Combining Lean and Six Sigma Methodologies

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Abstract

This paper will discuss the synergies between Lean methods and Six Sigma techniques. Specifically, the use of a combined roadmap will be used to illustrate in two examples how adding either one to the other can accelerate or amplify the results achieved. Lean manufacturing techniques generally aim to identify and eliminate waste in the production or service delivery system, while Six Sigma techniques were built around identifying and eliminating process variation and defects in delivered products or services. Both approaches have been independently and jointly elevated to full enterprise wide deployments with pre-defined roles and responsibilities organization wide. Those aspects have been documented elsewhere and are outside the scope of this paper.

Lean or Six Sigma?

Many people have contended that one of these methodologies should be deployed prior to the counterpart. In our experiences, either may be deployed first, depending upon business needs and circumstances. In the Art of War, (Tzu, 513 B.C.) counsels us on the need for Strategic Adaptation. In many ways charging forward with a change effort can be thought of as a war, with complacency and poorly executed change efforts viewed as the enemy. Hopefully our change efforts are accomplished with passion, but without any violence! The areas of understanding advantages and disadvantages for adaptation were especially emphasized in this early reference on strategy.

So it is with Lean and Six Sigma, each can benefit from the other if you understand the objectives, benefits, and limitations of these two approaches. Dr. Steve Zinkgraf has recently spoken about this topic in his paper on Matching Methodologies, albeit from a design perspective. Each may be deployed separately for certain organizational needs and goals, again depending upon the environment. If deployed separately, they should not be set up as competitors: rather, they should be introduced as having clear and complimentary goals. In the race for doing more with less, combining these two may be a good solution for your organization.

Most readers will already know that the objectives of Lean methods are primarily to drive out waste and increase efficiency. There are many variants of implementing the tools and techniques of Lean. There are also different variants of Six Sigma, however most process implementations follow 5 defined phases, usually along the DMAIC roadmap popularized at companies such as Honeywell and General Electric. Many readers are also familiar with these.

Many Lean implementations initially focus on rapid results and fast turn around, usually through a series of Kaizen events. These are very useful when efficiency

needs improvement and when roadblocks exist that prevent delivering value smoothly to customers. The variability in flow of product, service, and information may be rapidly improved. These events rely upon having the right people, with the right knowledge of the processes, involved to make these rapid changes. However, for low-yield processes, one should note that the right process knowledge may not exist, and thus the need for Six Sigma projects to more fully develop Y=f(x) type knowledge Kaizen practitioners should have as a goal, the identification of low-yield processes and technical barriers that create pull for six sigma projects and practitioners.

Many Six Sigma projects often uncover processes in need of clean up prior to making effective measurements necessary for variability understanding and analysis. In addition, flow of information, product and service may not be considered during the project, unless it appears as primary driver to the problem being addressed by that project. In addition, most initial training projects (First BB project) may take anywhere from 4 to 8 months to complete. In retrospect, some initial process clean up will usually shorten this cycle time for project completion.

Benefits and Limitations

In implementing only lean methods, many valuable and rapid improvements can occur quickly. Most associates in value delivery chains can learn to use these techniques and then replicate the approach in follow-up events without a lot of support and mentoring. The SBTI Lean-Leader™ program is an example of this approach. However, complex problems, that have persisted for a long time, with unknown causes, will usually require more detailed roadmaps, process-focused tools, and a numerical problem-solving methodology. Leadership is still required to demonstrate knowledge, passion and proficiency to make any effort last in Lean implementations.

In implementing solely Six-Sigma methods, large projects associated with complex problems will typically achieve large breakthrough results, albeit over a longer time period than a series of Kaizen events would take to complete. However, the statistical methods involved, sophistication of the tools and techniques, require an intermediate knowledge of mathematics, process literacy, some computer proficiency, and the ability to internalize these advanced methods quickly. Not all associates have these capabilities, some selection and screening is necessary from a personnel perspective.

Many organizations do not have appropriate technical and managerial mentors in place at the start of Six Sigma. Thus training of some key individuals as Master Black Belts and Champions is usually required to sustain the Six Sigma implementations. Leadership is still required to demonstrate knowledge, passion and proficiency to make any effort last in Six Sigma implementations.

