Lean Tools That Improve Processes: An Overview

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Lean emphasizes the learning by doing approach, where the members of a process improvement team are those most closely associated with adding value to the product. The whole process is based on defining customer value, focusing on the value stream, making value flow, and letting customers determine the product or service they want, with a relentless pursuit of perfection in a timely manner at an appropriate price.

We identify the value stream as a process, or series of steps, from concept to launch to production, and then the order to delivery and the disposition; in other words, from the raw materials to delivery of the finished product to the customer. Value stream steps can be value-added, non-value added, or non-value-added-but-necessary. Lean emphasizes the elimination or reduction of steps that do not have value. We start with the customer's request, strive for no interruptions or waste, avoid batch processing, and strive for smooth just-in-time one-piece flow.

An experienced teacher who uses the Socratic method of learning – a dialog of simple questions that leads to an agreed-to solution, facilitates the Lean process. This article presents an overview of 11 tools that have been shown to be productive for Lean initiatives.

These methods can be used in the *Improve* phase of the Six Sigma DMAIC roadmap (Define, Measure, Analyze, Improve, Control). These techniques are also applicable within Integrated Enterprise Excellence (IEE), the performance measurement and improvement process that orchestrates employee day-to-day activities so they align with true business needs.

These are the tools:

One-Piece Flow

One-piece flow describes the sequence of product or of transactional activities (e.g., insurance claims) through a process one unit at a time. In contrast, batch processing creates a large number of products or works on a large number of transactions at one time – sending them together as a group through each operational step.

In one-piece flow, focus is on the product or on the transactional process, rather than on the waiting, transporting, and storage of either. One-piece flow methods need short changeover times and are conducive to a *pull* system.

One-piece flow advantages are

- Reduced customer order to shipment times
- Reduction of work in progress
- Early detection of defects
- Increased flexibility for customer product/transactional demands
- Reduced operating costs through exposure/elimination of non-value-added waste

A project process improvement could be a work flow change that reduces batch size or changes from batch processing to single-piece flow.

Poka-Yoke (Error Proofing)

Wikipedia (http://en.wikipedia.org/wiki/Jidoka) describes Jidoka or autonomation as a term used in the Lean process that means automation with a human touch, which applies the following four principles:

- Detect the abnormality
- Stop
- Fix or correct the immediate condition

- Investigate the root cause and install a countermeasure

A poka-yoke is a mechanism that works with Jidoka to either prevent a mistake or make a mistake obvious at a glance; for example, an operator who creates customized assemblies from small bins in front of him: One approach would be to give the operator a list of parts to assemble by taking them as needed from the bin. This approach can lead to assembly errors since he or she might forget to include one of the parts or add parts not specified. A poka-yoke solution might be to install lights on all bins. When the operator is to create a new assembly, the bins that contain the specified parts for the assembly will be illuminated. The operator then systematically removes one part from each bin and places it in front of him. He does this until one part has been removed from each bin and he knows the assembly is complete when no parts remain in front.

Poka-yoke offers solutions to organizations that experience frequent discrepancies in the packaging of their products – e.g., someone forgot to include instructions or forgot to include a mounting screw. Poka-yoke ideas or devices can be more effective than simple demands on workers to "be more careful." Improvement focus should always be given to what can be done to error-proof a process more than on inspecting the quality of the finished product.

Visual Management

Visual management can address both visual display and control. Visual displays present information, while visual control focuses on a need to act. Information needs to address items such as schedules, standard work, and quality and maintenance requirements. Visual control can address whether a production line is running according to plan; it can highlight problems.

In both manufacturing and transactional processes, visual management systems can include

Visual management techniques:

- Expose waste for elimination/prevention
- Increase visibility and use of operational standards
- Enhance efficiency through an organized workplace

Visual management organizations:

- Improve quality through error prevention, detection, and resolution
- Increase workplace efficiency
- Improve workplace safety
- Reduce total costs

The 5S Method

Creation of standardized work is a primary reason for using the 5S method. It offers a basic housekeeping discipline for the shop floor and the office. It includes the following five steps: Sort, Straighten, Shine, Standardize, and Sustain.

