



TenStep Supplemental Paper

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The Right Mix

Theory of Constraints and Six Sigma...the complementary duo!

Improving manufacturing performance in terms of cost, quality, efficiency and speed is an ongoing challenge. Over the years, manufacturers have applied several strategies to boost performance. Some are simple, some elaborate while others are challenging. Yet, when implemented well, these strategies prove to be beneficial. Here, we look at two important strategies, Theory of Constraints (TOC) and Six Sigma (SS) that have become popular despite consuming considerable time and resources.

First we take a brief look at the two strategies and then a framework that combines the two to boost manufacturing performance.

Back to the basics!

We all know that Eliyahu M. Goldratt developed the Theory of Constraints (TOC) in the 1980s. The basic idea behind TOC is simple: Every organization has at least one constraint that prevents it from achieving its goals faster and better. The constraint can either be a physical entity or a policy. The TOC has five focusing steps that help identify and exploit the constraint. This systematic approach of five steps that work in a cyclic fashion is a continuous improvement initiative. The five steps are:

- Identify the system's constraints
- Think of ways to exploit the constraint
- Subordinate everything else to the above decision
- Elevate the system's constraints
- If a constraint is eliminated in any of the above steps, go back to step 1 and repeat the process before inertia sets in

A quick look!

Six Sigma (SS), as commonly known, is a business process improvement strategy wherein sigma is a statistical measure of variability in the process. Under normal circumstances, SS stands for 2 parts per billion (ppb). However, taking Motorola's strategy of accounting the long-term process drift of 1.5 sigma into account, a process operating at SS will produce 3.4 parts per million. Any SS initiative is designed to change a company's culture to achieve aggressive stretch goals with breakthrough improvements based on out-of-the box thinking. When deployed appropriately, SS can add substantial intellectual capital for a company. This in turn leads to unprecedented knowledge gains that can bring in excellent bottom line results. Just as in TOC, implementing SS also involves five sequential steps specifically designed to facilitate Continuous Improvement (CI). They are:

- **Define:** Identify customer requirements and a project suitable for SS.



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- **Measure:** Determine what and how to measure the performance of the selected process
- **Analyze:** Understand and determine the variables that create quality variations
- **Improve:** Identify means to remove causes of defects and modify the process
- **Control:** Continue the efforts to maintain the improvement

The basic objective behind the five steps is to recognize critical customer needs, identify and validate improvement opportunities and upgrade business processes. Companies like General Electric, Allied Signal, Texas Instrument, Sony, Lockheed Martin and Crane Co., have not only recorded profitability, but also improved customer satisfaction. The impact of SS can be clearly seen in their productivity line.

Now, in order to bring the two strategies together, several questions have to be answered. Topping the list are questions like: How do the two strategies complement each other? Are they mutually exclusive or can they work together?

Though the terminology defining the basic principles are different, both strategies are consistent in identifying key variables, improving key processes, designing critical measures, changing existing systems to support improvement and monitoring results of improvement. Hence, TOC and SS complement each other. In fact, TOC can be the framework for CI while SS can provide the techniques and statistical tools to implement changes.

Here we look at the outlines of an integrated CI framework that combines SS and TOC.

TOC	Six Sigma	Integrated CI Strategy
Identify constraints	Define needs and projects	Phase 1
Exploit constraints	Measure performance	Phase 2
Subordinate to constraints	Analyze root cause	Phase 3

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Elevate constraints	Improve the process	<i>Phase 4 & 5</i>
Check for next constraints	Control and maintain the improvement	<i>Phase 6</i>

The above figure describes the outcome of combining TOC and SS strategies. Phase I of the integrated framework is identical to both strategies with the basic purpose of identifying constraints that block the efficiency of company-wide performance like improving throughput or meeting customer needs. Following this, a specific process is selected for improvement. Phases 2 and 3 explore the capacity of the selected process and thereby take the TOC spirit.

Now Phase 2 measures the current performance of the selected process and identifies root causes to be corrected. Here two vital steps of SS, measure and analyze come into play. At the end of Phase 2, the root causes are confirmed.

Phase 3 of the integrated framework uses the key statistical, engineering and manufacturing techniques from SS to eliminate the root causes of problems. The aim is to improve processes or to best utilize their current capacity without incurring additional expenses.

Phase 4 of the integrated framework ensures that changes made in the previous phases are well supported in the organization.

Phases 5 and 6 follow the TOC spirit. If the improvements made to the selected process are insufficient to yield better goals, companies need to consider other options. Eventually, companies need to be aware of the dynamic nature of manufacturing processes and monitor the development of new constraints.

Hence, in the combined framework, the management aspect of TOC is made to complement the engineering aspect of SS. TOC provides the backup for identifying constraints and examining changes to the entire system. SS brings in the perspectives of performance measures, engineering and statistical tools and customer requirements during constraint identification and exploitation.