When Six Sigma projects uncover processes that are not stable nor ready for improvement, some initial efforts to remove waste and non-value added activity offer leveraged opportunities for the project. Implementing a short, 2-day Kaizen event, called a Special-K™, can often pull together a team and quickly eliminate obvious non-value-added activities, resources and space. This will only serve to accelerate the Six Sigma projects that employ such efforts.

Many Six Sigma projects identify and correct "low-hanging fruit" or items that are easily fixed along the way. If left to the practitioner, their knowledge of Lean methods may strongly influence how these are corrected, and how long these changes may last. Specifically, the understanding of bottlenecks and buffers for specific variability issues is crucial towards achievement of long-term success. Under-educated practitioners in these areas may attempt to reduce buffer sizes without removal of the underlying variability that drives them. If you are not managing your bottleneck, then it is most likely managing you! Knowledge of lean tools and methods can bring tremendous leverage to Six Sigma project work.

When working in the Improvement Phase, there are times when the flow of product, service and/or information turns out to be a root or contributing cause to the variability experienced at the end of the targeted process. At this point, Kaizen events may be utilized to make the necessary improvements to correct these flow issues.

Two primary advantages of combing the tools of Lean and Six Sigma include faster Six Sigma projects, and improved process efficiencies in those projects. Using a Special-K Kaizen up front and a full Kaizen during the improvement phase will achieve these results. Shortening the cycle time to 13 weeks overall requires full time Black Belts, but yields big results, and quickly. By week 13 for a full class, there should be over $1M in immediate operational savings from the Kaizen events. The use of Special-K™ upfront and Full Kaizen in combining Lean and Six Sigma have recently been implemented by SBTI in their K-Sigma™ program and discussed by Ficalora., see China BB Program

Combining the tools of Lean and Six Sigma

These tools may be organized along the traditional DMAIC roadmap, and taught together along the same lines to simultaneous Lean and Six-Sigma practitioners, or Black Belts.

The summation goals for tool usage would be as follows:

Sources of Variation and Waste can be:

- Identified
- Quantified & Prioritized
- Eliminated or Greatly Reduced

That combined with the understanding that all variation will be buffered or passed on to the next part of the value chain. The major buffers are inventory, time, and resources or capacity. A fast look at the three major components of inventory reveals some variation contributors:

Inventory Type	Variation Contributor
Raw Materials	Additional needed to cover process yields, unexpected orders, schedule variance
Work-In Process	Process variance, cycle times
Finished Goods	Demand Variance, Forecast Error, Cycle times, Process Yields

Many Lean and Six Sigma tools can be used throughout the 5 DMAIC phases. However, it is the introduction of the tool to new practitioners in the phase that is of particular importance at the outset of a project.

Specific links between the tools are outside the scope of this paper. However, these links are of critical importance, and should not be overlooked. Experienced practitioners in deployment of both methodologies are required to transfer such knowledge to new practitioners and coach them through first and sometimes second projects.

Accordingly the tools align as follows in the 5 operational DMAIC phases. Not all tools may be listed for both methodologies, but the following is a sampling of the major tools. See table 1 for this listing.

Table 1:

Define Phase

Tool	Objective
Project charter	Set project objectives, team members, scope
SIPOC Map	ID customers, suppliers, top inputs & outputs
Process Map	ID, classify independent & dependent variables
Value Stream Map	Understand Value flow through process
Spaghetti Map	Trace product, service and information flow throughout the business
Process Step Filter	Prioritize process steps for focused activities
Performance Assessment	ID value & Non-value Added work

Measure Phase

Tool	Objective
Process Variable Filter	Prioritize variables for further activity
SPC	Baseline variation, stability on key variables
Capability	Compare customer and process voices
MSA	Evaluate Measurement Systems
OEE	Evaluate critical equipment
Takt Assessment	Evaluate product velocity vs. customer needs
Special-K™	Removal of obvious non-value added items

Analyze Phase

Tool	Objective
VOC	Obtain & Analyze customer needs
Multi-vari studies	Passive data collection & evaluation
Hypothesis testing	Statistical evaluation of key inputs & outputs
Process Flow Analysis	ID of bottlenecks, buffers, use of Little's Law
FMEA	Analysis and correction of high risk items