Sort: Clearly distinguish what is needed or not needed among the tools, supplies, and other materials.

- Tag items if not used within a month, or that are unnecessary to perform a task, or that are broken or not usable, or insufficient for an intended purpose.
- Manufacturing: List all red-tagged items on a sheet of paper. Remove the red-tagged items and place them in an identified red-tag storage area. All items must be reviewed by the supervisor and initialed – if approved for removal.

Straighten: A marked space exists for all items in the work area, allowing for easy, immediate removal.

- Organize remaining items in the work area by usage. Label daily usage items on a shadow board. Place weekly usage items in labeled drawers, placing monthly usage items under the work station or in a cabinet labeled with pictures and text.

Shine: Work area is cleaned and kept in an orderly condition during working hours.

- Determine what needs to be done to create a visually attractive workplace. Keep the workstation clean and plan a weekly 10-minute cleaning maintenance for each area.
- Manufacturing illustration: Clean tools and paint machines as needed. Sweep floor. Tighten any loose fittings. Create specific cleaning instructions for the work environment, including which cleaning supplies to use and where. Add maintenance items to monthly schedule.

Standardize: Work method, tools, and identification markings must be standard and recognizable throughout the factory. 5S methods are to be applied consistently in a uniform and disciplined manner.

- Identify source for waste disposal. Workers must look at their jobs and machines while performing tasks to see where debris is created. Create discipline to prevent individuals from becoming the source of waste.
- Manufacturing: Check machine(s) for oil leaks, standardize maintenance, and check for broken but functional switches that need repair.

Sustain: 5S is a regular part of the working process with continuous actions required to maintain and improve the production environment. Established procedures are maintained with checklists. Areas must be kept clean so that everything is clearly identified as required or unnecessary.

- A maintenance list should be developed and discipline maintained.
- Create a check list that includes tagged items removed from the work station. List remaining items and locations, document steps for the cleaning process, and list action items for preventive maintenance.

Value Stream Mapping

Value stream mapping, or material and information flow, should play a very productive role in the entire Lean process since practitioners depict current and future conditions when they develop plans to install Lean systems. Infinite attention should be given to establishing flow, eliminating waste, and adding value.

Kaizen

Kaizen is another pervasive tool since it is a focused methodology that uses teams for making improvements. If analysis indicates that this is the best systematic approach for an improvement project, then a Kaizen event should be undertaken. A continuous improvement process that empowers people to use their creativity, Kaizen can be used to fix specific problems, workflow issues, or a particular aspect of a business.

Based on quantitative analysis, a good starting point is to look at the way people work – identifying waste through a time and motion study of tasks with input from both workers and managers. Generic steps for conducting a Kaizen event are

Prepare and train the team:

During event preparation, identify problem cells and select the cell that will be given focus. This work should have been done in the early stages if it is within an overall corporate/operational IEE project execution roadmap. Assemble the team and, if necessary, conduct training on waste control, standardized work, and continuous flow.

Analyze present methods:

The team uses a videotape to analyze the cell in action to determine material flow, cycle time, cell layout, process waste, and other vital measurements. During this time they can generate a standardized work and work combination table. The team needs to record the current number of operations over time, and the defect rates. Photographs should be used to document the overall Kaizen event.

Brainstorm, test, and evaluate ideas:

Divide the team into smaller groups to discuss ways to improve the cell, using the compiled work cell analysis statistics. Groups then test potential improvement tactics on the work cell, assessing their impact. Results from the tested ideas are shared with other team members. This keeps other groups from making similar mistakes and inspires new ideas. This cycle may be performed many times before desired results are achieved.

Implement and evaluate improvements:

After the team has developed its plan for achieving results, a maintenance request is generated, if necessary, where modifications are fully described so that management can authorize change(s) to the work cell and its processes. All of the working personnel are then trained in the new process by Kaizen team members. Improvements are monitored, and progress is video taped and standardized. Results are measured and items that require additional time are put on a future 30-day action list to be implemented by the team.

Results and follow-up:

Team members document all improvement items and compile results to determine monetary savings, improved space utilization, and time reductions. Team members make a presentation to top management with a commitment to complete outstanding items. Management recognizes the team's performance and makes suggestions for the future.

