

# LEAN'S TRINITY



*Next generation lean means targeting time as waste*

BY PAUL D. ERICKSEN

PART ONE OF “LEAN’S TRINITY” in the October issue of *Industrial Engineer* (Page 38) described the supply chain transformation required to support an order fulfillment initiative that focused on reducing an organization’s reliance on forecasts. The organization, which we are calling The Division, wanted to expand its distribution options to big box stores, all while maintaining or increasing customer fill rates and reducing the need for raw, WIP and prebuilt finished goods inventories. The supply chain side of this build-to-demand initiative relied on reducing supplier lead-times.

The strategy was a success, as true supplier lead-times were reduced from an average of approximately 90 days to 14 days. Correspondingly, customer fill rates were maintained and increased; raw, WIP and finished goods inventories were lowered; and The Division increased its ability to capitalize on incremental demand. This made The Division’s entry into big box store distribution a resounding success. Unforecasted orders came in, The Division filled the orders, and profits rose exponentially.

All of these outcomes had been hoped for and, at least in some way, anticipated. But along the way, supplier performance metrics showed that the

initiative unexpectedly had achieved lean’s holy trinity: better prices, better quality and more on-time deliveries.

This welcome news puzzled me, The Division’s manager of supplier development. Back then, I had an inkling, but no firm conclusion, about how we had achieved such “magical” results. Now, part two will explain the unexpected outcomes’ implications for lean theory and practice, as initial events and later activities pointed the way toward what truly should be “next generation lean.”

### An unexpected journey indeed

The Division worked with University of Wisconsin-Madison professor Rajan Suri, founding director of the Center for Quick Response Manufacturing, to define lead-times that could be applied across The Division’s supplier base. True lead-times were defined as manufacturing critical-path times, or MCTs.

An MCT is the typical amount of calendar time from when a customer creates an order until the first piece of that order is delivered to the customer. Division supplier development’s work with its supplier base bore fruit, as MCTs were reduced from an average of about 90 days to 14 days.

However, just like most large original equipment manufacturers (OEMs), The Division tracked supplier performance, primarily focusing on the holy trinity of price, quality and on-time delivery. The numbers showed that as MCTs declined, the holy trinity improved. Examples of these improvements are shown in Figure 1. Initially, Division officials were uncertain. They didn’t know if the results correlated or if better metrics came because The Division was paying closer attention to major suppliers – a Hawthorne effect, in essence.

As MCT reduction work with a critical mass of suppliers brought forth results, other Division branches started noticing. They wanted the secret recipe for improving supplier performance, assuming, incorrectly, that The Division had targeted each measure of the trinity for improvement. After all, several years into the initiative divisional factories were reporting the highest supplier quality and on-time delivery performance in the entire corporation.

About that time a call came in from former colleague Bill Butterfield, then at Delphi Corp. He related something that Toyota Vice President of Supply Management Simon Nagota said at a Delphi supplier conference: “Time is the shadow of waste.”

## LEAN’S HOLY TRINITY

Figure 1. This figure shows percentage cost reductions as determined by supplier financial staff. Quality and delivery results are from OEM supplier performance tracking.

Commodity	MCT		% MCT reduction	% On-time delivery		As-delivered quality (DPPM)		% Cost reduction
	Before	After		Before	After	Before	After	
Blades	15 days	2 days	87	74	97	4,500	300	11
Knives	104 days	15 days	86	40	88	12,000	1,500	22
Hydraulic valves	141 days	10 days	93	40	98	50,000	1,500	14
Hydraulic motors	42 days	18 days	57	40	97	15,000	500	13
Wiring harnesses	32 days	2 days	94	43	99	3,000	500	20
Seat assemblies	25 days	5 days	80	40	95	50,000	500	16
Machined parts	22 days	10 days	55	99	99	300	300	12
Circuit boards	25 days	16 days	36	99	100	3,164	14	17

## lean's trinity

Based on this remarkable quote, The Division began to view MCT reduction in the context of lean theory and the Toyota Production System.

