

## The Supply Chain and Manufacturing Improvement Tool Kits

### From Lean to Theory of Constraints, Here is a Quick Overview

#### SCDigest Editorial Staff

**T**he following article didn't quite fit into our recent Supply Chain Digest Letter on Lean Manufacturing. You can find an electronic copy of that Letter plus a wealth of other Lean information at our Lean Microsite: [Lean Manufacturing Resources](#).

Lean is one of several improvement methodologies for manufacturing and supply chain. To add some clarity to what can be a confusing amalgam of terms, we have summarized some of the key approaches below.

**Lean:** Pioneered by engineers at Toyota (originally called the Toyota Production System, or TPS), Lean is the term subsequently coined by authors **James Womack, Daniel Roos,** and **Daniel Jones** in their seminal book "The Machine that Changed the World," published in 1990, that described the Toyota approach.

In essence, Lean is about removing waste from processes, focusing on total system flow, and driving continuous improvement.

In a later book, Womack and Jones said Lean distilled five key Lean principles:

- Specify the value desired by the customer
- Identify the value stream for each product providing that value and challenge all of the wasted steps (generally nine out of ten) currently necessary to provide it
- Make the product flow continuously through the remaining, value-added steps
- Introduce pull between all steps where continuous flow is possible

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- Manage toward perfection so that the number of steps and the amount of time and information needed to serve the customer continually falls

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Lean has a defined and broad array of tools, such as Value Stream Mapping and Kaizen, which are used to analyze and improve processes.

Even within Lean, there are two main branches or philosophies:

**TPS:** The founding concept, which in addition to the principles mentioned above relies strongly on the concept of Just-in-Time (JIT) inventories, which are achieved by achieving a pull-based system, continuous flow, and predictable cycle times. However, some believe that traditional TPS does not do a good job of handling scenarios with high product mix, shared production assets across prod-

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ucts, and volatile demand.

**DFT:** Partly in response to the limitations of TPS in some scenarios, in the 1980s consultant **John Constanza** developed a set of tools known as Demand Flow Technology (DFT). DFT is primarily a set of mathematical tools to coordinate work flow into a synchronized stream, achieving balance and greater flexibility that TPS thinking may sometimes provide.

**Six Sigma:** Springing from the ideas of quality guru **Edwards Demings**, Six Sigma is a quality improvement methodology that in general seeks to reduce process and results variation. The term comes from statistical measures of this deviance, which at a Six Sigma level means there would be only 3.4 defects in a process/product per million "opportunities."

In the US, Six Sigma was championed in manufacturing by such companies as Honeywell/Allied Signal and GE, to their great benefit. The most popular approach is known as the DMAIC methodology, consisting of five steps: Define, Measure, Analyze, Improve and Control.

As with Lean, the technique has branched out beyond manufacturing to other supply chain and general business processes.

**Theory of Constraints:** Developed by the legendary **Dr. Eli Goldratt**, Theory of Constraints (TOC) is an approach that focuses on finding the single constraint that is limiting the performance of a given system. As that constraint is fixed/relaxed, or the system is optimized around this constraint, another constraint will emerge, and that constraint is then tackled, as are subsequent ones, each time improving overall system performance.

While there are also many tools in the TOC playbook, a key one is the concept of "Drum-Buffer-Rope": the drum – the constraint or weakest link; the buffer – the material release duration; and the rope – the release timing. The aim of



the solution is to protect the weakest link in the system, and therefore the system as a whole, against process dependency and variation and thus maximize the system's overall effectiveness.

### Hybrid Approaches

Of course, many companies and consultants have opted to combine these methodologies in one form or another. The most popular is **Lean Six Sigma**. In general, using this approach a company seeks to improve results by using Lean to streamline processes and eliminate waste, then improve the consistency and reliability of those processes using Six Sigma.

There are several principles that drive the strategy of bringing Lean and Six Sigma together:

- Lean cannot bring a process under statistical control
- Six Sigma alone cannot dramatically improve process speed or reduce invested capital
- Both enable the reduction of the cost of complexity, but in complementary ways

Some are combining all three of the improvement processes together, adding in Theory of Constraints as a front-end before both Lean and Six Sigma. This three-way combination is sometimes referred to as **TLS** (TOC, Lean, Six Sigma).

"TLS is by far the best approach – and in that order," says **Judy Yetter** of Shippensburg University in Pennsylvania and an expert in this area. "TOC must be the foun-