Improve Phase

Tool	Objective
Production Simulation	Simulate & analyze product flow options
Design of Experiments	Experimentation to determine Y=f(x)
Kanban	Replenishment analysis
Pull Systems	Reduced batch sizes, increase flexibility
Cell Design	Improved flow, higher efficiency
SMED	Reduced set-up time
Monument Management	Use of large capital investments
Total Preventive Maint.	Optimizing Uptime, minimizing downtime
5S	Efficiency in work area functions
Kaizen, Kaizen Planning	Removal of non-value-added items

Control Phase

Tool	Objective
Control Plan	Implement changes in sustainable ways
SPC	Control key independent variables
Visual management	ID & correction of problems as they arise
Audit Planning	Verification of new processes, procedures

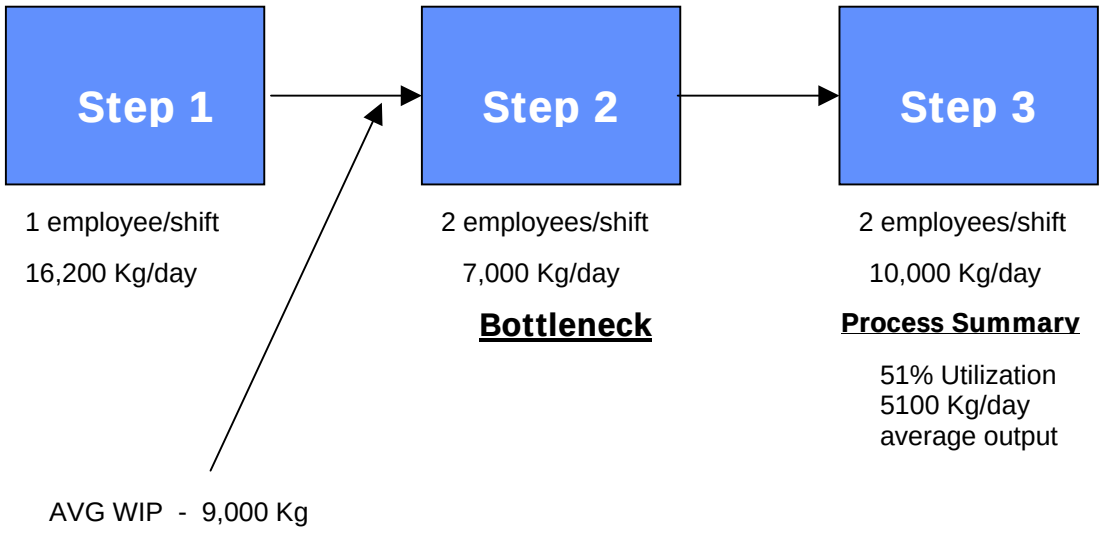
Case Studies:

The first case study is about work that was conducted by Mr. Todd Smith of Sylvania, who is credited for his hard work and contributions at integrating Lean and Six Sigma early on, prior to the existing K-Sigma™ roadmap. The forecast for a potential increased demand is one business consideration, and lower-cost foreign competition is another consideration, which may impact the first item.

This effort involves a 3-step chemical manufacturing process as depicted in diagram 1. By evaluating the quantity produced and the cycle times, it became clear that step 2 is the bottleneck of the process. This was one initial focus as it is the pacing item in flow of the entire process.

Diagram 1

Process Diagram



Focusing on the bottleneck revealed some additional aspects of this step in the process. There were 3 furnaces, with a theoretical capacity of 7000 kg per day of materials processing. However the uptime for this step was 71%. The scrap rate was 9.2%, and rework is not possible for out of spec batches.

Since this is bottleneck, increasing the uptime would be beneficial to the entire process. Utilizing the toolset of TPM and some Six Sigma tools reduced the guesswork at maintenance schedules and improved the predictability of uptime. Key items that were discovered to have synergy between Six Sigma tools and TPM can be seen in Table 2.

Table 2.

TPM item	Six Sigma Tools
Initiate Downtime tracking	Failure Mode Pareto, Time Series analysis
Operator Based Maintenance	Process FMEA
Preventative Maintenance Plan	Process FMEA
Cleaning and Inspection	Process FMEA
Wear Part replacement frequencies	CpK > 1.5
SPC on key parameters	Variable Priority Filter, Multi-vari Analysis
Process Control Plan	Process FMEA

After applying these tools together, the uptime increased to 91%, with a 6300 kg/day average output. Time series analysis revealed that start up and shut down were major sources of inefficiency so a 7 day schedule was implemented. Maintenance costs were reduced by over $10k per month. Additionally, the scrap rate was reduced to 5.1%, and breakage of a key handling item was reduced by 66%, for a net annualized savings in this step over $250k.