Kanban

A system that creates product that is then sold after it is produced is called a *push* system. If there is no mechanism to keep work in work-in-progress below some level that is consistent with product demand, production output can become excessive, which can lead to many problems, including product storage.

In *pull* systems, products are created at a pace that matches customer demand. Kanbans are used to buffer variations in customer or next process step demands. A most familiar form of kanban is the American-style supermarket where each product has a short-term buffer, replenished at the rate of customer demand. The Japanese word kanban refers to the pulling of a product through a production process. The intent of kanban is to signal a preceding process that the next process needs parts or material.

A bottleneck is a system constraint. In a pull system, the bottleneck should be used to regulate the pace for the entire production line. Buffers in high-volume manufacturing serve to balance the line. It's important that such operations receive the necessary supplies in a timely basis and that poorly sequenced work does not interfere with the process completion. Pull systems address what the external and internal customers need when they want it.

Rules to consider when operating an effective kanban:

- No withdrawal of parts is to occur without a kanban where subsequent processes are to withdraw only what is needed.
- Defective parts are not to be used for later processes
- Preceding processes are to produce only the exact quantity of parts withdrawn by successive processes.
- Variability in the demand process should be minimized.

If production requirements drop off, the process must be stopped. An increase in production requirements is addressed through overtime and process improvement activities within the IEE discipline.

Kanban can dramatically improve a process that produces few defects within workstations. However, if there are workstations that have high defect rates (i.e., a hidden factory), the system can become "starved" for parts. This problem could be avoided by integrating kanban with an IEE measurement and improvement system.

Kanban can be the relay signal between supplier and customer. Kanban signals can be generated by lights, colored balls down a tube, or a computer network. A food market can know when to stock by keeping track of product-volume sold through a barcode system. A stock person responds to a product pull by replenishing the prescribed number using first-in, first-out product restocking. The supplier knows the volume of product to supply because of the kanban system.

Kanban "label" data can include

- Kanban number
- Supplier name
- Line site address: location of line where the component will be processed
- Shipping area address: shipping location for finished assemblies
- Part store address: factory location for temporary storage of components before assembly line use
- Part description
- Quantity in kanban package
- Bar code
- Part number

Demand Management

Demand Management works best when there is a uniform flow of products within the system. While a company's policies should encourage stability, unfortunately that is not always the case. For example, a reward system for product sales might encourage a spike in manufacturing demands at the end of each month.

If these signals are ready incorrectly, it can lead to supply chain problems in the form of an inaccurate product forecast. Accounting procedures can encourage management also to produce excess inventory in order to make the number on which they are evaluated look better.

Supply chain improvements can be expected when lead times are reduced, which would improve forecasting accuracy, and when there is a sharing of supply-chain information that leads to agreement-to uniform schedules.

Another improvement opportunity is to change internal policies that impact demand volume. For example, consider an end-of-the-month/quarter sales-target bonus policy that results in the sales department giving temporary price concessions so they meet their monthly/quarter sales targets. This policy could be a candidate for change, since the sales-force reward policy may be causing a manufacturing demand peak that leads to much overtime and quality issues.

Heijunka

Heijunka is a traditional Lean scheduling methodology for environments that contain a repetitive mix of products, or a family of products. Heijunka is a kanban card post-box system that is usually at the pacemaker process. A Heijunka box provides process level scheduling/pacing, schedule visibility, and early problem highlighting.

Leveled production is customer order averaging so that small sequenced cycles produce the required volume and product mix. In a Heijunka box, customer monthly or weekly volume demands can be leveled into daily demands.

Pull systems and Heijunka work well hand-in-hand. However, system improvement may be needed for success, e.g., through quick change over. When the visual system indicates a problem, prompt identification and correction are absolutely essential.

Continuous Flow and Cell Design

The disadvantages of traditional batch production are the large amounts of work in progress, large conveyance time for parts, large lead times, and large liability for defects.

Small lot production removes the walls from batch production, and reduces work in progress, lead times, and conveyance. It can be impossible, however, to balance task durations for machine operations with this *push* system since one operator can spend a great deal of time waiting, and inventory can build up at a station.