In fact, TPS strongly associates waste reduction (lean) with reducing lead-times. It is almost uncanny how the definition of MCT independently developed with Suri paralleled remarks from the legendary Taichi Ohno, the father of the Toyota Production System:

“All we are doing is looking at the timeline from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time by removing the non-value-added wastes.”

### The supplier development tool kit

After process mapping supplier part families and quantifying their MCTs, The Division's supplier development team used typical lean tools. The only difference was that the strategy focused on processing activities that would most reduce lead-time, which also tended to be the low-hanging fruit for process improvement.

Was this focus on maximizing MCT reduction the secret recipe to improved supplier performance? While an exciting thought, in reality the only concrete data came from The Division's order fulfillment initiative. Confirming and selling a premise of this magnitude would require far more case history experience.

Shortly after launching The Division's order fulfillment initiative I had been appointed to the board of directors for the Wisconsin Manufacturing Extension Partnership (WMEP). This federally subsidized national network of independent state-based centers provides low-cost improvement help to small and medium-sized manufacturers. The Division thought the WMEP could be a resource for its significant population of suppliers in Wisconsin.

A couple of years later, the WMEP

was working to develop systemwide lean expertise. New WMEP Executive Director Mike Klonsinski wanted a supply chain improvement product valued by OEMs. He knew about The Division's resounding success in reducing MCTs and wanted a standard process that could deliver similar results.

WMEP developed this product, Accelerate, to reduce supplier waste and improve supplier performance as measured by their OEM customers. In this way, WMEP and other MEP centers aimed to garner OEM endorsements, making it easier to get MEP-affiliated manufacturers into OEM supply chains.

Accelerate is based on straightforward thinking, as all lean techniques should be. Under Accelerate, MEP manufacturing specialists help clients develop a current state value stream map to quantify the current state MCT. Lean techniques employed to project a more efficient future state are applied to sections of the value stream that likely will reduce MCTs the most; i.e., the non-value-added time. Accelerate then measures the difference between the current and future state MCTs to calibrate overall waste elimination.

For three years, three OEMs pilot-tested Accelerate with their Wisconsin-based suppliers. Results paralleled those seen by The Division. Namely, large reductions in supplier MCT were associated with improvements in the quality, on-time delivery and price as measured by their customers, the OEMs. This provided more proof that reducing MCTs could be a unifying factor in lean thinking and strategy in lean application.

I retired a few years after The Division's big box merchandising launch. A couple of years later, Klonsinski suggested that I might be interested in seeing the accomplishments of WMEP's ongoing Accelerate initiative, offering me a job to manage a WMEP Accelerate-based Department of Defense supply chain program. I accepted.

In brief, here is what WMEP had accomplished by then:

- Twenty-one OEMs had been engaged.
- For these 21 OEMs, 381 supplier projects had been delivered.
- Nineteen different state MEP centers had provided project support for these 381 projects.
- The average MCT reduction across supplier projects was 44 percent, with consistent reductions regardless of OEM, industry or MEP center.

Supplier performance improvements associated with these projects were along the following lines, as outlined in the public document “Executive Summary: DLA Contract No0140-01-C-L622 Accelerating Deployment of Defense Contracts through Improved Manufacturing Supply Chain Performance”:

- An average of \$75,000 in annual supplier direct cost reduction
- An average 56 percent reduction in supplier inventory (raw, WIP and finished product) with a \$32,900 associated annual carrying cost savings
- An average reduction of more than \$100,000 in annual supplier quality-related costs

One OEM that participated in the Defense Department program reported that its suppliers that participated in the program exhibited a 56 percent improvement in on-time delivery and a 26 percent improvement in as-delivered quality. Again, this parallels the lead-time related performance improvement experience of suppliers to The Division.

Combining The Division's results with the WMEP Accelerate projects yields a fairly extensive and convincing body of data supporting the idea that using lean activities primarily to reduce MCTs delivers meaningful business impacts. But

what does this mean for lean and how it needs to evolve?

