APPLICATION OF LEAN ENTERPRISE AND SIX SIGMA AS AN AMALGAMATED IMPROVEMENT STRATEGY

Nicholas Loyd, University of Alabama in Huntsville

Abstract
Lean Enterprise and Six Sigma are two of the most prominent improvement philosophies available to organizations today. This article investigated how these two philosophies can be used cohesively as an improvement strategy. A comparison was performed relative to the underlying principles, the respective tools used, and the implementation methodologies of each philosophy. A real world example was used to illustrate how Lean Enterprise and Six Sigma can be applied in unison. Finally, it was concluded that although Lean and Six Sigma have differences, primarily in the tools used, they do not have conflicting objectives or implementation methodologies and can be amalgamated, free of buzz words, to provide an effective overall improvement strategy.

Key Words: Lean Enterprise, Six Sigma, Continuous Improvement, Enterprise Improvement Strategy

Introduction

Process improvement is not a concept that is especially new. If the truth were actually known, the first process improvement idea likely occurred within minutes after the developer of the first process revealed it to his or her peers. Improvement philosophies in the United States are constantly materializing, disintegrating, being revamped, and resurfacing with glossier packaging.

Taking a walk through the hypothetical process improvement hall of fame, one might happen upon wings dedicated to such improvement legends as Eli Whitney's interchangeable parts, Henry Ford's assembly line, quality circles, Total Quality Management (TQM), just-in-time (JIT), and World Class Manufacturing (WCM). While each of these improvement ideologies offered companies varying degrees of isolated results, each became extinct largely because they were not integrated into a complete system. Today, the two most prominent philosophies that have emerged as forces in process improvement are Lean Enterprise and Six Sigma, each of which have made efforts to approach improvement from a more holistic vantage point.

Lean Enterprise is a systematic approach to identifying and eliminating waste (or non-value-added activities) through continuous improvement by flowing the product or service at the pull of the customer in pursuit of perfection (UAH, 2002). Lean concepts are rooted in the Toyota Production System (TPS), a philosophy pioneered by Taichii Ohno and Shigeo Shingo in post-World War II Japan at the now-successful automotive company. After Toyota's surge in productivity and quality came to the global forefront in the mid-1970s, many American companies began to study TPS and implement portions of it, such as kanban and 5S, into their own organizations. While Lean has often become synonymous with these tools, Toyota described the objective of TPS as simply reducing the time line from the moment a customer places an order to the point when the company collects cash by removing non-value-added activities, or wastes (Ohno, 1988). The term Lean originated after the 1990 book *The Machine That Changed the World*, in a study of automotive manufacturing, referred to Toyota's methods as "lean production" (Womack et al., 1990, 49).

Six Sigma is a rigorous, focused, and highly effective implementation of proven quality principles and techniques (Pyzdek, 2003). Literally, the term six sigma is representative of a quality standard of producing no more than 3.4 defects per million opportunities. Six Sigma as a process improvement philosophy began at Motorola in the mid-1980s under CEO Bob Galvin, with the actual term Six Sigma being coined by Motorola engineer Bill Smith. As a company facing fierce competition in the fast-paced and ever-changing electronics industry, Motorola began implementing Six Sigma concepts to reduce defects and improve customer service. After the company won the Malcom Baldrige National Quality Award in 1988, the public took notice and the word spread about Six Sigma. Six Sigma gained even more momentum as an improvement philosophy when Jack Welch began driving the implementation of the concepts at General Electric and today hundreds of companies worldwide have adopted the Six Sigma way of doing business (iSixSigma, 2006).

In recent years, a significant amount of interest has revolved around how to make these two popular improvement philosophies work together. Many large consulting firms have branded their own buzz words such as Lean Sigma (TBM) or Lean Six Sigma (the George Group) in efforts to market the combination of these two schools of improvement thought. However, despite the growing general familiarity with Lean Enterprise and Six Sigma, and recent efforts to package the two, many companies and their executives are still unsure of exactly how Lean and Six Sigma can be applied to help them achieve organizational excellence.

Analysis

This article will analyze the applicability of Lean Enterprise and Six Sigma as a cohesive process improvement philosophy by first examining the underlying principles of each and the tools traditionally applied to support those principles. Next, a comparison will be drawn between the primary implementation methodologies of Lean and Six Sigma. Finally, a real world example will be analyzed to demonstrate the application of Lean and Six Sigma tools in unison to support an overall organizational improvement effort.

