LEAN PROGRESS

Ideas for helping your company transition to lean effective and rapidly.

LEAN LEARNING CENTER

ISSUE 15
March 2009

A Fresh Look at Overall Equipment Effectiveness (OEE)

INSIDE THIS ISSUE:

Lean Learning Center

www.LeanLearningCenter.com

A Fresh Look at OEE

By Jim Sonderman

There has been considerable debate regarding the usefulness of OEE as a metric to help companies continuously improve equipment performance. Richard Schonberger recently stated in the December 2008 Issue Volume 141 No. 6 of the Society of Manufacturing Engineers "OEE comes up short as an equipment management device, and is poorly cast as a centerpiece of total productive maintenance (TPM)."

In a recent Industry Week article titled *OEE: The Heart of the Matter* by Jill Jusko Feb 1, 2009, Ryan Hale from Stroud Consulting stated that "OEE is a good beginning, and many organizations can use it to help themselves, but it's only part of the equation. As with anything, it can be applied well or not applied well."

In today's manufacturing environment, with it's strangle hold on access to capital for new equipment, companies are forced to make due with the resources they have. This tough environment demands structured systems such as TPM and the implementation of the best maintenance practices to ensure that equipment runs at peak performance when needed. Implementing structured systems such as Total Productive Maintenance requires measurement to help teams focus on the root cause of the problem and to let them know whether or not their efforts are effective.

Organizations must utilize data effectively in today's environment. Currently, Overall Equipment Effectiveness (OEE) is the predominant measurement for determining whether or not a companies equipment management practices are working effectively. It is defined as Availability Rate X Performance Rate X Quality Rate. There are other measurements such as Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) that helps determine effectiveness of an equipment wellness program. However, they are very specific and lack the complete picture that OEE can provide. Without a suitable replacement for OEE, be careful before you simply throw it in the scrap bin. In the spirit of continuous improvement, understand why OEE is not working well for your company and fix the problem at hand.

The following are some of the common issues that many companies struggle

with when using OEE in addition to recommendations for using the measurement more effectively.

Some organizations fail to correctly define OEE. They often confuse a process Performance Rate with a Productivity Rate or machine Utilization Rate. First and foremost begin with a clear definition of OEE. OEE should be defined as Availability Rate x Performance Rate x Quality Rate and not as Availability Rate x Productivity Rate x Performance Rate. Here is the mistake. Say for example that the capacity of a process is 100 pieces per hour and customer demand is only 50 pieces per hour. Lean would say you run 50 pieces and stop. This yields a machine utilization rate of only 50% or a productivity rate of 50% for the day. However, the Performance Rate is different than productivity or utilization. If an organization chooses to use productivity in the calculation, they will certainly drive to high utilization rates even when there is no customer demand. Performance is simply the actual cycle time of the process divided by the cycle time that the process should be operating at under optimal conditions. Use the following example at the bottom to help you clearly define OEE.

The **Availability Rate** is equal to the [Operating Time / Planned Production Time]. Availability takes into account the losses due to equipment downtime and setups. Operating Time is the time an operation is physically running good product. Planned Production Time is the time the operation is scheduled to run minus breaks, lunch and other planned activities.

The **Quality Rate** is equal to [Good Pieces Produced / Total Pieces Produced]. The Quality Rate takes into consideration losses due to not making product right the first time.

The **Performance Rate** is equal to [1-(Current Cycle Time-Designed Cycle Time) / Designed Cycle Time]. The Performance Rate takes into consideration the loss in cycle time compared to the rate that a process was engineered to run at during optimal conditions. Employees will often slow down the equipment cycle time to maintain a stable process as a result of wear and accelerated deterioration of the equipment.

The **Overall Equipment Effectiveness (OEE)** is equal to (Availability Rate x Performance Rate x Quality

SOME ORGANIZATIONS FAIL TO CORRECTLY DEFINE OEE. THEY OFTEN CONFUSE A PROCESS PERFORMANCE RATE WITH A PRODUCTIVITY RATE OR MACHINE UTILIZATION RATE.