## Next generation lean

Stories abound about how manufacturers are not satisfied with the results of their lean initiatives. The difficult truth is that while lean makes a lot of sense and is conceptually sound, it hasn't gained wide acceptance from the corporate executive community, particularly those in finance. All too often, lean initiatives fail to find their way onto executive level financial exhibits. Most of the time, lean activities are done in isolation, which dilutes, instead of compounding, their overall impact. If executives don't see that a program affects the financial metrics on which they are measured, that initiative probably won't gain their strong support.

The Division's executives understood that maintaining or improving customer fill rates while reducing raw, WIP and finished goods inventory required reducing supplier MCTs. All four of these metrics are executive-level financial exhibits. This gave supply management a seat at the table when the credit for savings related to inventory reduction was divided. The spoils exceeded any annual savings previously delivered by divisional supply management's standard cost reduction efforts. Divisional supply management even received financial recognition for part of the increased profitability related to supporting incremental sales, something the function normally gets no credit for.

So The Division's executive management strongly backed supplier development's lean activities because this work translated directly into "execuworld" metrics. Executives could see that this lean impact could be significant. Why? Because the entire array of lean activities across all suppliers was tied together by a single strategy of prioritizing and focusing on those that would have the biggest effect on high-level operational metrics.

Another issue that hampers executive acceptance of lean is the current inability to measure lean initiative progress. This is illustrated best by lean's lack of ability to answer the following two questions: How far along the lean road are we? What does it take for a company to be considered lean?

This question can be answered using the MCT metric. Consider this: Companies that can hit their customer fill rate goals without relying on forecasts and prebuilt inventory are build-to-demand capable. This doesn't mean that a customer arrives at a showroom expecting a specific product to materialize out of thin air. Depending upon the product, most customers are willing to wait some period of time, be it minutes, hours, days, weeks or even months. Officials in the Division's industry thought that sales would not be lost if customers could receive the products they wanted within a couple of days, which was the target of industry replenishment strategies.

Most companies need some product built ahead, even if only to have a physical example available for customer review. The issue relative to lean becomes the answer to the question: How much prebuilt inventory is needed for manufacturers in specific industries so they don't lose customers or at least can hit customer fill rate goals? It is common sense to think that the closer a company is to being build-to-demand capable, the closer that company is to being lean. Thus, build-to-demand as the lean endgame defines a condition of lean-ness. The closer you are to being build-to-demand capable, the "lean-er" your business is. Consequently, a primary measure of company "lean-ness" should be the MCTs of the products.

## Supply management

MCTs include the time it takes for suppliers to deliver their products to their customers. That implies comparatively large MCTs for most overseas sources.

This does not necessarily eliminate overseas suppliers as sources. But depending on the demand characteristics of the product built with these supplier parts, it could.

Longer supplier MCTs might make business sense for parts used on products that have predictable market demand. Lower piece prices can make a difference when you don't have to worry about variations in demand getting in the way of meeting customer fill rate goals. But predictable demand usually is the exception, not the rule. The Division's order fulfillment initiative needed 14-day supplier MCTs. This reduced The Division's previously large stocks of prebuilt inventory. The shorter time frame also added supply chain agility, making it possible to support incremental sales and maintain customer fill rates. Based on this, Division management decided that no parts for the models targeted for its entry into the big box channel would be sourced outside of North America. The risk of negative financial impacts from lengthy MCTs was just too high.