Principles and tools. Until very recently, it has been commonly accepted among organizations that two improvement philosophies exist and to accomplish improvement goals, they should choose one. Companies often embark on a Lean initiative after a top manager reads about Toyota while other companies choose the Six Sigma path after studying a case study on GE or Motorola. In other instances, a company may find itself on a Lean or Six Sigma journey as a result of a mandate from corporate headquarters. Many executives find their organizations in a crisis and, after desperate research on process improvement, find themselves staring at a difficult decision—do I implement Lean or Six Sigma? While it has been a popular practice to weigh the pros and cons of Lean and Six Sigma, there are also many subtle similarities in their principles.

The basic objective of Lean is to eliminate non-value-added activities, or wastes, in order to shorten the response time to customers. Waste is any activity or effort that does not add value, with value being defined as activities that change the form or function of a product or service based on customer specifications. To achieve this objective of waste elimination, there are five common guiding principles, as set forth by the epic book *Lean Thinking* by Womack and Jones (1996):

- Specify value: in other words, in order to eliminate non-value-added activities one must first specify which activities do, indeed, add value
- Map the value stream: mapping the value stream includes creating a visual representation of all activities involved in the material and information flow from raw material to finished goods; mapping the value stream helps to make wastes visible
- Flow: the product or service should move as immediately as possible from one value-adding activity to the next
- Pull: the rate of flow should be dictated by customer demand, not the capability of the process
- Perfection: improvement should be made continuously to eliminate wastes

While Lean is based on waste elimination, Six Sigma's primary objective is to eliminate defects. Six Sigma is often thought of as a quality program, but such a proclamation is short-sighted. Six Sigma is about helping organizations become more profitable by improving customer value and efficiency (Pyzdek, 2003). This is accomplished through the following four principles:

- Eliminate defects: Six Sigma strives to eliminate all defects, which as defined by George et al. (2004b) are anything that is unacceptable to a customer
- Reduce variation: it is necessary to reduce process variation in order to reduce product variation, which is key to eliminating defects
- Data: Six Sigma is data-driven, which serves to reduce political influence so that more effort can be focused on true improvements
- Voice of the customer: projects are defined with a goal of identifying and eliminating costs which provide no value to customers (as opposed to cutting costs in activities that might affect quality or delivery time) so that customers may be serviced faster, better, and cheaper

Although the principles of Lean and Six Sigma may differ in language, there is certainly no conflict in their objectives. Many process improvement experts consider Lean to be about speed while Six Sigma is focused on quality, but in actuality both philosophies place an equal emphasis on speed and quality, along with cost, in order to respond faster, better, and cheaper to customers.

Lean is focused on eliminating waste while Six Sigma is focused on reducing defects and variation, but these two focuses are not conflicting; waste elimination inevitably leads to a reduction in process variation, which potentially leads to a reduction in product variation, which potentially leads to fewer defects. In addition, defects are actually one of the seven deadly wastes identified by Ohno (1988) at Toyota.

Six Sigma's emphasis on data to reduce variation is complementary to Lean's emphasis on flow and pull; variation only impedes flow and must be reduced in order to achieve flow. Lean's goal is to flow at the pull rate of customer demand, thus extensive data analysis must be performed to assess demand and analyze respective processes versus that demand to evaluate a value stream's capability of flowing at the desired rate.

Finally, both Lean and Six Sigma place a strong emphasis on the customer. Both philosophies are in agreement that systematic continuous improvement is necessary to consistently meet customer requirements. In order to promote continuous improvement, both Lean and Six Sigma advocate varying degrees of structured training for employees at all levels of the organization. Once proper training is administered, employees are able to understand their respective roles in the improvement initiative and are able to speak the Lean or Six Sigma language. With adequate training, employees are then viable candidates to be a part of the many variations of process improvement teams utilized by both Lean and Six Sigma to accelerate continuous improvement.

While there is a significant amount of similarity in the primary principles and objectives of Lean and Six Sigma, the greatest point of differentiation between the two resides in the tools traditionally used by each to support those principles and achieve those objectives. Lean utilizes value stream mapping to look at the big picture and prioritize implementation efforts. Value stream mapping is a tool used to document all actions currently required (material and information flow) to bring a product or service into the arms of the customer (Rother and Shook, 1999). Six Sigma utilizes other various methods in project selection, including scoring methods that assess cost benefits and quality function deployment (QFD). In the beginning phases of the initiative, Lean improvement projects favor the selection of tools such as 5S, quick changeover, and point-of-use-storage; these tools are generally applied immediately to eliminate low-hanging waste and the benefits of these tools are visually evident. As Lean initiatives grow more mature in an organization, advanced tools such as cellular flow, kanban, and total productive maintenance require more analytical attention. Six Sigma tends to use more statistically-based quality tools such as Pareto analysis, statistical process control (SPC), process capability studies, and design of experiments to analytically address problems throughout implementation. The results of these efforts are generally less visible to the uninvolved and show up on paper in the form of productivity reports, quality reports, and financial statements.