AVAILABILITY RATE:

Operating Time Calculation		Planned Production Time	
Planned Production Time	380 min.	Shift Time	480 min.
Setup time	-30 min.	Breaks	-20 min.
Machine failure	-20 min.	Lunch	-20 min.
		Planned Downtime (PDT)	-60 min.
Operating Time	330 min.	Planned Production Time	380 min.
Availability Rate = 330 min. / 380 min. = .868 or 86.8%			

PERFORMANCE RATE:

Current Cycle Time	Designed Cycle Time
12 seconds/piece (Loss of 2 seconds)	seconds / piece under optimal conditions
Performance Rate = 1-[(12 sec/piece-10 sec/piece) / 10 sec /piece] = 1-.20 = .80 or 80%	

Quality Rate:

Good Pieces Produced	Total Pieces Produced
1228 (1320 total -92 pieces of scrap & rework)	1320
Quality Rate = 1228 / 1320 = .93 or 93 %	

Overall Equipment Effectiveness

OEE %
OEE % = .868 x .80 x .93 = .65 or .65%

Rate), as shown in the calculation that follows:

In addition to not clearly defining OEE, many organizations overemphasize the Availability Rate and Performance Rate measurements when evaluating the performance of supervision. When this occurs a company runs the risk of driving the wrong behavior. Supervision in these circumstances will typically reduce the number of setups, put off activities such as training and preventative maintenance in attempt to maximize equipment availability. In addition, they may reduce line speed to boost up the Performance Rate simply for the sake of getting more output per unit of time. All of this leads to longer production runs and increased inventories following the process. This is certainly in contrast to one of the primary objectives of lean which is to run the right part, in the right quantity at the right time.

One recommendation to consider is using a balanced score card approach and make sure your overall measurements continue to drive lean behavior when you adopt the OEE measurement. Consider trending average changeover time and the number of setups and inventory levels after the process. The idea is to be balanced with measurements so that no single measurement can sub-optimize the total system and drive the wrong behavior. Leadership should hold middle managers and supervision accountable for achieving pre-established targets on the balanced card.

You may also want to consider allowing supervision to deduct important activities such as TPM, team meetings, training and running pilot samples from the Planned Production Time calculation. This ensures that critical activities are given sufficient time for completion without penalizing supervisors for pulling down the equipment.

The most frequent complaint from managers regarding the effectiveness of the OEE measurement is that it is time consuming. The response from managers is always the same. "How in the world do we track OEE on 400 pieces of equipment?" The answer to this question is simply don't track OEE on every piece of equipment. If you are not engaged in a focused improvement effort on every piece of equipment then why collect the information. Start with

THE IDEA IS TO BE BALANCED WITH MEASUREMENTS SO THAT NO SINGLE MEASUREMENT CAN SUB-OPTIMIZE THE TOTAL SYSTEM AND DRIVE THE WRONG BEHAVIOR.

A Fresh Look at OEE (Cont.)

Lean Learning Center

tracking OEE on your critical pieces of equipment like your bottlenecks then expand the effort as you expand your TPM implementation across other pieces of equipment. The most frequent complaint from operators is that they simply do not have the time to write everything down and go through the calculations. The calculation of OEE is complex and time consuming. Without technology such as programmable controllers that can automatically calculate OEE for you from equipment generated data inputs, the manual approach is very labor intensive if you want to separate and understand each component of the equation. This labor intensive data collection process is by all means wasteful in itself. Organizations often go to great lengths to record every non-productive time occurrence. Positions are often created to keep track of OEE and historical data. Put yourself in the shoes of the customer and ask yourself if you as a customer would be willing to pay for this. The answer will hopefully be no. It is quick response and structured processes that bring speedy problem resolution at a root cause level that is important.

REGARDLESS OF HOW YOU COLLECT AND MEASURE OEE, YOU WILL ALWAYS NEED TO DIG FURTHER TO FIND THE ROOT CAUSE OF THE PROBLEM.

Regardless of how you collect and measure OEE, you will always need to dig further to find the root cause of the problem. Availability, Performance and Quality are not broken down enough to completely determine the root cause of failure. Many companies attempt to do all the problem solving based on what the operators write down in an OEE log book without visiting and observing the process. Recorded historical data rarely tells the complete picture and truth of what is actually happening. So why make the calculation complicated. A far easier method of calculation is to simply take the good pieces produced and divide it by the target pieces produced for the given time period. The end result calculation is OEE without all the complications of having to keep track of every downtime

Good Pieces Produced	Target Pieces Produced
Total good pieces = Total Pieces – (Scrap + Rework)	Planned Production Time / Design Cycle Rate Per Piece
1472 good pieces produced	(380 min. x 60 sec per min.) / 10 sec per piece = 2280 pieces possible
Good Pieces Produced / Target Pieces = 1472 / 2280 = 65% OEE	

A Fresh Look at OEE (Cont.)

occurrence. (See table below)

Trend this measurement by shift. Make a regular practice of directly observing the process for the causes of lost production. While you are directly observing the process, keep track of the causes of lost production and the amount of time by occurrence. Develop a simple pareto chart of the lost time causes. Develop countermeasures focused on resolving the root cause of the problem. Implement your countermeasures and watch the OEE trend line for movement in the right direction.