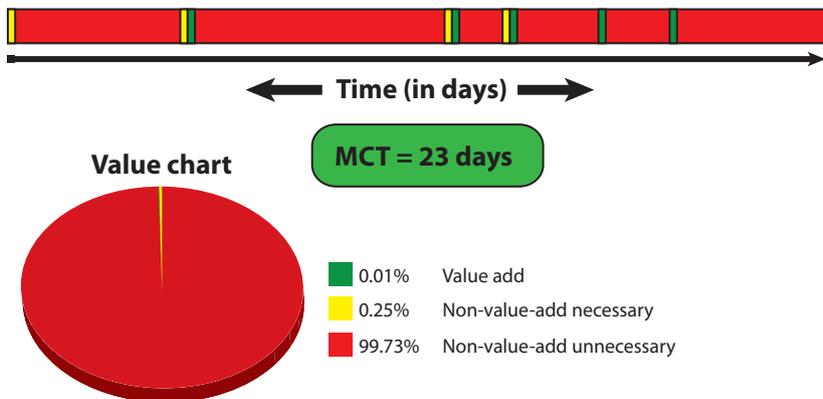
Adopting this strategy was a big deal, especially in the era being discussed. At the time, most U.S. OEMs were racing each other to source in China or India. A convincing counterargument against this lemming-like way of doing business could not be made. There just wasn't a business case that argued against such offshoring. For The Division, a credible business case was based on defining those executive-level financial benefits that would be at risk by sourcing with suppliers that had lengthy lead-times. In this case, long MCTs would mean less supply chain agility, less ability to increase production for unpredicted incremental sales, lower chances of meeting customer fill rates and less overall profit.

## Lead-time is the future

U.S. industry needs next generation lean. If it doesn't evolve, lean likely will become

## DEAD RED REDUCTION

Figure 2. This process map defines manufacturing critical-path time (MCT), revealing plenty of non-value-added activities to target for lead-time reduction.



just another in the plethora of manufacturing efficiency improvement strategies, rather than a primary one. Here are some observations about how lean needs to transform into its next generation:

- Gaps exist in how traditional lean principles and tools have been applied to industry.
- New strategies, metrics and tools are required to close those gaps, as well as to tie lean impacts to executive-level financial metrics.
- Next generation lean should provide the needed structure by building on, not replacing, current lean practices such that its relevancy to – and support from – high-level executives is increased.

Specifically, reducing true lead-times, or MCTs, should be a fundamental strategy of next generation lean. Correspondingly, build-to-demand capability according to industry demand specifics should be the endgame of every next generation lean practitioner. And MCT should be a baseline measure of lean progress. In other words, MCT is both a measure of lean-ness and a means by which the impact of lean activity can be consolidated, made visible and recognized.

Process mapping is an example of the new next generation lean tool. By defining

the non-value-added elements of MCT, it prioritizes lean activities and helps identify low-hanging process improvement fruit.

Take a look at the process map in Figure 2. A principle of Suri's quick response manufacturing is that reducing all time is of equal value in increasing efficiency. Since most companies focus on part processing, the green portion of the chart, these processes usually are highly efficient. But less attention has been paid to red, non-valued-added activities like inventory and inspection or, in some cases, yellow value-added-but-necessary processes like setup. Process maps like this show low-hanging fruit that offers massive opportunities for reducing MCTs.

The Division had access to two other tools during that initial order fulfillment initiative. Once a current state value stream map had been defined, MPX Value Stream Modeling allowed for the quick creation of a shop manufacturing model for running "what-if" scenarios to assess which of the lean projects being considered would reduce MCTs the most. It didn't replace value stream mapping; it complemented and supplemented it. And an inventory planning tool was used with suppliers who could not reach the needed 14-day MCT to define the exact amount of prebuilt inventory they would have to hold "on hand" on a real-time-basis to support

The Division's replenishment needs.

The traditional performance metrics OEMs use to compare suppliers often show little differentiation between competing sources. One reason is because the three most popular metrics – lean's holy trinity of price, quality and on-time delivery – reveal nothing about how suppliers achieve their performance. Correspondingly, suppliers learn to "game" OEM supplier performance measurement systems to indicate high performance, regardless of the strategies that yielded the numbers. Because of this, these three traditional metrics should be regarded only as secondary indicators of supplier capability.

MCT is a primary indicator of supplier performance. Suppliers with relatively short MCTs achieve their performance the "right" way, while suppliers with relatively long MCTs do it through waste. Who would you want to buy from, an efficient or a wasteful source? Going forward, knowing the how of supplier performance should be just as important as the performance itself. Not only should knowledge of supplier MCTs become fundamental to the practice of world-class supply management, knowledge of the demand characteristics of the product that parts are used on will need to be understood. ~

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