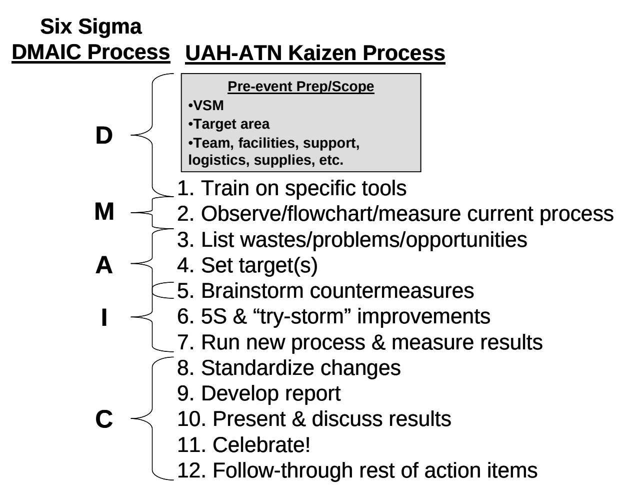
Methodologies. The previous section discussed the similarities and differences in the principles and tools associated with Lean Enterprise and Six Sigma improvement programs. This section will analyze the methodologies used by each in the implementation of their respective tools--including personnel used to implement, length of implementation projects, and the implementation processes themselves.

Six Sigma has a structured hierarchy of implementation personnel with varying degrees of Six Sigma mastery, including green belts, black belts, and master black belts. Typical Six Sigma projects last from 3-12 months and are led by green belts, who are coached and mentored throughout the project by a black belt. Six Sigma implementation is based on a standardized methodology known as DMAIC (define-measure-analyze-improve-control).

The Lean implementation methodology is called kaizen. Kaizen, in a literal sense, is Japanese for “change for the good” and is a word that has become synonymous with improvement, not only at work but in every day life (Imai, 1986). Kaizen, as used in Lean implementation, is a continuous improvement process that involves gathering a small team and performing an intensive waste elimination effort on a specific process. Although Lean does not have the formal personnel ranking system inherent in Six Sigma, a typical facility that is firmly established in a Lean initiative often features one or more kaizen facilitators who oversee several kaizen leaders. In its purest sense, kaizen is essentially everyone’s job. There are varying incarnations of kaizen, the most typical form being a kaizen blitz event, which is a project led by a kaizen leader and lasts from 3-5 days. Other forms of kaizen include kaizen super blitzes, which last for 1 day and are often performed on an individual level, and kaizen projects, which last from 2 weeks to several months and involve upper management.

Lean and Six Sigma have differing approaches to implementation in regards to project length and the formality of personnel positions, but the logic of the DMAIC implementation process and kaizen are strikingly similar. Exhibit 1 illustrates the similarities in the DMAIC process and the 12-step standardized kaizen process developed by the Alabama Technology Network at the University of Alabama in Huntsville (UAH, 2002).

Exhibit 1. DMAIC and Kaizen Processes



Regardless of the complexity and length of the project scope, the same 12-step kaizen process can be applied. There are numerous methods by which areas may be targeted for kaizen. Areas may be chosen strategically because they are in a highly visible area or because it is an obvious bottleneck and a quick-win kaizen effort could result in excitement being generated across the organization. However, the scope of a kaizen effort is most effectively defined through using the value stream map. A properly implemented value stream map consists of a current state map, a future state map, and a detailed implementation plan of all necessary improvements needed to achieve the future state. Thus, targeting areas for kaizen using this method ensures that the resulting efforts will directly affect the overall value stream. Regardless of the method of targeting an area for kaizen, the effort is scoped prior to the event, corresponding with the define phase.

Part of scoping, or defining, a kaizen effort involves the determination of the specific training to be performed at the kick-off of the kaizen effort. While some or all participants on the kaizen team may have been trained on Lean and waste identification, each kaizen effort should offer training just-in-time on particular tools to be used during that specific event. For example, if a five day kaizen blitz is to be held to organize and 5S an office area, participants on that kaizen event would receive training on the exact 5S process to be used during that event.

Once the specific training is complete, the next step in the kaizen process is to measure the current process by collecting appropriate data. This data may include cycle times, 5S scores, process maps, inventory levels, changeover times, or general waste observations. Before any improvement can be made, a baseline of the current process must be set in this step (step 2), which corresponds to the measure phase of DMAIC.

After measuring the current process, the kaizen participants then analyze the collected data and identify existing wastes, problems, and opportunities for improvement within the current process. Based on this analysis, the kaizen participants next set goals, relative to the scope, to be achieved throughout the remainder of the kaizen effort. For example, a kaizen goal may be to reduce setup time by 50% or reduce work-in-process to less than one day. This analysis phase (steps 3, 4, and 5 of the kaizen process) is concluded by brainstorming countermeasures that can be implemented to address the previously-discussed problems and achieve the goals.