It is really not a question of whether or not OEE is a suitable measure of the effectiveness of an equipment wellness program. It does precisely what it is intended to do which is to measure how well an organization is maximizing the use of it's equipment assets when they are required to run. It is misunderstanding and mismanaging OEE that creates problems. If you feel that OEE is driving the wrong behavior in your organization, then you may want to balance OEE with other measurements so that lean is not compromised. Secondly, if you feel that OEE is overly complicated and difficult to calculate, you may want to consider simplifying the measurement. No matter what your measurement is, you will always need to go to the point of activity and dig deeper. That is why it is important to spend more time directly observing equipment problems and developing sound countermeasures in real time and less on time-consuming calculations and data collection.

Jim Sonderman is a lean consultant and coach for the Lean Learning Center. His background encompasses 18 years of experience in the automotive industry with General Motors and Delphi. He spent approximately 9 years in management and 9 years in direct continuous improvement roles supporting the lean transformation of the company.

Lean Learning Center

Lean Quick Tip: *Creative Use of Andon*

Andon is most commonly associated with lights, buzzers, or music on a factory floor as a way to signal for help when a problem occurs. Thinking more broadly of andon as a concept to establish a help chain, many possibilities emerge to apply this tool.

A construction company that builds large office buildings and tower made use of andon. Imagine the waste incurred when a worker has a problem that requires assistance on a large construction site, far removed from other workers and supervisors. Instead of the worker stopping his work and walking to find someone for help, each worker instead carries large flags which can be displayed to signal for help. The foreman sees the flag and goes to the worker to ask how they can help.

In an emergency dispatch center, handling calls incoming immediately is obviously critical. What happens when a call is made, but the dispatcher is busy with another call? A light blinks above the workstation alerting the floor supervisor that another call has come in that needs to be handled. The supervisor then assists the dispatcher by answering the call or assisting in whatever means necessary.

Another interesting application comes from an executive limo company. If a vehicle in transport with a client becomes disabled, the automatic vehicle locator senses that the car has stopped and sends a signal to the nearest available vehicle to respond. The specific, self-diagnostic help chain is thus established.

There are countless ways to specify and alert the help chain for any situation. Think creatively about how to do so when it is critical for your processes to have rapid intervention when problems inevitably occur.

ANDON IS A LEAN TOOL THAT CAN BE APPLIED THROUGH LIMITLESS CREATIVE APPLICATIONS.

Leading Lean A-Z *I:Integrity*

By Jamie Flinchbaugh

Integrity is paramount. Integrity begins with yourself and then can be extended to others. What is integrity? A dictionary definition is the quality of being honest and having strong moral principles. In common language, it is keeping your word, saying what you mean, and doing what you say.

Many will confuse integrity with intent. Intent is "I meant well". Integrity is about acting well. It is about connecting your actions consistently with your intent. Our intent might be not to insult someone, but by flaw of our actions, we end up doing exactly that. This is a breach of integrity. Even intending to be home in time for dinner is a breach of integrity if you fail to do so.

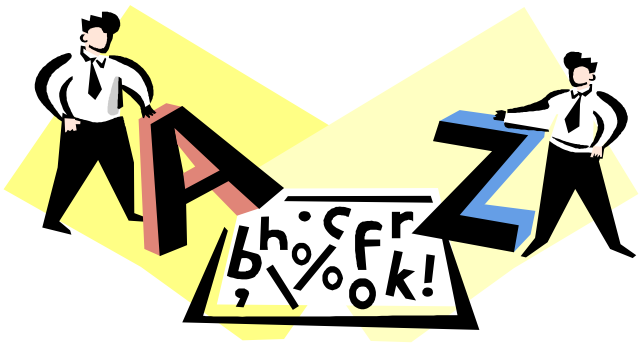
Being a liar is of course not having integrity. That means your intent isn't even consistent with your words, let along your actions. This is quite rare that we're surrounded by liars. But to those around us, there is little difference. To another person, your actions and your words do not match. They do not care about your intent, only their experience. To them, there is a little difference between a liar and a failure in integrity.