Within U-shaped layouts, employees are cross-functionally trained and move with changing cell layouts. This means that one person can control the work in progress. Close proximity of workers also enhances communications, makes quick defective part detection possible, and workload adjustments can be made for volume changes.

Changeover Reduction

One of Lean's major objectives is reduction of lead time. To achieve this, the size of batches often needs reduction, which, in turn, creates a focus on reducing changeover times – i.e., the time from the last piece of one batch to the first piece of the next batch.

Changeover time can have several components; e.g., internal, when a machine is stopped, and external, which involves preparation. Other types of changeovers are manufacturing line changeover, maintenance operations, vehicle/aircraft loading/unloading, and office operations. The classic changeover is, of course, the Grand Prix pit stop! It's important not only to reduce the mean changeover time, but also to reduce its variability using a standardized process.

Moving internal activities to external ones, when possible, permits more up time for a machine since the maximum amount of preparation is accomplished before it is stopped. Example applications for improving external activities are placing tools on carts near a die and using color codes to avoid confusion. Example applications for improving internal activities are quick-change nuts and standardization of activities.

Lean Tools and Six Sigma: The Relationship

Traditionally, Six Sigma is a project-based methodology led by Black and Green Belts who work with teams of area experts and those involved in overall day-to-day enterprise operations. Lean movers and shakers believe their hands-on approach works better than a single project-based approach led by Black and Green Belts. The general consensus seems to be that Six Sigma project execution takes longer, but is more sustainable than most Lean events.

Overall, the revolutionary Integrated Enterprise Excellence (IEE) management system offers more than either Lean or Six Sigma. IEE tightly interconnects all corporate and operational processes, using the strengths of both Lean and Six Sigma so that each methodology is used at the right time in the right way to achieve the right result relative to true measured and quantified business needs.

Author

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About the Author
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In a professional career spanning over a quarter century, Forrest Breyfogle has established himself as a leading edge thinker, a prolific author, an innovative consultant, a world-class educator, and a successful business executive. His work is documented in eleven books and over ninety articles on the topic of quality improvement.

A professional engineer, Forrest is also a member of the board of advisors for the University of Texas Center for Performance Excellence. He is the founder and CEO of Smarter Solutions, Inc., an Austin, Texas based consulting firm offering business measurement and improvement consultation and education to a distinguished list of clients worldwide, including BAMA, CIGNA, Dell, HP, IBM, Oracle Packaging, Sherwin Williams, Cameron, TIMET, and TATA. He served his country on active duty in the US Army for 2 years, and has played an active leadership role in professional and educational organizations. Forrest received the prestigious Crosby Medal from the American Society for Quality (ASQ) in 2004 for his book, *Implementing Six Sigma* (second edition). This award is presented annually by the American Society for Quality to the individual who has authored a distinguished book contributing significantly to the extension of the philosophy and application of the principles, methods, or techniques of quality management

He is a widely recognized authority in the field of management improvement and is a frequent speaker before professional associations and businesses. His earlier work in the field of management science has been widely acclaimed. A previous book, *Implementing Six Sigma*, sold over 40,000 copies and still ranks among the top Amazon books in Applied Mathematics/Engineering Statistics and Industrial Engineering /Quality Control.

He founded Smarter Solutions in 1992 after a 24-year career at IBM. The associates of Smarter Solutions specialize in helping companies throughout the world improve their bottom line and customer satisfaction through the implementation of techniques that are beyond traditional Lean Six Sigma and the balanced scorecard methodologies. His latest and most extensive work has been in the documentation of a new system of enterprise management, the Integrated Enterprise Excellence (IEE) system, in a series of four books. IEE provides a detailed roadmap that builds on and integrates the best practices of earlier disciplines like Six Sigma, Lean, TQM , PDCA, DOE, and TPS combined with innovative analytical tools to produce improvements at the highest level of an enterprise.

In addition to assisting hundreds of major clients in the wise implementation of improvement systems worldwide, Forrest has also developed over 300 hours of classroom instruction used to train executives, managers, and Black Belt practitioners to plan for, implement, and manage IEE systems. He also leads formal seminars and workshops worldwide.

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