

Got Lean? Six Sigma?

HERE'S ANOTHER THEORY

Jack McGuinn, Senior Editor

Most readers are at least familiar with continuous improvement programs such as lean and six sigma. Perhaps your shop or company is well along in the implementation of one or the other—if not both. But what about theory of constraints (TOC), introduced in Dr. Eliyahu Goldratt's 1984 book, The Goal? Despite its rather negative-sounding name, this continuous improvement process has much to offer manufacturers of all stripes. And when combined with lean and six sigma, the results can be dramatic. Dr. Lisa Lang, a TOC consultant and speaker, explains why and how in the following Q&A session with Gear Technology.



Dr. Lisa Lang

How would you define the theory of constraints ?

Theory of constraints (TOC) is a holistic management process that identifies an organization's system constraint, then systematically exploits and/or elevates it to reach a higher level of goal attainment. In a for-profit business, the goal is to make more money now and

in the future. The constraint (most businesses have only one at a time) is what's limiting the business from making more money. One example is market restraint. You can have plenty of capacity internally, but you don't have enough orders to use all or the majority of that capacity.

TOC advocates strategically placing your constraint (instead of chasing it around) and then focusing management attention and company resources on leveraging it. Consider that before this recession (manufacturers) would know where their bottleneck was. But because most manufacturers followed conventional wisdom—which is to balance capacity—their constraint is constantly moving. If you have balanced capacity, meaning the same average capacity at each step, and then a big slug of work comes in, the constraint then moves from one step, to the next and to the next, depending on the mix of work and what just came in. By strategically placing the constraint and unbalancing capacity, you make it easier to leverage the thing that is limiting your ability to make money. You can't leverage a moving target. If your constraint is constantly moving, it's really difficult to leverage it. Most manufacturers are more accustomed to chasing the constraint in operations, but are less experienced when it comes to leveraging market or cash constraints.

There are different ways to leverage, and the key is that the more the constraint stays in one place, the easier it's going to be to leverage. A financial example of leveraging a constraint is throughput per constraint unit—How many dollars will I generate for how much of my constraint time? We look at how much throughput will we generate with this job, and how

much of my scarce resource constraint capacity will it take to do that. If the amount I can get out is dependent on my constraint, then what I want to do to maximize my profits is get the most throughput dollars per unit of constraint time.

Why isn't TOC as popular as lean?

Except for the CEO, most managers have limited spans of responsibility and control. Cost management and cost reduction are valid objectives for these managers. Lean has excellent tools to accomplish cost reductions and local process improvements; so does six sigma. This is something a manager can do within his or her own silo (e.g., operations, engineering, etc.) without the need for a lot of coordination with other silo managers.

So if you don't have involvement from the top, a manager within a silo can only go so far. Dr. Eliyahu Goldratt, the developer of TOC, wants TOC to be the main way of managing organizations. He has thought about your question for a long time. His answer is that TOC requires multiple paradigm shifts (e.g., cutting work in progress (WIP), a change in accounting practices [see below], etc.) from any person and organization that implements it. TOC has a solution for most every aspect of organization management, most of which are counterintuitive, and often require doing the opposite of what we were taught (common practice and conventional wisdom) and in coordination with other silo managers. Hence, there are multiple paradigm shifts required to *fully* implement, including:

- **Drum-Buffer-Rope**—A scheduling system for WIP operations and/or sales processes. Drum: the rate at which the work moves through is the constraint, and sets the rate at which work can move through the system—like a drumbeat; Buffers: protect the drum from running out of work, protecting the constraint, and a shipping buffer protects our due date commitments; Rope: how new work is released into the process, because what we want to do is release new work into the process at the rate that the constraint/drum can actually consume it.
- **Critical Chain Project Management**—The process of applying the drum-buffer-rope concepts to

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a project environment.

- **Throughput Accounting vs. Cost Accounting**—Cost accounting is old technology. Throughput accounting is what TOC uses instead of cost accounting. It is used for financial decision making—"Should I take this order or not?" "Should I buy this piece of equipment or not?" Throughput is the sales dollars we generate minus what we had to pay for raw materials or outside services (heat treating, e.g.) and sales commissions. So when we talk about throughput, we're talking about dollars.
- **Mafia Offer**—For exploiting a marketing and/or sales presentation constraint (*See below and Drewco sidebar for more on mafia offer.*)

Can TOC work with lean and six sigma?

Yes! TOC, lean and six sigma share an interest in defining and improving processes. TOC has no equivalent to the toolkits represented by lean and six sigma, and they have no equivalent to the focusing process provided by TOC. So, the initial steps are provided by TOC, meaning the definition of the organization's goal and identification of the system's constraint. Lean and six sigma help with the next step, which is exploiting the constraint. In TOC, "buffer statistics" will highlight the weak part of the process. Buffer statistics are simply regular data that are applied to the buffers in front of the constraint and at shipping. The buffer, remember, is the mechanism that ensures that the drum—or work rate—is not interrupted, thus protecting the constraint. Buffers absorb variability and are the mechanism that ensures we don't starve the constraint or miss our due dates.