The brainstorming of countermeasures also sets the roadmap for the improvement phase. The next steps (steps 5, 6, and 7) in the kaizen process involve making the physical and procedural changes necessary to implement the countermeasures, try-storming and running the new process, and measuring the results in order to show improvement. Once actual improvement is verified by running and measuring the new process, control mechanisms must be integrated to ensure the improvements are sustained.

The remaining steps (steps 8-12) in the kaizen process each serve as important control mechanisms. Standardizing the new process provides documentation of the changes so that employees can be trained and the related activities do not regress to the ways of the old process. Preparing and presenting the report of the kaizen activity gives the participants ownership of the new process. Because participants are typically those who perform the related tasks, their involvement in the presentation contributes to their subsequent buy-in. Celebration is also an important element relative to control. Management has power over celebration, and it often does not take much to give the kaizen participants a feeling of accomplishment and recognition. Accomplishment and recognition, according to Herzberg (1968), are motivators, thus management-driven celebration of improvements goes a long way toward promoting behavior conducive to sustaining those improvements. Finally, prompt follow-through on any unfinished tasks from the kaizen event is important because a failure to do so has the potential to be interpreted as viewing the effort as unimportant, thus vanquishing any momentum from the kaizen effort.

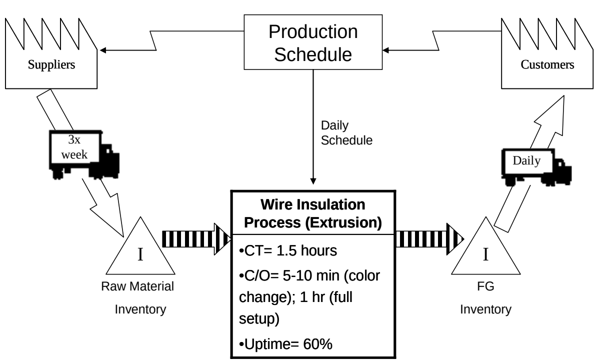
Relative to the comparison of implementation methodologies, Lean and Six Sigma vary in the formality of personnel rankings and length of project duration. However, once terminology is set aside, the structured thought process that both Lean and Six Sigma advocate for implementation are virtually identical.

Example of application. This section will demonstrate one application of Lean and Six Sigma tools utilized in unison throughout a systematic process improvement effort. The Alabama Technology Network at the University of Alabama in Huntsville (UAH-ATN) is a not-for-profit provider of process improvement assistance, including expertise in the areas of Lean and Six Sigma, for a wide variety of organizations. One such organization, Syndeo Corporation, was an ideal candidate for the employment of both Lean and Six Sigma offerings to help achieve their organizational goals.

Syndeo Corporation is a small insulated wire fabricator in north Alabama that supplies primarily tier 1 automotive companies. As a relatively young company (established in 2000), Syndeo had found its niche in the automotive market as a minority-owned supplier with a strong focus on customer service and quality. In late 2004, Syndeo was enjoying success and looking at a potential increase in sales of over 60%, a figure that would double the company's profit. Syndeo management wanted to avoid addressing this drastic increase in sales volume through capital additions for two reasons: capital investments were not feasible because of the company's small size and Syndeo believed, according to equipment specifications, that it had the needed capacity on its two existing wire insulation machines to meet projected sales. However, if the company did not make improvements to their process they would not be able to realize their full existing capacity, which could result in overwhelming the production department and taking a hit on quality and customer satisfaction. UAH-ATN was brought in to work with the company to analyze current capacity utilization and suggest improvements necessary to increase utilization to meet the projected sales.

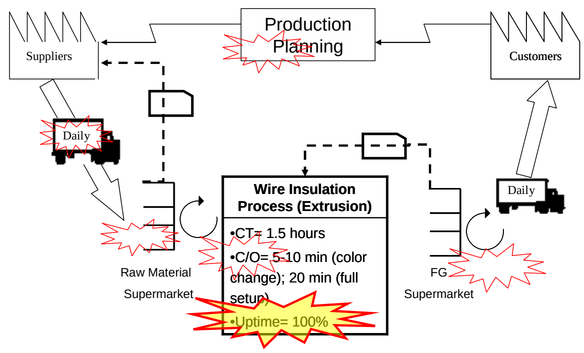
The process improvement effort at Syndeo began with a value stream map in order to gain a holistic view of the company, including the integration of material flow, inventory locations, information flow, and key process parameters which could serve as capacity constraints. The current state value stream map is shown in Exhibit 2.

Exhibit 2. Syndeo Current State Value Stream Map



The current state value stream map offers an avenue to look at the big picture and see opportunities for improvement relative to key problem areas. In the case of Syndeo, these key problem areas included equipment downtime (uptime in the current state was only 60%), lengthy set-up times, excess inventory (both in raw materials and finished goods), and supplier relations issues. The purpose of value stream mapping is to use the current state to identify and define problems in order to design and implement a future state to address those problems (Rother and Shook, 1999). Thus, based on Syndeo's current state, a future state value stream map was created featuring improvement bursts that defined implementation projects necessary to achieve the desired future state. The future state is shown in Exhibit 3.

Exhibit 3. Syndeo Future State Value Stream Map



Value stream mapping is an effective tool for defining problem areas on which to focus improvement efforts. Future state maps highlight necessary improvement projects, each of which with the potential to utilize Lean and/or Six Sigma tools during implementation. Thus, value stream mapping is an ideal tool to use in the define phase to visually demonstrate how Lean and Six Sigma can be used together throughout the organization to achieve overall business objectives.

While the value stream mapping process serves to integrate Lean and Six Sigma efforts at the overall organizational level, each individual improvement burst also has the potential to utilize both Lean and Six Sigma offerings simultaneously and seamlessly. For example, the design of a finished goods supermarket during the implementation of a pull/kanban system would greatly benefit from a statistical analysis of the variation in customer demand. In Syndeo's situation the improvement burst that took priority, because of their business objective of increasing capacity to meet increased sales, was improving equipment uptime. The remainder of this section will demonstrate the use of Lean and Six Sigma in parallel to address this area of opportunity as an example of how the two ideologies can be used in concert on isolated improvement projects in addition to holistic planning. With the similarities having already been drawn between the Six Sigma DMAIC methodologies and the Lean kaizen process methodology, the DMAIC terminology will be used for the remainder of this example.

With the problem--lack of equipment uptime--having been defined through the use of value stream mapping, the next phase was to determine how to measure downtime in the existing state. The Lean tool of total productive maintenance (TPM) was chosen as the vehicle of measurement. TPM is a strategy to achieve zero unplanned downtime and zero defects through integrating equipment maintenance into the manufacturing process by achieving overall equipment effectiveness. TPM works to measure and eliminate the six big losses that are obstacles to equipment effectiveness (Nakajima, 1988). Exhibit 4 lists and defines these six big areas of loss.

Exhibit 4. The Six Big Losses of TPM

Loss	Definition
Breakdowns	Equipment failure
Setup and Adjustment	Process changeover from one production run to another
Idling and Minor Stoppages	Due to abnormal operation of sensors, blockages of chutes, etc.
Reduced Speed	Discrepancies between equipment's designed run speed and actual run speed
Defects	Lost run time for good product due to running out-of-specification product or repairing defects
Startup Losses	From machine startup to stable production of good product

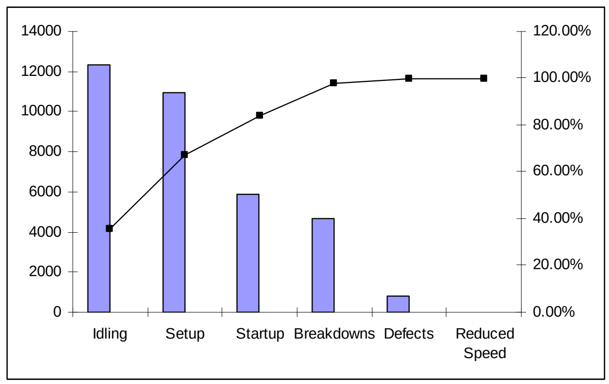
To execute the measure phase at Syndeo, UAH-ATN facilitated a 3-day kaizen event with a team featuring representation from management, production, and maintenance. The scope of the kaizen event was to develop a measurement tool to capture equipment downtime, train operators in using the measurement tool, and implement and validate the tool for data collection for use in the analyze phase. In order to ensure accurate data collection, the kaizen team decided on a simple form that could be filled out by hand by the equipment operator as downtime occurrences happened. The downtime data collection form was developed and implemented on the first day of the kaizen event and operators on all three shifts were trained by the kaizen team on why the data was being collected and how to fill out the form. The kaizen team monitored and adjusted the data collection process for the remaining two days of the kaizen event to validate that correct downtime data was being captured.

A computer spreadsheet was also developed during this kaizen event to prepare for analysis of the downtime data. The computer spreadsheet was designed to allow for analysis of downtime by shift, by machine, and overall. Data was captured by operators; the data forms were collected and entered into the spreadsheet daily by management. A follow-up kaizen event was scheduled a month later to begin analysis of the downtime data.