Returning to Step 1, it was discovered that while rework is possible, it takes 4 days to rework a faulty batch. The first pass yield in this step was 92%, with corresponding subjective criteria for the rework decision. A measurement systems analysis revealed that the measurement system contribution was 56% of total variation in the data. Correction of measurement system deficiencies resulted in a first pass yield of over 99%. Additionally, a second shift employee was able to run another process due to the lack of rework. The net annualized savings at this step was over $150K.

The final effort was to look at Step 3, which had been ignored previously because it followed the bottleneck. The total output initially was only 5100kg/day. This step had a utilization of 41%, meaning that one shift too many existed. This buffer was unnecessary and was costing money. The third shift was then staffed with only 1 operator to build ahead for shifts 2 and 3. The second issue in Step 3, was an unknown scrap cause. This work followed the traditional Six Sigma roadmap. Work on a faulty measurement system followed by a multi-vari study of key factors resulted in over $500k of additional savings.

Case Summary

3 additional projects generated from measurement phase of this project, which eventually netted $600,000 annually. None of the savings in this project required moving past the analyze phase of the MAIC roadmap. Over 50% of the savings in this project were realized just by correcting poor measurement systems. The total project time was 4 months. This is just one portion of the Lean & Six-Sigma effort in this area. The total analysis resulted in a 26% reduction in labor cost with no loss of production capacity and much greater

flexibility with which to serve the customer. The total savings annualized were projected at $2900k.

Case Study 2:

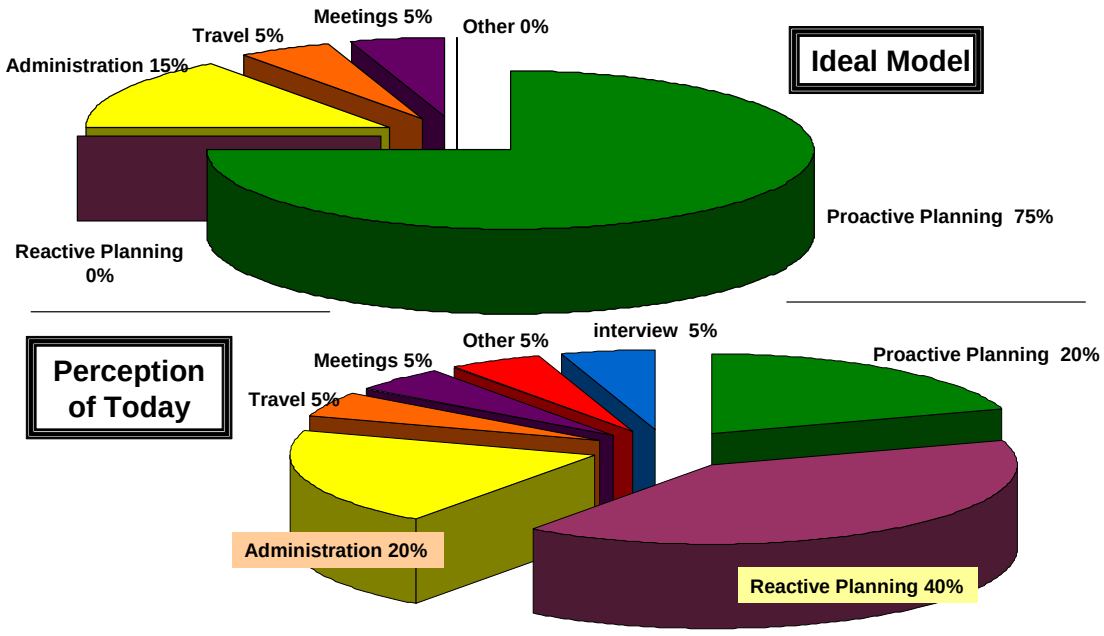
The second case study is about shop floor deployment and comes from Julien Renaud and Joe Costello.

Shop Floor Deployment Roadmap
The Operational Assessment,

The business assessment process set the direction for operation improvement. One of the key elements of the assessment is to dissect the plant into value propositions, basically determining the key processes in the operations that can be the focal points of operational improvement. The assessment was designed to determine the level of activities in each of these focus areas, the target level of improvement that could be expected and an estimate of the timeline for improving the business area.