Lean and six sigma usually have specific tools that will rapidly improve the weakness. Perhaps it is setup reduction on a key piece of equipment, or reduction of variability of a key step in the process. No organization has unlimited resources. Focusing where and when to apply lean and/or six sigma is high leverage.

Recently, an analysis was conducted in a large company where some plants used lean in isolation, others six sigma in isolation, and others where TOC was combined with lean and/or six sigma. The most significant improvements were with the combination of all three. You can read that article here: <http://www.scienceofbusiness.com/Portals/0/2006MayTLSArticle.pdf>.

Your "mafia offer boot camp," what is that, and how does it work?

Initially, Dr. Goldratt defined a mafia offer as "an offer so good that your customers can't refuse it." I extended the definition as follows: "An offer so good that your customers can't refuse it and your competition can't or won't offer the same." A mafia offer typically requires that you do something different (make operational improvements) to actually deliver something (that can't be refused) to your customers, and something that your competition can't or won't do because they are not willing—or don't know how—to make the same

improvements. Most companies offer solutions that solve their customers various problems or symptoms. With a mafia offer, we are addressing our customers' core problem.

When most of us are presented with a concept, particularly if it is not one we developed, we have this wonderful ability to think of all the reasons why it won't work. So if you read about the process to create one (mafia offer), you would simply do what we all do—come up with all the reasons why it won't work for you. During the boot camp, you and your team build your mafia offer. You know your company, your competitors and your customers best. We combine your knowledge with a solid process to facilitate and guide you to develop the offer that will not be refused by your customers, but something your competition can't or won't do. We usually know we are on track when your team is worried about being able to deliver the offer. During a mafia offer boot camp, we start over with fresh eyes and a fresh look at your business—and this is something you can't read about or someone can't just tell you about.

One of the most difficult things about implementing lean is securing a complete buy-in from top management/ownership. How do you go about doing that with TOC?

It must be led by the CEO. A CEO that wants to dramatically increase the bottom line of the company must have the collaboration of the top management team. To gain collaboration and to communicate what must be done, we use a strategy and tactics tree. What's a strategy and tactics tree? It is a concise explanation of what needs to be done throughout the organization to meet the company's goal. And while it is concise, it is also perfectly clear what needs to be done in each silo, at each level, which is very powerful. People don't really resist change. They resist what they don't understand or what they think will have a negative effect on them personally. We don't see "resistance" to change when we use a strategy and tactics tree with strong leadership. This tool is how/why we can achieve results very quickly, even in large organizations.

Are there any start-up costs with implementing TOC?

No. TOC is about leveraging the people and resources you already have. In *The Goal*, the elevate step (the step associated with spending money) is step No. 4, and in many cases we don't need to elevate until we have substantially grown sales. TOC should be self-funding and self-resourcing if you implement it correctly. When we start working with somebody, one of the things we have them do is cut their WIP in half. As soon as they do that, there's less stuff to deal with; (clients) resist it, but that's the first step. When you do that—i.e., self-resourcing—you'll free up some time. You'll absolutely free up some cash—self-funding—and with this free time we go to the next step. And we organize the implementation in such a way that the first actions produce huge results. Getting big results quickly also helps with the buy-in. So cut the WIP in half, just focus on what's started (on the floor)—and all of a sudden you're shipping more stuff, invoicing on a regular basis, getting more cash—with the same resources.

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An Offer a Godfather Would Love

As mentioned in the Q&A, Drewco, a Wisconsin-based tooling company, began implementing TOC in 2006. And, as also mentioned, they started with a mafia offer to their customers. But aside from the benefits to buyers, the offer also served to focus Drewco's attention internally on identifying their constraint and doing what was necessary in order to deliver on the offer. (*For more information on how the mafia offer served as an internal, process change agent at Drewco, please see the accompanying Q&A—Ed.*)

So what was the Drewco offer that promulgated change internally and was deemed by the company as unrefusable?

Everyone knows that in this crazy economy there is a razor-thin line that separates the winners from the also-rans—everyone is looking for an advantage. Well, how about improved lead time? Drewco focused on that and implemented an on-time and rush delivery system backed up by meaningful rebates for noncompliance.

The highlights:

- All delivery times are guaranteed, backed up by a minimum 10 percent per day rebate for late shipments.
- Rush delivery is always available. Rush deliveries are backed with an even higher guaranteed on-time rebate.

In other words, if a standard order is submitted and the shipping date is one business day late, the customer then pays 90 percent of the originally quoted price. (*See the accompanying charts for more information—Ed.*)

That's a pretty nifty offer, but it's one that Drewco is comfortable in making as a result of their internal improvements via TOC implementation.

"We have found (TOC) to be a highly effective method to get fast results," says Richard Pettibone, Drewco president. "It is a more-targeted and often-counterintuitive method that can quickly yield significant benefits."

Indeed, post TOC implementation, Pettibone says Drewco "improved from accepted industry performance of 40-50 percent on-time delivery, with an average of two or three days late, to being consistently over 95 percent on-time and zero days late. This new performance gave us greater manufacturing capacity to sell."

Going forward, Pettibone says in addition to the guaranteed on-time delivery program, TOC has enabled Drewco to reduce its standard delivery lead time. It has also reduced production lead time from six to three weeks, "with the same guaranteed and rush delivery still available."

For Drewco, at least, TOC is more than a theory. It works.

— Jack McGuinn

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Typical quote options:

Collets			
Example: Collet Delivery Options			
	Standard Delivery	Rush Delivery	Express Delivery
Order Lead Time	3 Weeks	2 Weeks	1 Week
Selling Price	Standard	Rush	Express
Rebate	10% / day of selling price	20% / day of selling price	30% / day of selling price

Arbors, Mandrels, & Chucks			
Example: Fixture Delivery Options			
	Standard Delivery	Rush Delivery	Express Delivery
Order Lead Time	8 Weeks	5 Weeks	3 Weeks
Selling Price	Standard	Rush	Express
Rebate	10% / day of selling price	15% / day of selling price	20% / day of selling price

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What would you say to those who believe being lean is sufficient without TOC?

Lean tells us to reduce waste—but where?—everywhere. And an 80/20 rule is used to decide the order of this improvement. Once you understand TOC, you realize that there is one place where you should focus management time, attention and your resources to have the biggest bottom line impact. Using TOC to focus these efforts is more like using the 99/1 rule, and you can get bottom line improvement (real ones) much faster. In addition, throughput accounting will help you to make decisions that will have an incremental bottom line improvement. This is much more difficult to do with cost accounting or lean accounting. So, we use TOC, lean and six sigma in combination.

What are some of the more common constraints that affect a manufacturing organization?

Dr. Goldratt recently declared that the most common organizational constraint worldwide is management attention. Keeping management focused on doing what needs to be done—and not doing what doesn't need to be done—is a real problem. Beyond that, more than half of all manufacturing organizations are limited by sales. They could produce more, if only they could get the sales. So that's a market constraint, which we overcome with the mafia offer. The rest have some form of internal constraint which, when addressed, usually goes away quickly, and then the constraint is again lack of sales. Internal constraints are typically an overloaded department, where the demand placed on it is greater than its capacity. The challenge that many of your readers face is that they have a highly complex environment. An environment where the mix changes dramatically, and where the variability is high, usually results in a situation where the constraint moves day-to-day or week-to-week. And how do you leverage a moving target? We've worked with a number of highly custom, complex job shops and have created a TOC solution specific for these situations. We call it a velocity scheduling system (VSS). It is a system similar to drum-buffer-rope, but customized for the starting conditions of highly complex job shops. But, if you are not using VSS, it is most common for you to be chasing your ever-moving constraint around.

Please discuss your work for Drewco in implementing TOC.

We started working with Drewco at the end of November 2006. We started by creating a mafia offer, even though they had an internal constraint at that time. Why? The offer will dictate the strategy and tactics, or another way to say it: The offer will indicate where we need to improve and by how much. And by starting with the offer, the operational improvements happened much faster because we had a reason to change, and everyone was excited about the offer.

After creating the mafia offer, we developed the full strategy and tactics tree. This was communicated throughout the organization. Within one month, Drewco had improved their due date performance from 39 percent (on first date

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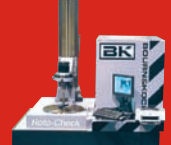
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given) to 100 percent for the collet part of their business. And velocity through the shop went from 19 days to 6 days—or 217 percent.

This improvement was accomplished by doing just the first step from the strategy and tactics tree. So we accomplished the “big results, fast” idea I mentioned earlier. From there, Drewco applied the concepts to the workholding side of their business with similar results, and then continued implementing. Their velocity board (the visual scheduling component of the velocity scheduling system) went up in 2007. This approach has enhanced communication in the shop and is the key to making this approach stick. They now have a process—the velocity scheduling system—and they get better and better at it all the time. The results?—due date performance up instantly (30 days) and dramatically (156 percent). Velocity through the shop increased about 68 percent, all while sales have been increasing and have remained consistently over 95 percent since then. And the dramatic increase in velocity has led to increased profits and improved cash flow. Sales have become Drewco’s constraint, and Drewco’s mafia offer is a competitive weapon.

Lean is known as a journey that never ends. Does the same hold true for TOC?

Yes. The subtitle of *The Goal* is “A Process of Ongoing Improvement.” That’s true of any TOC implementation, in any company. And it is also true of the development of the TOC body of knowledge, which has rapidly expanded in the last five years, as truly holistic implementations have been initiated with some of the largest organizations in the world.

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Dr. Lisa Lang is the president of the Science of Business, a consulting firm. She has recently served as the global marketing director for Goldratt Consulting. She has a doctorate in engineering and is a TOCICO-certified expert in Theory of Constraints. Lang is the author of two books—*Maximizing Profitability and Achieving a Viable Vision*. In addition, she specializes in increasing profits of job shops and applying theory of constraints, lean and six sigma to sales and marketing. Before becoming a consultant, Lang was in operations, strategic planning, purchasing, R&D and quality while working for Clorox, Anheuser-Busch and Coors Brewing. She also provides professional keynote speeches—most recently at the National Tooling and Machining Association’s annual convention—and at workshops.