

# QUALITY TOOLBOX

## ***Lean, Six Sigma, and the Systems Approach: Management Initiatives for Process Improvement***

It is all too easy to dismiss process improvement initiatives as the “flavor of the month.”

This characterization may even have some truth in it, especially when it comes to the “one-size-fits-all” programs offered by some technical assistance teams and consultants.

Some elements of these programs may help your operations perform more effectively, at least in certain areas. But if you want to ensure a lasting effect and continuous improvement, you need approaches with more “staying power.”

This column examines two proven approaches that currently are very popular: “lean” and “Six Sigma.” Both methods offer opportunities to use many of the quality management tools that have been described in previous installments of this column.

As the discussion below makes clear, both lean and Six Sigma work best when they are implemented using the structured decision-making tools featured in the Systems Approach for Process Improvement™. The Systems Approach enhances both lean and Six Sigma—and can even help integrate the two methodologies.

For an explanation of how the Systems Approach is implemented, see **Exhibit 1**. For brief descriptions of the tools commonly used in the Systems Approach, see my Winter 2002 “Quality Toolbox” column, entitled “Creating a Value-Added, Performance-Driven Environmental Management System.” *Environmental Quality Management*, 12(2), 81–88.

Let’s now look at lean and Six Sigma in more detail. By doing so, you will get an idea of which methodology best fits the culture of your organization, and which may be right for the situations you must address.

### **Lean**

Lean is an operating philosophy that originally derived from the Toyota Production System. It focuses on shortening the time that elapses between a customer’s order and the shipment of the product or the provision of the service that fills the order.

Lean accomplishes this by eliminating waste from processes, with waste being defined as anything that is not necessary to produce the product or service. Lean helps organizations reduce both costs and cycle time, resulting in a more agile and market-responsive company.

The U.S. Department of Commerce’s National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP) defines lean as “a systematic approach to identify and eliminate waste (non-value added activities) through continuous improvement by flowing the product only when the customer needs it in pursuit of perfection.”

NIST MEP has also adapted the lean philosophy to the environmental function with a pro-

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## Exhibit 1. Implementing the Systems Approach to Process Improvement™

There are three steps to implementing the Systems Approach:

- Understand the process and the system within which it operates
  - Production processes—flow of resources, activities, and costs (use hierarchical process maps and linked accounting sheets)
  - Main processes linked to the supporting processes
  - Suppliers treated as supporting processes
  - Process maps locate all “aspects” for the environmental management system (EMS)
  - Determine “significance” and select opportunities to improve the process
- Plan and implement a program to improve the process
  - Employee-driven, “bottom-up” component; 8 to 11 project teams
  - Teams use quality management tools: analyze root causes, derive alternative solutions, select alternative solutions, and write an action plan/environmental management program (EMP)
  - Objectives and targets are set from EMPs
  - Management oversight, “top-down” component
  - Integrate existing programs; cross-cutting projects
  - Involve other interested parties
- Drive continuous improvement by measuring true performance
  - Identify the program-in-place at a facility (if applicable)
  - Conduct baseline survey using a 22-question performance scoring survey
  - Improve the program
  - Continue to score the true performance and trend continuous improvement
  - Score the program's results
  - Involve other interested parties in the survey
  - Extend to supply chain

gram now known as “Clean.” Some organizations operate these programs separately from each other.

### Tools and Techniques

The tools and techniques used during the implementation of lean are referred to as the lean “building blocks.” Although these tools vary somewhat from consultant to consultant and from company to company, the most common ones can be described as follows.

- *Five S*

The Five S technique is named after five words that begin with the letter “S” in Japanese. It aims to bring orderliness, tidiness, and cleanliness to operations—along with the discipline needed to keep processes orderly and standardized. See Pojasek, R. B. (1999, Autumn). Quality Toolbox. Five S's: A Tool that Prepares an Organization for Change. *Environmental Quality Management*, 9(1), 97–103.

- *Visual Controls*

With visual controls, all tooling, parts, and other production activities are kept clearly in view to help everyone involved understand the status of the process at a glance. Visual controls are usually linked to Five S.

- *Poka-Yoke*

Poka-yoke literally means “mistake proofing.” By using poka-yoke, process designs can be modified to make it nearly impossible for mistakes, spills, leaks, and other process upsets to occur. See Pojasek, R. B. (1999, Winter). Quality Toolbox. Poka-Yoke and Zero Waste. *Environmental Quality Management*, 9(2), 91–97.

- *Cellular Design*

Cellular design refers to a technique in which facility layout is designed according to optimum operational sequences. Raw materials, parts, information, tooling, and work standards are stored where they are needed and used.