The elements of the assessment included focused interviews. The objective of these interviews is to get an idea of the different number of tasks that were completed during a typical day. The tasks are then categorized into several groupings such as administrative, scheduling, traveling, meetings, expediting and other. The amount of time spent on each of the categories of activities was then compared to what his or her supervisor believed to be the case and then finally these times were compared to what the whole group believed was the ideal case. The differences in the time spent between observed time and ideal time was then evaluated for improvement options. This was the beginning of the project selection process. An example of what we found can be seen in the following
graphs.

Ideal vs. Perception of the Production Scheduler's time



Reactive management vs. proactive management is the key finding in this area. Obviously there are a lot of possible reasons for the high level of reactive management. Possible instability in the process capability, suspect raw materials quality that may be causing inconsistent available goods for shipping, disconnects between the forecast and actual demand for the finished goods. All of these potential root cause reasons would need further investigation before an actual project could (or should) be launched but the assessment allows us to look in the right direction.

Other observations during the assessment process included: Shift startup processes. How well were the shifts prepared to make the first few minutes of each shift as effective as possible? Did the operators have to go and look for production plans? Look for materials? Look for tools? Did they know if the previous shift hit their daily targets? Were there daily targets to know about?

We also assess the inventory management system. With critical questions such as; what is the purpose for the inventory on hand? Is the current inventory level driven by a demand analysis? Is the inventory segregated by demand behavior of the products? Does a majority if work-in-process inventory sit at the least mature level possibly? Is there an inventory improvement objective in place?

Most of these questions are typically very hard to answer in the average production operation of today. In a World-Class operation there is an ongoing inventory reduction program in place. In some of the most sophisticated operations we see inventories that are shared by multiple customers. For example, in one company that provides large horsepower electric motors to industry we have installed the shared inventory concept. This is where more than one customer actually owns the same motor sitting in finished goods. These motors are inventoried for the specific purpose of emergency breakdowns. These three or four customers would need this motor sent with as little as 1 hour notice in order to keep critical processes running.

The motor company could never have stocked these motors just-in-case there was a breakdown, the holding costs would have been too high since the needed emergency replacement occurred as rarely as once a year or less. But if 3 or 4 customers all agreed to share the same motor and when one of them needed it there would be a replacement build and stocked in as little as one week the probability of multiple emergencies within the same week was so low that the risk was deemed worthy. Each customer paid upfront of 1/3 or ¼ the value of the motor each to have the motor build. This allowed the motor company to have zero cash outlay (inventory that was already paid for) and each customer would be out only a fraction of the motor cost with a frozen price guarantee! The agreement was when one of these motors left the shelf all of the potential customers of this motor would be informed of the limited exposure for the following week.

Creative inventory management systems like this motor company's can be used in various industries including: textiles, chemicals, mining equipment even after-market car parts.

The organizational structure,
The organizational structure is, without a doubt, the most important consideration to any successful operational improvement initiative!
Who will be accountable for the project selection?
Who will be accountable for the project tracking?
Who will be accountable for the Black belt selection?
Who will be accountable for the curriculum selection and training provider?

A proper organizational structure addresses all these questions and more.
The organizational structure is typically made up of 4 levels:

The Executive Steering Committee,
The ESC, In the case of multi-plant operations, this committee is made up of divisional representations in Operations, Finance, Human Resources and

Distribution. Often the plant managers are members of this executive team and represent the operational leg of this committee.
The purpose of this team is very different than a divisional staff meeting and needs to have a specific and detailed agenda focused on the operation's Lean Sigma deployment. The agenda for this steering team is to report on the progress of each plant's Lean Sigma program, to share best practices and to get a roll-up of the improvement targets, planned vs. actual.

The executive team may sponsor (Champion) many of the Lean Leaders at the plant level. By having a direct link to the Executive Steering Team the Lean Leaders understand that their projects and they themselves have a very high profile in the organizational direction.

The Plant Steering Team,
Similar to the Executive team, the Plant Steering Team (PST) has the responsibility of setting the direction of each of the Project Teams, selection of the Lean Leaders and tracking the improvements, planned vs. actual, for each of the Kaizen events, Lean implementation plans and project teams. The most effective PST meetings occur weekly and last only about 45 minutes, focused on what was accomplished last week by the operations teams, kaizen events and other improvement initiatives and what is targeted to be completed this week to support the operational goals.

