to Toyota experts from Japan to conduct an assessment and provide recommendations for improvement.

A *kaizen* event was planned at the facility. The juice manufacturer was quickly informed that it was out of step with best practices. The recommendations from the "Lean experts" were to close-couple the machines and eliminate all conveyors except what was necessary to move the product from one machine to the next. *This is perfectly in line with the application of Lean in a low-speed manufacturing environment*.

Fortunately, the juice manufacturer did not experiment with a no-conveyor manufacturing system. Line performance certainly would have suffered.

The reality of high-speed manufacturing is that micro stops occur throughout the course of a production run. Adding just enough buffer between machines allows operators to deal with a jam while the line continues to run. High-speed manufacturing systems use buffers like cars on the interstate. If you maintain enough of a distance, the car in front of you can slow down for a moment without causing you to change speed.

To function smoothly, a high-speed line needs a minimum amount of buffer. Calculating the necessary buffer is done by tracking Mean-Time-To-Recover, time analysis, or (more recently) use of simulations. This right-sized buffer allows the packaging line under normal conditions, which includes the normal amount of material variance, to function smoothly. The only time the high-speed line will stop with the correct buffer is when there is an abnormal condition.

Conclusion & Summary

So buffers are good, right? The truth is that we all work with finite resources. Space, money, time, and labor all constrain our businesses. Buffers cost money to purchase and then must be maintained, serviced and repaired. However, in a high-speed environment, these costs become minor compared to the cost of not utilizing the right-sized buffer.

Don't follow others down the path of manufacturing mediocrity by adopting a tools-based approach – or misinterpreting Lean. Rather, apply Lean with an understanding of its principles and your system. Only then will you realize the desired results of higher quality, reduced waste and reduced cost.