The design model centers on one-piece flow, which is considered to be the best batch size. If this is not appropriate, the batch size is reduced.

- *Quick Changeover*

The ability to change tooling and fixtures rapidly allows for multiple products in smaller batches to be run on the same equipment.

- *Pull Scheduling*

Under the pull scheduling system, the internal supplier does not produce until an internal or external customer signals a need for the part or service using a “kanban” system.

This practice contributes to “just in time” production and creates what the practitioners refer to as “flow.” At all times, standardized work or prescribed methods are used.

- *Kaizen*

Kaizen is a staged event where many minor adjustments are made in a particular part of a process. This approach allows for continuous improvement.

### ***More on Lean Tools and Techniques***

Many of the building blocks discussed here are interconnected, and generally are implemented in tandem.

In addition to the specific tools and concepts noted in this column, there are some other jargon-laden techniques—such as takt time, jidoka, heijunka, and muda elimination—that are not discussed here.

### ***Implementing Lean***

The general path for implementing lean includes the following steps.

- *Value Stream Mapping*

This technique details the specific actions required to bring a product family to the state of

being “finished goods,” based on customer demand. Value stream mapping, which operates at a high level of abstraction, concentrates on information management and physical transformation.

Using a value stream map, the lean implementation team can determine ways to bring the lead time for a product much closer to a value-added processing time by modifying bottlenecks and other process constraints. The team produces a “future state map” to show how the preferred process should operate after the bottlenecks are identified and remedied.

- *Lean Baseline Assessment*

Lean is an assessment-based procedure. This means that the implementation team uses interviews, flow charts, process observation, and other data to generate a situation or “current state” report. Specific changes and recommendations for improvements are then detailed in the assessment report.

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- *“Critical Mass” Training*

Most lean implementation programs rely on training a “critical mass” of employees in the basics of the operating philosophy before implementing changes.

- *Kaizen Teams*

In lean programs, kaizen teams make specific changes to address bottlenecks or constraint areas. By using the lessons learned from these experiences, lean implementation can then spread to other areas of the operation.

- *Value Stream Planning*

A typical value stream plan looks like a cross between an action plan and a Gantt chart (a plan-

ning chart that depicts the expected duration of tasks). The value stream plan sets forth the work that will be conducted to improve the value stream over an entire year.

In many cases, the facility creates a lean promotion department to oversee a team of value stream managers. These managers lead those who are operating the process, encouraging them to take responsibility for cost factors, quality considerations, and product delivery, while also mapping and leading implementation of the future state map.

### ***Using the Systems Approach in Connection with Lean***

To those who are familiar with quality management, it will be obvious that lean building

blocks are used at a much higher level than the more basic quality management tools of the Systems Approach, such as process mapping and root cause analysis.

For this reason, the Systems Approach tools can be used effectively with each of the lean building blocks. Furthermore, the entire lean program can be organized and implemented within the basic structure of the Systems Approach.

Process mapping can convey all the same information that a value stream map can convey, without the complexity of value stream mapping. Process maps are quite simple and easy for most people to understand. They also offer much more detailed information, thus allowing for better understanding of the process that is being considered.

In addition, process maps portray a process as a system, and place it within a larger system of supporting processes and supplier inputs. This is

a significant advantage since it is much easier to select opportunities for improvement when systems information is readily available and understandable at a glance. The systems aspects of process mapping are largely missing from the lean approach.

Moreover, the Systems Approach helps facilitate the development of employee action plans for making agreed-upon process improvements. Such action plans serve as accountability documents, while also providing a very strong “bottom-up” element to a process improvement program. Projects also are converted into process improvement programs using a management oversight function, providing the “top-down” element.

Finally, the Systems Approach includes a true performance scoring system (based on the Baldrige quality model) that can actually quantify and trend the continuous improvement effort. The results can be given as a single score—something that is not possible using any of the lean tools.

### **Six Sigma**

The Six Sigma philosophy maintains that reducing “variation” will help solve process and business problems. By using a set of statistical tools to understand the fluctuation of a process, management can begin to predict the expected outcome of that process. If the outcome is not satisfactory, associated tools can be used to further understand the elements influencing the process.

Most Six Sigma programs focus on process improvement. These efforts seek to eliminate the causes of variation in processes while leaving the basic process intact. In Six Sigma terms, process improvement teams find the critical “Xs” (causes) that create unwanted “Ys” (defects).

A definition of a Six Sigma project is “a problem scheduled for a solution with corresponding

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metrics that can be used to set project goals and monitor progress.”