One of the key agenda items in every PST meeting is the report of Kaizen event status. Each kaizen event will have a report to the PST approximately 10 days after the event itself has been completed. By setting the expectations that the Kaizen facilitators are accountable to the PST will drive completion and implementation of the Kaizen action items.

Another PST requirement is **implementation benefits tracking**.
Best practice benefits tracking will have 3 levels of implementation being monitored. Level #1 is "Benefits Identified", this is the amount of savings that will occur when all the action items form previous kaizen events are closed.
Level #2 of benefits tracking is the "Benefits Implemented" by tracking the implemented actions we can start to identify risks of identifying more than we are following up with. As strange as it may seem, often times we see that we are doing Kaizen events simply because they tend to generate so much excitement in the target areas and we don't want to loose momentum. As was said by a deployment expert "It's like we have only one tool, a hammer we call Kaizen and now everything is beginning to look like a nail"
Level #3 is "Benefits Realized". These are the actual benefits that have hit the bottom line (the ones that pay the bills), validated by the plant controller.

If there is too much of a gap between any of these levels we can take a better look at what is really happening. Are we identifying a lot of savings but not pulling the trigger?

Have we overstated the benefits during in the improvement stages? Are we not identifying an accountable person to "own" the implementation? Are we giving full credit to the savings?

The Deployment Teams

Work stream teams (WSTs) – Several teams per operations usually divided by specific targeted areas for improvement i.e.: Stamping, Molding, Assembly, Sub-assembly, Finishing, Administrative, Supply chain, Warehouse, Distribution, etc.

a. Each team has a dedicated team leader. This person is trained and coached by a Lean consultant. The team leader is dedicated for the length of the project implementation phase as a minimum. The team leader is responsible for the development of a team charter, identifying improvement opportunities, identifying methodologies to implement improvement ideas (Blitzes, Mini projects, etc.), ensure that the team members meet the team objectives and report weekly to the PST on his teams progress to plan.
b. Team members (no more than 7) are partially dedicated to the project (usually 20 – 25 % of their time) during the implementation phase of a project. They have the responsibility of making the physical improvement changes in the affected processes.
c. The team has the responsibility to ensure the charter addresses the team's goals and objectives. They also work together to ensure the opportunities are identified and priorities to maximize results and minimize resources to achieve those results. The team must also work together to raise issues that prevent them from achieving their goals and objectives as soon as possible in order to get help in removing roadblocks that may come up.
d. The team must meet at least once a week to discuss strategy, update the overall status of specific team tasks and re-direct as required.
e. Maintain an open action list to ensure that new issues are captured and followed up (what, who and when).

The Lean Leaders

One of the 1st activities was to develop the internal Lean skills of the client. This was conducted via Lean Leader™ training. A Lean Leader™ is a core, full time, improvement leader. Focused at driving the Lean philosophy into the fabric of the company the Lean Leaders are process improvement zealots that, once

trained, will be the support system for the deployment team's implementation plans, conductors of Kaizen events and Lean awareness trainers.

Lean Leader™ is a multi-week training course that includes at least 2 waves of Kaizen events. Lean Leaders will bring the lean tools to life in internal real-world applications. From multiple forms of detail process mapping, 5S, SMED, Visual Factory concepts, flow, project management and Lean management tools these Lean Leaders will be able to carry the ball forward thus reducing the dependency on external experts. Typical Lean Leader training is 6 weeks in duration including 2 kaizen weeks.

Traditionally there will be 3 waves of Lean Leader™ training before a client will be self sustaining in Lean Leader™ deployment. During the 1st wave the Lean Leaders will trained in Lean tools, implementations techniques and Lean management concepts. This training will be totally facilitated by outside experts in Lean deployment. By the end of the Lean Leader™ training these Lean Leaders will also have identified their own Lean implementation project plans for their area if influence within the operations.

During the 2nd wave of Lean Leader training some of the previous Lean Leaders will be asked to support wave #2 rollout. Some of the training modules during this 2nd wave will be presented by wave #1 Lean Leaders. By conducting training elements the lean Leaders will be able to drive home the concepts and give credibility to the tools as they have been deployed in the business.