Obviously this matters in life. So is this a generic principle that we can assume also applies to lean or is there something more? I think there is something about lean that requires a specific look at integrity. In a lean journey, leaders ask their employees, peers, and bosses to adopt certain principles and exhibit behaviors that attach to those principles.

For example, we teach, preach, and cajole the principle of systematic waste elimination as a principle. This means that we want to develop an intolerance for waste, and that intolerance compels us to take action. This behavior requires risk-taking and stepping outside our own comfort zone. Like the rest of the lean principles, this is a tall order to be able to exhibit on a daily basis. Every leader will fail at some time to live up to those same principles they are teaching others about. This is, in fact, a breach of integrity. The more we do it, the greater the breach, and the people around us will quickly draw the conclusion that we are not serious about this lean journey. The ideal state is of course that we never falter, but since a few stumbles are inevitable then we must be prepared to repair and maintain our integrity. Otherwise, not only will lean be a program of the month, but so will we.

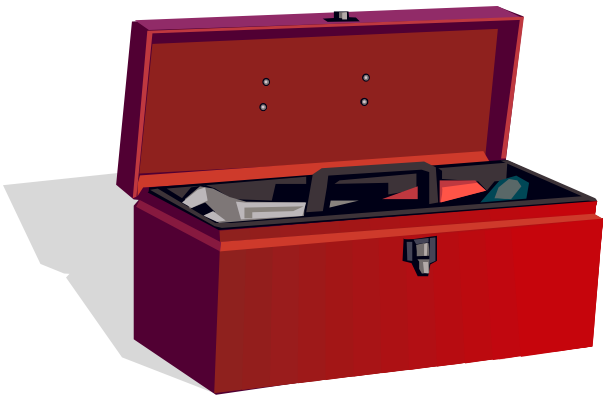
The most important act you can take to maintain integrity when you fail to live up to lean principles is to admit it. You must acknowledge your own gaps, your own failings. You have two choices. You can either acknowledge the gaps first, or hope that no one notices. Of course, the latter strategy is just a fantasy. It will not work. Of course people notice. They probably notice more than we do.

Integrity also requires insight and reflection. To be honest with yourself means reflection and corrective action on the gap between your intent, and your results. Intending to help someone when your actions achieve the opposite is a violation of integrity, and only a "good look in the mirror" will enable one to improve the ability to connect their actions and results to their intent. This is continuous improvement of the self, and that's all people can ask of you.



JAMIE FLINCHBAUGH, PARTNER AND CO-FOUNDER OF THE LEAN LEARNING CENTER, OFFERS LEADERSHIP TIPS IN LEAN PROGRESS. READ PAST COLUMNS AT: WWW.LEANLEARNINGCENTER.COM

Lean Toolkit: After Action Reviews



Lean Learning Center

Proper Uses of Tool

1. To learn as a team through a structured approach

2. To identify performance gaps relative to stated objectives on repetitive events and find ways to improve performance on these events

Improper Uses of Tool

1.To use an AAR as a post-mortem exercise

2. To use the AAR structure to find blame with individuals or organizations or to find excuses and explanations

Description of Tool – How-to

The After Action Review is simple in structure, yet slightly more complicated to organize and conduct. At its core, an AAR is a planned event that brings intact work teams together to discuss four ***questions:***

-What did we want to happen?

-What actually happened and why?

-What can we learn, specifically what successes to sustain and weaknesses to improve?

-What actions can be taken for the next iteration?

AAR's can last from 15 minutes to a full day depending on the team size and complexity of the event that took place. The US Army, an organization that has been a pioneer in using AAR's, will conduct reviews that last as little as 15 minutes for simple, simulated missions, and up to a day to examine an overall simulated battle.

Planning: The best time to start an AAR is actually before the event (e.g. installation of new equipment, a pilot run of a new product, a key design phase) that a team will be engaged in takes place. An intact work team that includes each of the key participants in the event should be assembled beforehand to define: "*What do we want to accomplish, and How do we want to accomplish this task?*" Detailed exploration of this question will help define the baseline goals and gain agreement on how to accomplish those goals before the team is engaged in the event.