After a month of data collection, the analyze phase of the uptime improvement effort was kicked off with another 3-day kaizen event facilitated by UAH-ATN. Initial analysis included reviewing and discussing the raw data comparing downtime between shifts and between lines, both by number of occurrences and by total lost time. In general, this situation would be an ideal candidate for Six Sigma statistical analysis to determine if there were, indeed, any significant differences between shifts or machines. At Syndeo, this data was analyzed graphically with bar charts and no obvious trends suggesting any difference in either shift or machine were apparent, thus it was decided to focus analysis efforts on the overall downtime data (for all shifts and both machines).

The overall downtime data at Syndeo was then further analyzed using the Six Sigma tool of Pareto analysis. Pareto analysis operates on the principle that a small percentage of issues cause a large percentage of the problems (Pyzdek, 2003). Exhibit 5 shows a Pareto chart of Syndeo's overall downtime, in minutes and percentages, for the six big losses.

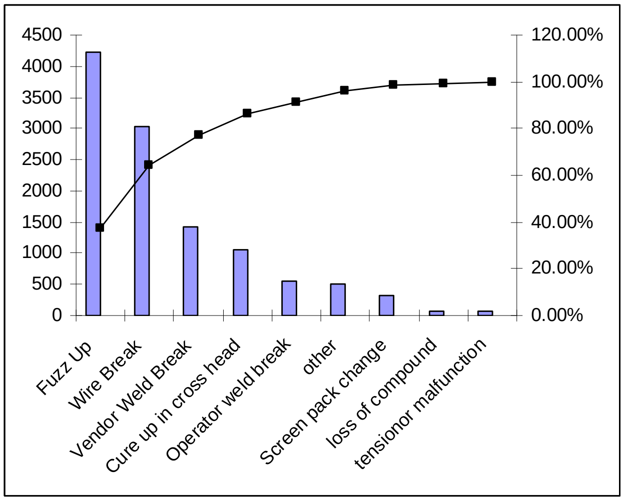
Exhibit 5. Pareto Chart of Six Big Losses



Of the six big losses, the majority could be accounted for in the categories of idling/minor stoppages (36%) and setup/adjustment (32%). This analysis helps to pinpoint exactly where to focus efforts during the improve phase and also demonstrates how both Lean and Six Sigma tools can be applied during both the analyze and improve phases. For example, the Lean tool of quick changeover and the principles of SMED (single minute exchange of dies) could be implemented to reduce lost time due to setups and adjustments. SMED is a theory and set of techniques used for performing setup operations and adjustments between production runs in a matter of minutes as opposed to hours. This reduced setup time results in gained run time and also allows a drastic reduction in inventory (Shingo, 1985).

In the case of Syndeo, the Pareto analysis also led to further analysis of the categories accounting for the most lost time. The fact that idling/minor stoppages was the most frequent cause of downtime prompted the kaizen team to pull the downtime data forms filled out by the operators and investigate further into this category. Again, a Pareto analysis was performed, this time within the category of idling/minor stoppages. The idling/minor stoppages Pareto chart is shown in Exhibit 6.

Exhibit 6. Pareto Chart of Idling and Minor Stoppages



This analysis of idling/minor stoppages also leads to vast opportunity for the application of Lean, Six Sigma, and other strategic improvement tools. Syndeo's vendor weld break issues, which were a contributor to lost time due to idling/minor stoppages, could be addressed through an organizational strategy of sharing Lean Six Sigma training and coaching with suppliers in order to reduce inventory and increase supplier quality (George, 2002). The wire break issue, which is more of a result of a tension setting on the equipment, is an ideal candidate for a design of experiments on key relative process parameters. Each individual problem area is a candidate for the use of a variety of Lean and Six Sigma tools geared toward root cause analysis, such as 5-why analysis, brainstorming, and cause-and-effect diagrams.

Problems often have multiple root causes and proper root cause analysis in the analyze phase can lead to even more opportunities to utilize Lean and Six Sigma tools in the improve phase. In the Syndeo example, the leading cause of idling/minor stoppages was a quality issue called a fuzz-up, which was an instance where a loose strand of the multi-stranded raw material wire would snag and stall the machine. Through a problem/cause/countermeasure brainstorming session, the kaizen team determined potential causes of the fuzz-up problem and developed a list of countermeasures to implement in the improve phase. Exhibit 7 shows a sample of the problem/cause/countermeasure brainstorming analysis and demonstrates the involvement of both Lean and Six Sigma tools.

Exhibit 7. Brainstorming Analysis of Fuzz-up Problem

Problem	**Cause**	**Countermeasure**
Fuzz-ups	Some extruding tips are dented and damaged	5S tip storage area to purge out bad tips
	Wire feed misaligned due to eyeballing adjustments	Perform DOE on alignment settings, document proper ranges with visuals controls
	Damaged raw material wire from vendor	Contact vendor, work on supplier relations

Once countermeasures are implemented during the improve phase, additional potential to utilize Lean and Six Sigma tools exists in the control phase to ensure improvements are sustained. At Syndeo, substantial effort was focused on documenting setup procedures using the Lean tools of standardized work and visual controls. The result was a pictorial standardized setup procedure useful for training operators on best practices to eliminate both waste and variation in setup times. Statistical process control (SPC) could also be utilized to monitor setup times to ensure that the procedures have indeed reduced setup time, and if not SPC would alert management to take action. Syndeo also developed an extruder tip evaluation program during the kaizen event as a control mechanism to prevent that particular cause of fuzz-ups. Once a design of experiments is performed on machine alignment settings, the determined appropriate settings could be marked with visual controls that would both reduce setup time and reduce fuzz-up problems.

The Syndeo case does not begin to touch on all of the possibilities that exist throughout organizational process improvement to use Lean and Six Sigma tools with their company. This example only encompasses one part of one improvement burst (increase uptime) from the future state value stream map. Each additional burst has the potential to offer even more instances for cooperation of these two continuous improvement superpowers. For industries and businesses in general, the possibilities are seemingly endless.

Interestingly, at Syndeo, although a small group of managers had received introductory Lean training in the past, the improvement efforts were never sold as Lean, Six Sigma, Lean Six Sigma, or anything else. There were no banners adorning the walls or trumpets sounding to announce the arrival of a new process improvement savior to exonerate them from their sins of inefficiency. Syndeo is a small, privately owned company in an industry where competition and change are high-paced. The company felt their energy should be focused less on buzz words and more on the improvements needed to meet their organizational objectives—regardless of the brand name.

Conclusions

Lean Enterprise and Six Sigma are the two most prominent improvement philosophies available to organizations today. Lean and Six Sigma each have their own distinct set of principles, tools and methodologies; however, their objectives are similar. Both Lean and Six Sigma have the objective of satisfying their customer by offering a shorter response time, perfect quality, and lower cost for all products and services.

The points of differentiation between Lean and Six Sigma seem to be more of a source of complement, rather than one of conflict, for achieving the objectives. The Lean principles of waste elimination and flow harmonize with the Six Sigma principles of reducing variation and defects. In order to achieve the faster-better-cheaper objective, both waste and variation must be eliminated from all processes. Together, Lean and Six Sigma's respective tools offer a complete set of proven techniques to eliminate waste and variation.

The areas of similarity between Lean and Six Sigma only serve to strengthen the argument that the two philosophies are complementary. With the detail of formality aside, Lean and Six Sigma advocate training at all levels of the organization to support empowered employees leading the continuous improvement efforts. Lean's traditional quick, bias-for-action kaizen implementation couples well with Six Sigma's longer, analytically based implementation mentality to offer a balanced set of options for project implementation. Regardless of the project timeframe or terminology used, the structured thought process used by Lean and Six Sigma for implementation is virtually identical. For any given problem, Lean and Six Sigma implementation is as simple as clearly defining the problem, measuring and analyzing the current process to fully understand the causes of the problem, implementing appropriate tools as countermeasures to improve the problem, and standardizing and controlling the improvement to ensure that results sustain.

The example of Syndeo Corporation demonstrated how Lean and Six Sigma tools can be employed with synergy throughout a systematic improvement effort. In the define phase, value stream mapping was used to generate a list of improvements, each with the potential of using Lean, Six Sigma, or both to address issues. In the measure phase, the Lean tools of TPM and kaizen were used to capture downtime data. In the analyze phase, Pareto analysis and kaizen brainstorming were used to highlight root causes. Those root causes were then addressed in the improve phase by using a variety of Lean and Six Sigma tools such as 5S, design of experiments, SMED, and visual control. Improvement efforts have the potential to be controlled with standardized work, visual controls, and SPC. More importantly, Lean and Six Sigma tools were used seamlessly throughout the Syndeo improvement effort with less of an emphasis on the brand name of the improvement style and more of an emphasis on applying the right tools at the right time to benefit the organization.

Recommendations

Lean Enterprise and Six Sigma have each allowed hundreds of organizations to realize significant results from their respective implementations. However, the benefits of employing either Lean or Six Sigma alone are limited compared to the benefits of employing an amalgamation of both. To fully realize the next level of improvement available by using Lean and Six Sigma simultaneously and seamlessly, executives, engineers, and professionals practicing in the field of continuous improvement consulting should place consideration on the following recommendations:

- *Consolidate the toolbox*- Lean and Six Sigma each offer tools useful in addressing problems that face all organizations. The key is having all the correct tools available and trained personnel to use them when the problem arises. A trained mechanic does not only keep metric tools on hand and attempt to use a 25-milimeter socket on a one-inch bolt head. Doing so would possibly achieve the immediate goal (loosening or tightening the bolt), but would likely cause greater problems in the future (a worn or stripped bolt head). Likewise, having only Lean or only Six Sigma tools available within an organization reduces the chances of effective long-term solutions to problems.

  It is important for organizations to have expertise in Lean and Six Sigma philosophies. It is not necessarily a requirement that all individuals involved in continuous improvement in an organization to be experts on Lean and Six Sigma, but it is necessary for those individuals to have an understanding of when and where to use the appropriate tools, and to have access to those resources of expertise for all problems.

- *Acknowledge the similarities of Lean and Six Sigma and embrace the complementary differences*- The sooner those involved in continuous improvement get past the notion of choosing whether Lean or Six Sigma fits for their company, the sooner they will be able to realize the real results of using both. All processes have waste and variation which impede response time, quality, and cost efficiency. The key is to adopt a philosophy of using the structured problem solving approach shared by Lean and Six Sigma to implement the appropriate tools (from the now-consolidated toolbox) at the appropriate time to achieve overall organizational improvement by eliminating the existing waste and variation.
- *Tear down the departmental walls of continuous improvement*- While having only a Lean department or only a Six Sigma department for continuous improvement certainly results in limitations, the existence of both departments within an organization also is a short-sighted approach. Organizations that vaunt a Lean group and a Six Sigma group separately can expect to encounter the same issues as a facility with a functional layout—islands of optimization, lack of understanding of the big picture, turf-battles, and a lack of flexibility to respond to needs. Ultimately, a departmentalized continuous improvement structure will have the same detrimental effects on the response time, quality, and cost efficiency of improvement efforts that a departmentalized facility layout has on deliverable products or services.

For decades, organizations have focused efforts on integrating departments and functions to eliminate the over-the-wall-mentality in order to place an unmistakable focus on the customer. The time has come to break down the walls of continuous improvement to accomplish that same customer focus.

- *Eliminate the buzz words*- While the buzz words of Lean, Six Sigma, and any combination thereof may be important from a marketing standpoint in the embryonic stages, the time must come, sooner rather than later, to focus on the results and not the packaging. The organizations that achieve greatness focus little energy on rolling out brand name initiatives or launching programs and focus more energy on achieving results (Collins, 2001). In terms of improvement, customer requirements are the following: faster, better, and cheaper. Customers do not care if those requirements are met by Lean initiatives, Six Sigma initiatives, or any other buzz word. Thus, in relation to improvement efforts, energy spent focusing on buzzwords is non-value-added.

References

Collins, Jim, *Good to Great*, Harper Business (2001).

George, Michael L., *Lean Six Sigma: Combining Six Sigma Quality with Lean Speed*, McGraw-Hill (2002).

George, Mike, Dave Rowlands, and Bill Kastle, *What is Lean Six Sigma*, McGraw-Hill (2004).

Herzberg, Frederick, “One More Time: How Do You Motivate Employees?”, *Harvard Business Review*, (January/February 1968).

Imai, Masaaki, *Kaizen: The Key to Japan’s Competitive Success*, Random House (1986).

iSixSigma, *The History of Six Sigma*, Available from Internet: http://www.isixsigma.com/library/content/c020815a.asp (cited 2006-02-06).

Nakajima, Seiichi, *TPM: Introduction to Total Productive Maintenance*, Productivity Press (1988).

Ohno, Taiichi, *Toyota Production System*, Productivity Press (1988).

Pyzdek, Thomas, *The Six Sigma Handbook, Revised and Expanded*, McGraw-Hill (2003).

Rother, Mike, and John Shook, *Learning to See*, Lean Enterprise Institute (1999).

Shingo, Shigeo, *A Revolution in Manufacturing: The SMED System*, Productivity Press (1985).

The University of Alabama in Huntsville, *Kaizen Facilitation Training*, training materials developed by UAH (2002).

Womack, James P., Daniel T. Jones, and Daniel Roos, *The Machine That Changed the World*, HarperPerennial (1990).

Womack, James P., and Daniel T. Jones, *Lean Thinking*, Free Press (1996).

About the Author

Nicholas Loyd received his M.S.E in Engineering Management and his B.S.E in Industrial and Systems Engineering from the University of Alabama in Huntsville. He currently works in the Office of Economic Development at UAH with the responsibility of providing client companies with training and implementation in the arena of Lean Enterprise. He is a certified Lean instructor by both the National Institute of Standards and Technology (NIST) and MIT’s Lean Aerospace Initiative and a certified Six Sigma green belt by the Institute of Industrial Engineers.