Wave #3 Lean Leader training will be equally facilitated by previous Lean Leaders who have been successful in deployment practices and by the outside Lean experts. During this training cycle the internal facilitators will be coached on key concepts that must be driven to ensure successful Lean Leaders. By having the previous Lean Leaders facilitating the Lean training this will give visible career path examples of what opportunities may be in store for each new wave of Lean Leaders.

The Kaizen Events

Kaizen events are the most powerful and exciting of all the Lean tools!
The origin of the word "Kaizen" actually comes from the Chinese. The concept of change or "kai" is combined with good or "zen" creating Kaizen, or "good-change"

Kaizen events are 4 or 5 days of precisely targeted improvements to an operational area.
With ½ of the first day dedicated to Kaizen tool training, by the end of the 1st day the team will have mapped the current process and started to separate what is value added vs. non-value added steps in the process.

By the end of day 2 the team will have gone from concept design, through detailed design and defined the implementation plan for the desired process state.
Day 3 takes the plans to the process, implementation day for the Kaizen team means that the design steps have been validated and approved by the process owner. Any articles that may have been in the way of the team's design should have been moved by maintenance the previous night and the new process is taking place today.
Day 4 stabilizes the improved state and full support from the Kaizen team is in place to help any of the operators with the transition into the new process. Today the control tools are put in place and all operational questions are fully supported by the kaizen team and the process owner. The team drafts their report to the executives and validates savings with the Controller.
Day 5 is simply the Kaizen report-out. A low tech report showing the improvements that the Kaizen team has put in place and any follow-up action items that will be reported to the PST in about 10 days time.

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Operational Kaizen Examples

Process Target	Event Focus	Lean Tools used	Benefits Realized
Vertical Unit chemical reactor	Turn Around Time	Mapping, SMED, Visual,	$440,000
Accounts Receivable	Reduce cash-to-cash time	Process map, Supplier Alignment,	Improve cash-to-cash lead time by 35%
Dryer Boil out Procedure	Cycle Time	SMED	37% improvement of product swap time
Catalyst Load	Maint. Reduction	SMED, Visual,	$125,000
Lab testing	Reduce the delays of lab test results	Process map, VA-NVA, Standard work, transition scorecards, supplier/customer alignment	Increase mean lead-time of the lab process by 35%
Reactor Startup	Reduce # of Reactor Startup per year	SMED, Flow & Pull, NVA, Line Balancing	$140,000
Master Batch Mixing area	Reduce inventory, increase mix prep time	5S, Visual Management/work instructions, kanban	Improved floor space utilization by 35%
Batch mixer utilization	Reduction of changeover time	SMED, Shift transition scorecard, visual management, Poke-Yoke	Decreased downtime due to changeover by 55%
Production of 'doffing' process	Reduce inventory, improve yield and lead time	Process Map, Spaghetti map, VA-NVA, Shift transition	Reduce operator travel by over 3000 ft. per shift (over 50%) reduced WIP >50%

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Summary:

Combining these two methodologies can enhance many of the benefits of both Lean and Six Sigma efforts. With that combination comes the challenge of identifying personnel appropriate for the rigors or numerical analysis and rapid internalization of many process tools and techniques. In the efforts to integrate, one should not overlook the fact that many associates not suited for this can become Lean-Leaders™, with all the benefits of the Lean and Kaizen methodology change efforts. Keeping them separate can create confusion and strife unless there is clear explanation in both camps of the objectives, benefits and limitations of both methods.

Integrating them together makes great sense. However the integration requires great commitment to set-up the projects, implement the full-time personnel planning, and setting the expectations for breakthroughs and follow-up support resources. In addition it requires an integrated roadmap and tool linkages that must be clearly explained by experienced practitioners of both methods. Finally, like any successful change effort, Lean and Six Sigma integration requires leaders that are knowledgeable, passionate and proficient in the methodology. They do not need to be experts, but they must be able to speak about why, and how these methods are being deployed.

The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

-Albert Einstein

References:

1. Leading Six Sigma – Snee and Hoerl, pp 182-185
2. Matching Methodologies – Steve Zinkgraf
3. The Art of War - Sun Tzu, Research and Reinterpretation by J.H. Huang
4. MBB Project - Todd Smith
5. China, 1st Annual Shanghai Blackbelt Convention– Joe Ficalora

6. Factory Physics – Hopp & Spearman
7. Lean Thinking – Womack and Jones