Conducting an AAR: Whenever possible, the formal leader of the team should facilitate the AAR. In this manner, the leader can role model that the AAR exercise is an effort in learning and improving, not blaming and excusing. Using the leader in this capacity can help reduce the defensiveness of individuals on the team and assist in drawing out essential information from everyone on the team.

The facilitator then leads the group through the four questions outlined above, one at a time. Using the objectives stated during the planning process, the team examines what actually happened in comparison to what was planned. After explaining and understanding the gaps, the team then determines the practices to sustain and reinforce, and the improvement opportunities for the next iteration.

The team should leave an AAR with a list of improvements and assigned responsibility to implement those improvements. Before engaging in the event again, the team should cycle back to the beginning and go through the plan-

AFTER ACTION REVIEWS ARE THE CENTER TOOL OF THE US ARMY'S PURSUIT OF A LEARNING ORGANIZATION

AAR (Continued)

Lean Learning Center

ning phase of an AAR once again and become forward focused on the next repetition of that event. This keeps the team in a **Plan-Do-Check-Act (PDCA)** cycle that will promote sustained learning and improvement.

Variations on the Tool

The four questions can be rephrased, expanded, split or added to. The overall structure is the same but the questions may change.

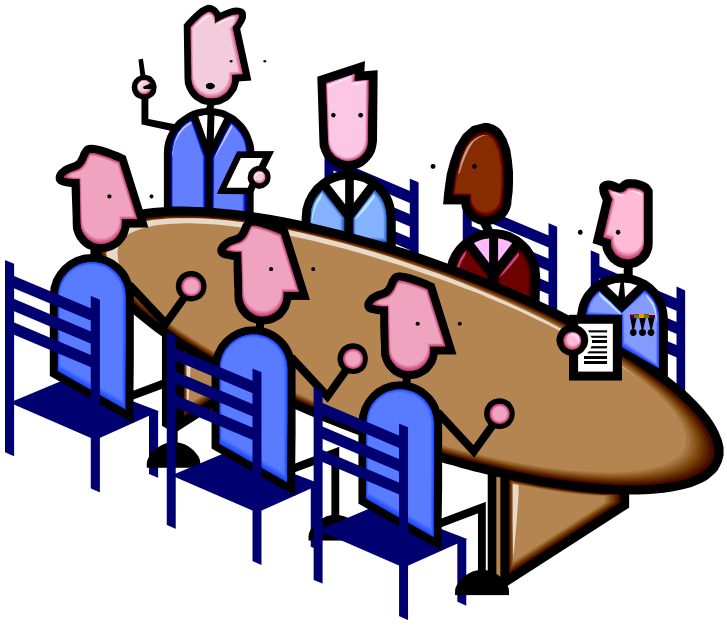
Another variation is using rigorous tools such as systems dynamics or even just the Five Why's to explore the "why" part of question 2.

THE AAR FORCES A POINT OF REFLECTION TO TEST WHETHER THE CHANGES HAVE LED TO HIGHER PERFORMANCE LEVELS AND THEN FORWARD FOCUSES TEAMS ON THE NEXT EVENT.

How Tool Relates to Rules and Principles

The After Action Review Process primarily enables **Rule #4: Improve through experimentation at the lowest possible level towards the ideal state**. By design, the AAR process engages teams closest to the point of activity to learn and improve performance. Rigid adherence to the AAR process forces teams to learn and improve through small and specific structured experiments. Teams test hypotheses (improvement ideas) from previous AAR's as they carry out the next iteration of a specific task or event, and then engage in the AAR process to reflect on the success of the changes, in effect completing a full Plan-Do-Check-Act (PDCA) cycle. The AAR forces a point of reflection to test whether the changes have led to higher performance levels and then forward focuses teams on the next event.

The principle of **create a learning organization** is most obviously supported by instituting AAR's. Through effective use of the AAR teams are clearly learning through reflection on their recent actions. The improvements generated by teams engaged in an AAR discipline will no doubt **systematically eliminate waste** from the processes and activities that are being examined. Additionally, using an AAR practice over time will enable teams to understand and **establish high agreement on what and how** to carry out a given task or event. As teams learn together how to more effectively execute a task, a deeper, and most importantly, shared understanding of the ideal state begins to emerge.