### ***Understanding DMAIC***

Under the close supervision of a corps of trained “black belts,” Six Sigma project teams address problems using a five-step process known as “DMAIC”:

**Define** the problem and what the customer requires;

**Measure** defects and process operations;

**Analyze** data and discover the causes of the problem;

**Improve** the process to remove the causes of defects; and

**Control** the process to make sure defects don’t recur.

- ***Define***

Six Sigma practitioners begin by defining the problem. They ask about customers and what they require, and identify the problems that are causing the operation to fall short of customer expectations.

The Six Sigma process identifies key characteristics that are important to the customer and the processes that support these characteristics, along with existing output conditions and process elements.

- ***Measure***

The team next focuses on measuring the process at issue. During this step, key process characteristics are categorized, measurement systems are verified, and data are collected.

- ***Analyze***

Once data are collected, they are analyzed in the Six Sigma model. The intent is to produce information that provides insights into the process and its problems. These insights include identify-

ing the fundamental and most important causes of defects and/or variability in the process.

- ***Improve***

At this stage of Six Sigma, the team identifies and implements potential solutions to process problems. The results of these process changes are carefully measured, and adjustments are made as necessary.

- ***Control***

Finally, if the process is found to be performing at a desired and predictable level, it is put under “control.”

This step is the “maintenance” portion of the Six Sigma methodology. The process is then monitored to assure that no unexpected changes occur.

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### ***Implementing Six Sigma***

Six Sigma projects are implemented with a “black belt” practitioner serving as the project manager. Projects are expected to provide a measurable benefit to the organization in terms of cost, quality, and timing. The Six Sigma program is managed with a five-step approach:

- define processes, key customer requirements, and process “owners;”
- measure performance to customer requirements and key process indicators;
- analyze data to enhance measures, and refine process management mechanisms by prioritizing and implementing process improvements;
- control performance through ongoing monitoring of inputs/operations/outputs, and respond quickly to problems and process variations;

- expand and integrate the Six Sigma system into the organization's core business.

As is the case with lean, Six Sigma generally involves "mass training."

An organization that implements a Six Sigma program typically makes a large investment in developing black belts. In order to ensure a sound return on this investment, the black belts must perform well.

### ***Using the Systems Approach in Connection with Six Sigma***

The DMAIC process allows black belts to use literally hundreds of different quality management tools. It can take black belts a long time to develop the skills necessary to use these tools effectively.

The Systems Approach helps simplify the learning process by focusing on a smaller number of proven tools. These tools have been chosen because they have key characteristics that make them valuable. They are interactive, which helps elicit good participation from employees. They also are visual, which facilitates communication with managers and other stakeholders.

I have found that Six Sigma black belts can easily adapt to the Systems Approach tools. Repetitive use of this smaller number of tools helps black belts develop the skills they need to use the tools properly, allowing them to work more effectively with employees.

Other Systems Approach components—such as written action plans and a program management function—bring order to a Six Sigma program, and help to hold black belts accountable.

Moreover, the true performance scoring offered by the Systems Approach provides a means of tracking the continuous improvements being made within a Six Sigma program.

### **Lean Six Sigma**

Instead of choosing between lean and Six Sigma, many companies develop both. Given the popularity of the two methodologies, it was inevitable that organizations would start to merge them.

### ***Culture Clash***

Unfortunately, however, companies that try both lean and Six Sigma sometimes find that the programs compete for resources or foster a "culture clash" within the organization.

Lean programs rely on value stream managers who coach teams to improve processes. The kaizen events featured in lean tend to be of short duration, with many limited to a week's time.

By contrast, Six Sigma requires organizations to develop a group of black belts who spend months collecting data and using computers to analyze process variation, often with little input from people on the shop floor.

### ***Successfully Combining Lean and Six Sigma***

Although lean and Six Sigma have evolved from different paths, combining the two methods can offer companies many advantages.

Lean brings action and intuition to the shop floor, allowing employees to make quick improvements (picking the "low hanging fruit") through kaizen events. Lean is great for boosting productivity, changing a culture, and cleaning up a factory.

Six Sigma uses statistical tools to uncover root causes, and provides metrics as progress markers. Six Sigma programs are popular, focused, and effective—but projects often take months to finish.

**Although lean and Six Sigma have evolved from different paths, combining the two methods can offer companies many advantages.**



Using the two approaches together can allow organizations to have the “best of both worlds,” leading to ongoing business improvement.

### ***Coordinating Lean and Six Sigma via the Systems Approach***

The Systems Approach offers an ideal way to coordinate lean and Six Sigma. Using this approach, employee projects can be coordinated with a management oversight function that includes value stream managers and black belts. The facility can get by with fewer of these “overhead” personnel involved in the program, since they can more effectively monitor written action plans, and do not need to be constantly in the workplace to supervise activity.

Neither lean nor Six Sigma has a simplified means for determining continuous improvement and tracking it. They may track costs, but not per-

formance. By contrast, the Systems Approach uses a Baldrige-model scoring method to track performance and score the results.

Many practitioners of lean and Six Sigma have not yet been properly trained in using Systems Approach tools, and have not had the opportunity to become skilled at them. Fortunately, however, as past installments of this column have made clear, the tools are relatively easy to learn.

As a functional manager, you can learn to use the Systems Approach tools to integrate lean and Six Sigma. In fact, the Systems Approach offers an excellent means to link processes within these frameworks.

Without the appropriate tools, however, the popular lean and Six Sigma methodologies can actually be at odds with corporate environmental, health, and safety programs.

**Exhibit 2. Comparison of Lean, Six Sigma, and the Systems Approach**

Program	Lean	Six Sigma	Systems Approach
<b>Theory</b>	Remove waste	Reduce variation	Improve process
<b>Application guidelines</b>	<ul style="list-style-type: none"> <li>Identify value</li> <li>Identify value stream</li> <li>Flow</li> <li>Pull</li> <li>Perfection</li> </ul>	<ul style="list-style-type: none"> <li>Define</li> <li>Measure</li> <li>Analyze</li> <li>Improve</li> <li>Control</li> </ul>	<ul style="list-style-type: none"> <li>Understand process and system</li> <li>Link to accounting sheets</li> <li>Select opportunities to improve the process</li> <li>Employees create action plans for improvements</li> <li>Managers oversee the improvement program</li> <li>True performance is scored using a Baldrige model</li> </ul>
<b>Focus</b>	Flow-focused	Problem-focused	Opportunity-focused
<b>Assumptions</b>	<ul style="list-style-type: none"> <li>Waste removal will improve business performance</li> <li>Many small improvements are better than systems analysis</li> </ul>	<ul style="list-style-type: none"> <li>A problem exists</li> <li>Measurements are valued</li> <li>System output improves as variation in all processes is reduced</li> </ul>	<ul style="list-style-type: none"> <li>Supporting processes linked to main process</li> <li>Main processes linked internally</li> <li>All improvements can be leveraged within the system</li> </ul>
<b>Primary effect</b>	Reduced flow time	Uniform process output	Understanding linkages in the system
<b>Secondary effects</b>	<ul style="list-style-type: none"> <li>Less waste</li> <li>Fast throughput</li> <li>Less inventory</li> <li>Improved quality</li> </ul>	<ul style="list-style-type: none"> <li>Less variation</li> <li>Uniform output</li> <li>Less inventory</li> <li>Improved quality</li> </ul>	<ul style="list-style-type: none"> <li>Conservation of resources and reduction of waste</li> <li>Less waste</li> <li>Less inventory</li> <li>Improved quality</li> </ul>
<b>Criticisms</b>	<ul style="list-style-type: none"> <li>Statistics or system analysis not valued</li> <li>Training all employees can be time-consuming</li> </ul>	<ul style="list-style-type: none"> <li>System interaction not considered</li> <li>Process improved independently of system</li> <li>Black belts may become an elite corps</li> </ul>	<ul style="list-style-type: none"> <li>Lacks popular appeal of other methods</li> <li>Takes time to develop the skills to use the tools properly</li> </ul>

## Choosing the Best Approach

Selection of an appropriate process improvement methodology depends on the culture of your organization. When considering lean, Six Sigma, or the Systems Approach, one main concern is the speed at which the methodology will be accepted by the organization. To help your company decide which would work best, keep the following guidelines in mind:

- If your organization values analytical studies (and their associated data, charts, and analysis), then Six Sigma may be a great program to lead off with.
- If your organization values visible progress and immediate change, lean may be the best way to initiate a process improvement program.
- If your organization is seeking a systematic decision-making approach with employee

participation, then the Systems Approach to process improvement will work well. Just be sure that you develop the requisite skills to use the decision-making tools.

**Exhibit 2** highlights commonalities and differences among the three process improvement methods.

## The Decision Is Up to You

Despite the protestations of purists, these programs can all work well together in nearly any organizational culture.

Each improvement methodology contributes valuable concepts, ideas, and techniques to your organization. Your challenge is to use the particular strengths that each approach possesses to help your organization improve.

And remember that it is important to never stop learning!

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