Missteps in Mapping

Jamie Flinchbaugh contributes a regular column Leading Lean to Assembly Magazine. Visit www.AssemblyMag.com for more

One thing that has lasted longer within companies is process mapping. Unfortunately, it has not changed and grown, as it should have over the last decades. Every organization engages in process mapping at some point. Resources are dedicated to it, software is purchased to support it and auditors check it. But in the end, are you getting true value from all of that expended money, time, and energy? As we visit many sizes of companies across many industries at different maturity levels, we continue to see the misuse of process mapping. The top four failures experienced when using process mapping are as follows.

First, you must be clear about your purpose and objective before beginning to map. In fact, be clear even before choosing what type of map to build. You've all seen the standard process maps with a collage of squares, circles, triangles and arrows. It is a useful map, but its purpose is planning or training, but not continuous improvement. For example, on this type of map you would see a process block that states "enter customer order." At this level, no real improvement can take place because we can't see the waste, and the most dangerous kind of waste is what we can't see. When using maps for improvement efforts, use activity and product process maps in order to see that waste. What you can't easily see is the waste in walking to the fax machine, returning with the order, opening up two different programs, logging in, cut and paste order numbers, and so on. You could never just cut the step "order entry" but virtually everything surrounding that process can be improved or eliminated.

This leads to the second point, look not only at the elimination of steps but also at making simple improvements to what remains. Obviously, when you have a chance through creatively or simply deciding to stop doing something wasteful, you should take advantage of this. In other cases, it is making some of the small things simpler.

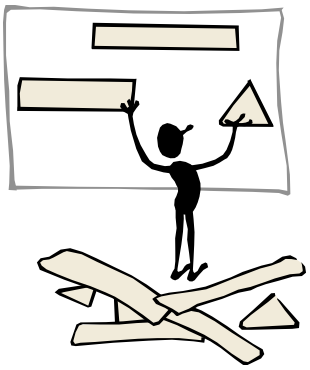
The third mistake, which is almost universal, is trying to include everything in one flow, one map. Often the information, material, and people actually follow different routes. When we try to combine them, we lose the possibility for most of the insight required. A common example of a map is what many refer to as the "spaghetti map" which will physically follow a product through the process in a 2-D view of the area. But whether you follow the person, or the material, you are still missing something. We actually refer to this map as the "3-flows map" because we attempt to capture, using three colors, each of the three flows: material, information and people.

The fourth mistake is how we gather the information used in process mapping. When our objective is improvement, we want what is currently happening, not what is supposed to happen. To do this, we need to put away some of the tools we often use, including process standards. Instead we need two different inputs. First is the inclusion and focus on those who do the work. We need the direct input from those doing the work, no matter how complex. They will know better than anyone what it takes and what gets in the way. The other tool is direct observation. We should go to where the work is occurring and see it through our own two eyes. This is obviously harder when the process takes three months and is spread over three continents, but that is when including those involved in the process is most critical.

Process mapping is a useful tool in any environment, but only if done effectively. I suggest re-evaluating your use of the tool from the ground up. The benefit is greater gains from your invested time.

Lean Learning Center

PROCESS MAPPING EXISTS IN ALMOST ALL ORGANIZATIONS, BUT THE APPLICATION OF THE TOOL IS NOT ALWAYS OPTIMAL



Lean Learning Center

40028 Grand River Avenue
Suite 300
Novi, Michigan 48375

Phone: 248-478-1480
Fax: 248-478-1589
Email: info@leanlearningcenter.com

Lean Learning Center

For more visit www.leanlearningcenter.com

The Lean Learning Center was founded in 2001 by manufacturing and consulting industry veterans Andy Carlino, Jamie Flinchbaugh and Dennis Pawley to address the gaps and barriers that are holding back companies from successful lean transformation. In addition to the advanced curriculum, the Center has developed a learning environment designed specifically for adult learning, utilizing techniques that include discovery simulations, case studies, personal planning and journaling. Together, with affiliate Achievement Dynamics, founded by Andy Carlino in 1991, the companies offer a complete array of lean transformation services.

Lean Learning Center Announcements

Lean Value Stream Improvement

November 9, 2009

Lean Experience

March 9, 2009

May 11, 2009

August 3, 2009

Leading Lean

May 18, 2009

November 11, 2009

Lean Kaizen Boot Camp

September 28, 2009

For more information visit: