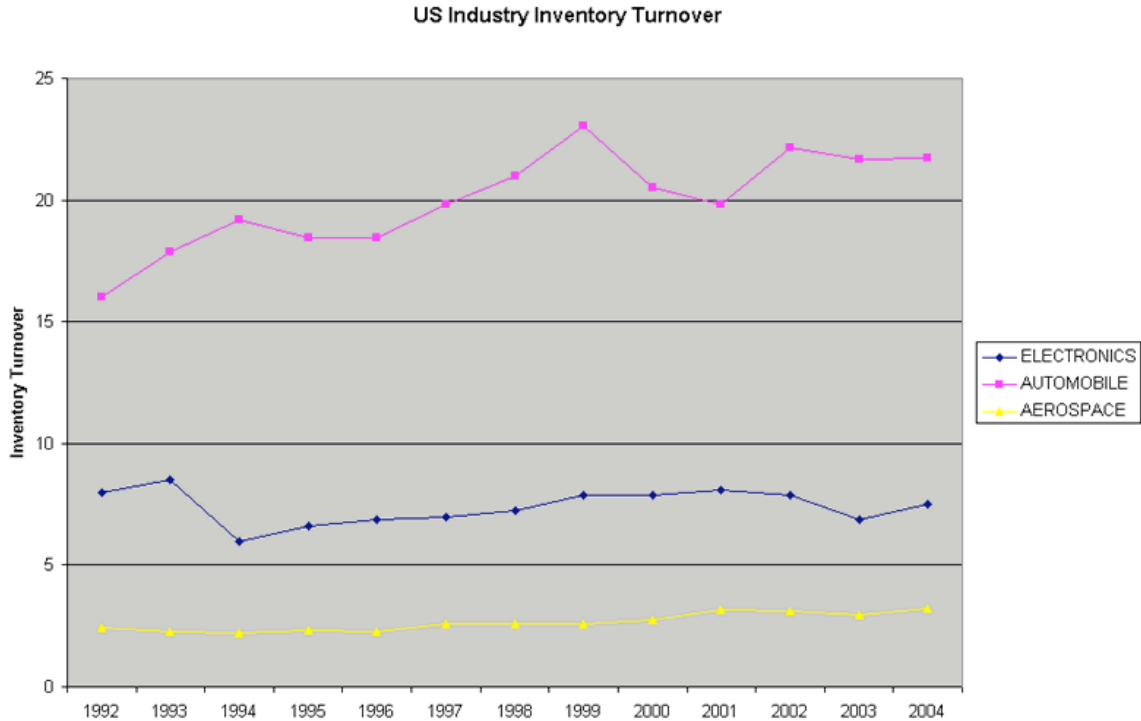


The SEA Lean Enterprise System

Foreword by Michael G. Beason, Chairman, Supplier Excellence Alliance

Few people in the Aerospace and Defense industries would argue that competition on a worldwide basis is now a supply chain problem. The need to accelerate supply chain performance is acute. Many believe that the effectiveness or “leanness” of our supply chain is measured by inventory turns¹ because it so adeptly shows our material velocity normalized by industry. It is clear that in this respect, we have made little progress.



Courtesy of the Lean Aerospace Institute

Today's supply chains are becoming highly inter-dependant rather than independent as has been the case in the past. In the past, a prime might deal with 1000 to 3000 suppliers on one program. Each would be responsible for delivering parts on-time. The prime would have the responsibility of integrating thousands of parts to make an assembly. The prime would have to stock a buffer of inventory on everything in order to ensure that material shortages didn't stop a multi-million dollar aircraft from moving forward. If a supplier didn't deliver on-time, or delivered a poor quality product, the prime would have inventory to solve these problems. Today, the prime is using a moving assembly line with major assemblies built by the supply chain. In order to meet increasingly demanding cost goals, the prime has only enough space for the assembly that will bolt onto the aircraft today. The supply chain must produce the needed assembly exactly

¹ Annual Cost of Goods Sold (12 month rolling average) divided by period-average inventory (average for the most recent month) Inventory includes raw, WIP, and finished goods.

on time, not early, not late. And the supply chain is now vertical and not horizontal as before. This means the best little supplier in the world, having improved operations to a high level of quality and responsiveness, will not be noticed unless the entire supply chain performs.

As Brad Hart, President of Roberts Tool says, "It no longer matters what I do alone. I am now dependent on my competitor to perform because if my customer doesn't look good to their customer, we all lose."

The solution is no longer a Boeing solution, or a Northrop solution, or a Lockheed solution, but rather a solution that embodies the cooperation of all three entities and ten others as well as all of the suppliers in the entire supply chain. It is not the elegance of the solution that matters, but rather the paradigm in which it is implemented. In other words, it is more important that we make progress inside a framework of collaboration than independently by ourselves. The goal of "customer success" has replaced its predecessor, "customer satisfaction²."

Competitive Advantage

Primes often worry about competitive advantage and whether the supply chain is a significant part of that advantage. As the industry continues to collaborate, the 30% overlap currently present between customers and suppliers will grow to 60 or even 70% and the best suppliers will be working with everyone. The competitive advantage in the future will not be the capability of "our supply chain" but how well we design and partner with a group of highly capable suppliers. The competitive advantage at the prime and tier one levels will consist of our competence to put together and manage a highly integrated supply chain.

The Highly Inter-Dependent Supply Chain

Here is a working model suggested by many as a starting point for establishing a strategy to develop capabilities and cooperation throughout our supply chain. No doubt it will undergo many refinements and improvements as time goes on. As primes/OEMs articulate strategies to distribute design and production responsibilities down through the supply chain, the need for increased supply chain capabilities becomes acute.

² Dr. Dan L. Shunk, Professor and Chair of SNI, ASU



The top levels capabilities required for success will be quite different than those required for tiers 2-4. These “sub-tiers” will need mastery of lean production, and the ability to collaborate and integrate efforts to produce final assemblies, kits, and other solutions ready to bolt onto an aircraft.

Sub-tier suppliers will need to develop very high process capabilities in order to produce quantity one on-time with very little lead time and continuously decreasing cost. Obviously the challenge for sub-tier supplies will be to remain profitable while doing this. A production line designed to produce product in the old way will need more than “tweaking” – it will need a complete redo.

More than a decade before, the automotive industry made the same transformation and by 2003 the 30,000 suppliers who started in 1986 had dwindled to 5,000 of which 36% were not financially viable.³

SEA Lean Enterprise System

In order to promote effective collaboration across the industry, the SEA framework needed to promote a common language and an integrated approach to continuous improvement.

The SEA Lean Enterprise System (“SEA LES”) was designed to be simple and fast to implement. Perhaps it embodies the lesser-used meaning of elegant – “neat, simple, and concise.”

It is comprised of three tracks or “process groups” that hold the best practices determined to be the root source of success within small supplier companies who have a proven track record.

The SEA LES is all-inclusive – it provides a high level framework in which all techniques and disciplines for lean, six sigma, and more fit.

³ Restructuring Aerospace, ATK 2003



The SEA LES provides a common language. It gives us a common vocabulary – one based on the language of process maturity. It also acknowledges that long-term sustainability of improvements relies on enterprise-wide solutions and well-managed change.

The SEA LES is for small and mid-size aerospace production suppliers. This is a unique audience with unique needs. This supply chain must deal with the complexities of high mix, low volume manufacturing. It must produce to exacting levels of quality demanded by the defense, space, and commercial markets.

What is most important...the SEA solution embodies industry-wide collaboration, the elimination of duplicate effort and mixed messages. It is a common, industry-wide approach that makes sense to suppliers and customers alike.

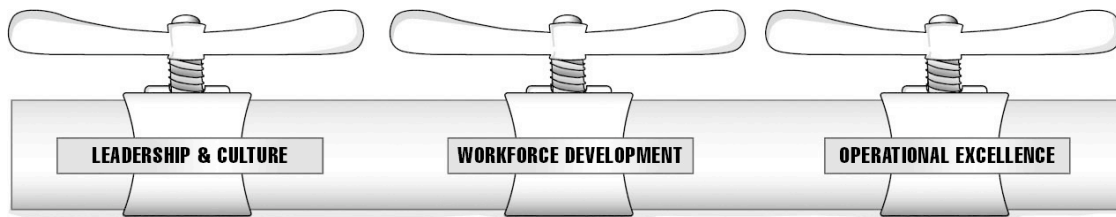
The SEA LES was developed by suppliers for suppliers.

The SEA Lean Enterprise System captures the best practices for manufacturing enterprise improvement with a model using three key process areas. The reason for these three areas is to emphasize the importance of a total organizational approach to managing the transformation. Large-scale changes that do not address all three areas often fail. Implementations of lean that address all three take less effort and are more often successful.

If lean manufacturing is proactive and preventive in nature, then this model for change is also proactive and preventive. It asks senior management to anticipate the cultural barriers to change and to organize a plan to address these barriers. It also asks management to build a workforce with the competencies to implement the lean system.

Baldrige⁴ Award-winning companies have distinguished themselves for years in financial performance by addressing improvement as an enterprise-wide process. They have continuously improved their leadership system, the competencies of their workforce, and processes throughout the enterprise.

The SEA Lean Enterprise System follows these excellent examples by addressing all three areas as critical to successful implementation.



The Theory of Constraints⁵ may provide the best example of the interdependence between the three process areas.

If we envision teams of people working to make operational improvements, then that valve could be wide open enabling the flow at maximum rate through the pipe.

But if Leadership is unwilling to change, thwarts changes in the work areas, and fails to enable and recognize the workforce when they improve operations, then the valve for Leadership & Culture could be said to be partially closed.

By the same token, a failure to train and develop a competitive workforce might have the same effect.

Many companies have distinguished themselves by building a culture of excellence. When company culture supports continuous improvement, innovation, and change, employees initiate action themselves. In the absence of a roadmap, they randomly speed up the learning and experimentation process. How much more effective could companies become with a roadmap?

In this three-valve illustration, the speed of water through the pipe will be minimal if any one valve is partially closed even though the other two are not.

And so we must conclude that in order to accelerate, we would do well to take an enterprise-wide approach to continuous improvement.

⁴ Baldrige National Quality Program, National Institute of Standards & Technology, <http://www.quality.nist.gov/index.html>

⁵ Eli Goldratt, The Goldratt Institute

Leadership & Culture

Every company is making improvements. Nobody is standing still. But often we find that certain elements of an improvement system have been missed, and that gap makes it harder to accelerate improvement to the pace needed to ensure competitiveness. It is therefore the speed of improvement that is the primary issue, not the fact that improvement exists.

Take for instance the absence of Process Owners as one example. Process Owners are a method for developing and involving employees in the leadership of the improvement process. It is also a method for deploying accountability for improvement. Many senior leaders complain that people have not taken “ownership” for the enterprise...another way of saying, “They aren’t accountable.”

Process Ownership deploys accountability. If a Process Owner has been trained to improve processes, if they have been given the time and resources to make improvements, and if their performance management plan has objectives for improving their process along with rewards for doing so, then an effective system for accelerating improvement has been deployed and is likely to be very successful.

Most organizations must also address culture in order to be successful. You could suggest that the reason process improvement hasn’t been deployed to Process Owners in the past is because management didn’t believe in this approach to employee involvement. Unless the culture can change, the Process Owner system will fail because senior management will, through lack of direct support, allow it to fail without consciously knowing their role in the failure.

Every major effort to implement improvements eventually runs into the culture barrier...whether it’s ISO, MRP, TQM, and so on. Most companies can try a number of times to implement these disciplines only to eventually decide that they do not work. The truth is hidden, although Pogo discovered it many years ago when he said, “We have discovered the enemy and he is us.”

The ways that our culture resists change are very subtle. I recently reviewed a lean assessment report with a team of senior leaders. The report showed that this \$50 million per year company could avoid \$500,000/month in costs if they would implement lean. Although they believed the report and could not argue with its findings, they asked that we wait 6 months until the implementation of their MRP system was complete. The MRP system had no immediate payback projection and used the same outdated procedures and processes that were used before the system was purchased. When a management team lacks urgency in changing priorities to achieve better performance immediately, because the members of the senior team agree upon that lack of urgency, we can define it as a cultural barrier. Note that this particular barrier affects the rate of improvement, but not the fact that they are improving.

Workforce Development

Another subtle barrier to change is the skills of the workforce. Many smaller companies do not have a formal method for ensuring that someone fully certified in the skills they must employ to follow the process and minimize errors and variation holds each position. Few companies of any size have a formal system for assessing training needs and developing a training plan and resources on a regular annual basis.

Although you can often find pockets of expertise within the workforce, it is rare that you will find a high level of knowledge about statistical process control, lean production methods, setup time reduction, and other such advanced process methods.

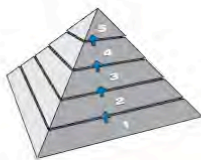
Managers have a high level of interest in seeing teams begin to take charge and exhibit higher levels of accountability. They yearn to see teams lead themselves, solve their own problems, and make decisions affecting their day-to-day processes.

In order for the workforce to have the confidence necessary to achieve these aims, the training system must anticipate the future needs of the workforce and provide training and practice in these skills.

A training system that uses a learn-do approach can build knowledge, skills, and confidence at the same time.

Operational Excellence

All of the methods and techniques of lean production, flow manufacturing, Six Sigma, and more, are contained in this category. Many of the most important techniques will be explained elsewhere in this book.



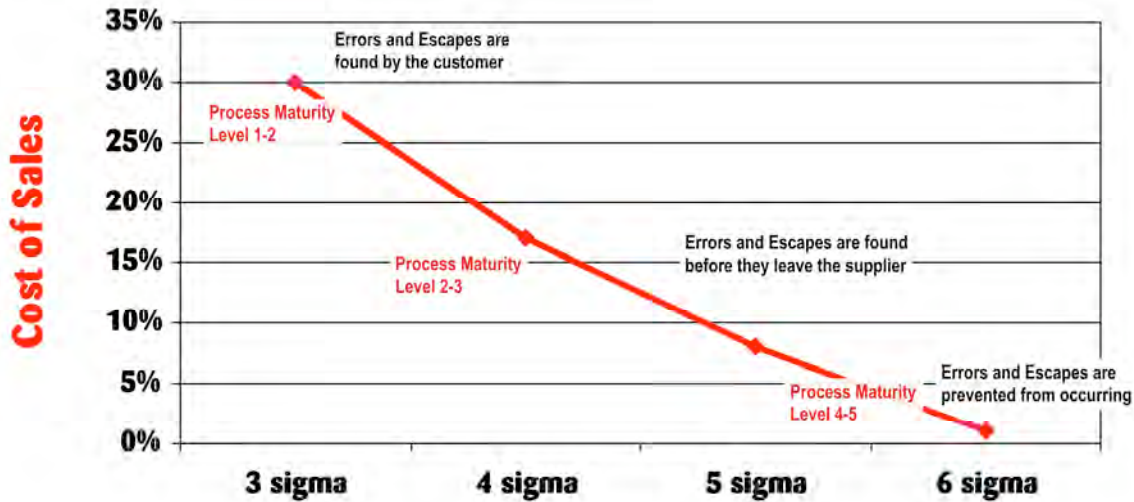
Process Maturity Levels

5. The process shows continuous positive trends and benchmarks world class
4. The process is under process control, is analyzed, and improved using data
3. The process has certified trainers and is standardized
2. The process has been documented to the work instruction level
1. The process has been identified, defined, and has an owner

Process Maturity

I served as a Baldrige examiner in the early 1990s and the Awards Council Chair for the California awards program in the late 1990s. I developed the Process Maturity Model (PMM). The pilot was conducted with the help of a team of professionals at Solar Turbines in San Diego in the two years immediately preceding the presentation of the Baldrige Award to Solar in 1998.

Process Maturity and cost are directly related. The higher the process maturity,



the lower the cost of quality. Baldrige award-winning companies demonstrate this truth on a continuing basis. They are more profitable and consistently produce higher return on investment because of their intense focus on process maturity.

The PMM was developed as an aid for companies who wanted to self-assess themselves using the Baldrige Criteria and as a management tool to assist in the management of overall process improvement. Companies often find the Baldrige scoring guidelines difficult to use and especially when most self-assessment is conducted without training on the criteria. The PMM simplifies the process.

Because the PMM serves as the backbone for all process improvement efforts whether lean, six sigma, or whatever comes next, it provides for long term integration of all improvement approaches.

Various levels of process maturity are applied one process at a time. In other words, the model is used to define the maturity level of a process, not a function, department, or company.

Specific tools and their use are generally available from many sources. For now, we will focus on an overview of the PMM.

Level 1 – the process has been identified, defined, and has an owner.

The beginning stages of process improvement are confirmed by the identification of a process. Immediately before this stage, the process does not have an official name. Everyone calls it something different and everyone thinks of it as containing different steps with different beginning and ending points. As the process moves into Level 1, it gains an official name to that everyone refers when speaking about the process.

Also in this stage, the scope of the process - that is, the steps that are a part of the process and where the process begins and ends - becomes defined. The most direct way to ensure that everyone agrees on the scope is to draw a high-level value-stream map of the process. A deployment flowchart is often a valuable tool for this step because it denotes the various departments or functions for each step in the process. It also shows the transfers from one step to another. At this stage, the map of the process is often at the “50,000 foot level,” meaning that it is not very detailed and only seeks to show the major steps and their sequence along with the beginning and ending of the process.

It is hard to imagine going very far with process improvement efforts if there isn't someone who is accountable for the improvement effort. A Process Owner is therefore an essential starting point. A Process Owners is often a person, who works in the process, manages the process, or is already accountable for most of the process. It is not particularly important what level they function at; what matters is whether they are capable of leading and motivating others to make improvements.

Level 2 – the process has been documented to the work instruction level.

In higher levels of maturity, a process is at its best when there is very little variation. This state is only achieved through the development of standard work instructions. Achieving standard work is, in part, a matter of documentation and training. Standard work is important both on the factory floor and in the offices that support the enterprise. Its application is just as important in engineering as in production or administration.

Most companies have achieved ISO or AS9100 certification. If they haven't, they should at least be on their way. These disciplines ensure that critical processes have policies and procedures established. They don't, however, always ensure that work instructions suitable for certification of workers are used.

In this step, the establishment of work instructions is guided by the usability by the workforce and by “master” trainers who will conduct job skills certification. Good work instructions can be turned into a training guide and used to ensure consistency in a skills certification-training program.

Our modern workforce is often multi-national. Non-native English-speaking workers often have difficulties with work instructions in English. To compensate for this problem and a continuing literacy barrier, work instructions are often more effective in visual form. Instead of describing how to set up a machine in 4 languages, and risking that none will be used to train someone in how to set up the machine, visual instructions can be created easily by taking a series of photos of the process and training the employee by using the pictures. Pictures can be mounted on the wall in the form of a poster as a quick reminder of how to set up the machine. Good work instructions are “visual” and can be referenced and followed by those doing the work.

If a task is complex and prone to variation for that reason, a job aid such as a checklist, a fixture, or a tool is often used to increase the effectiveness of the documentation. These must be included in the work instructions – otherwise they become “workarounds” and a new source of variation.

For a process that is at level 4, work instructions must include statistical process control instructions – how to measure and manage the process within the control limits.

Documentation is not complete without corrective action plans. Corrective action plans are contingency plans that must be followed by the person performing the process when something out of the ordinary occurs.

Level 3 – the process has certified trainers and is standardized

The focus at this level is standardization of work processes. Someone working in a process may progress through three levels to achieve mastery.

1. Completed training in how to do something using the work instructions
2. Certified by a master trainer as capable of following the work instructions in the time allowed
3. Certified by a master trainer as capable of training someone else

At this level, not only are the standard work instructions followed to a high degree of conformance, but the corrective actions must also be followed. Therefore all work, whether normal to the process or abnormal, follows a standard work procedure.

This level ensures that most “special causes” of variation have been eliminated and what are left are those causes of variation that are inherent to the process itself called “common causes.”

Many experts argue that until Level 3 is completely achieved, you cannot actually improve a process. Most quality systems such as ISO, AS9100, and CMMI for software are based on this principle. Management doesn’t always want to hear that because it doesn’t make sense that you can’t improve a process in the most direct manner available. It is certainly true that until you understand a process fully, and that includes all of its sources of variation, you will have a hard time defining an improvement that doesn’t interact with other causes to produce a net zero result. Therefore the improvements that can be made in a low maturity process are defined in level 1-3 of the PMM.

Consider a process that is more culture than standard process. The people working in the process see it as an art rather than a science. As we work to standardize the process, the culture rebels. Small islands of resistance spawn variations in how the process gets done. As each improvement is made, aiming

to further standardize the process, the “resistance” adopts some changes, others partially, and others not at all, until the amount of variation in the process increases, taking us further from our goal.

Until the process is verifiably standardized in every respect, we cannot be sure that other sources of variation will not interact with any changes we make to increase the variation and at least counteract any improvements we might make.

However, standardization on a poorly designed process will yield less than optimum results. Kaizen events are used continuously to “lean” out the process, to eliminate wasted time, to reduce setup time and lot sizes, to improve lead-time, and to reduce inventory. Given this constant state of change, it is important that the Process Owner understand the responsibility for bringing the process back to Level 3 at the end of each Kaizen event. Documentation and work instructions can often be revised and re-issued by the end of an event. Everyone can be trained and re-certified in the new work instructions and procedures.

The Process Owner along with the Master Trainers is a team whose job is to make this foregoing vision a reality.

Level 4 – the process is under process control, is analyzed, and improved using data.

The focus of this level is the introduction of statistical methods for the analysis and improvement of processes. Statistical Control is the application of analytical methods to reduce defects. Statistical controls can help us in a number of ways.

1. They help us to provide for a more scientific method for triggering corrective action. If a process being monitored using statistical controls begins to vary above or below the norm, any person within the process who has been trained can take action to correct a defect before it occurs.

For instance, consider that the temperature in a food processing line is an important variable. If the temperature is too high, the food is ruined. Temperature can be monitored and if the temperature begins to vary outside the normal range of variation, it signals the operator to take some prescribed action to correct the problem before the food is ruined.

2. They help us to prevent tampering. Tampering is when someone applies a solution without understanding the process or underlying cause of a problem. When a solution is applied without this knowledge, the solution often causes more variation and more defects rather than less. So tampering, although well-intentioned action by those who should know, is often the reason why a process cannot achieve lower error rates. Tampering exists mainly in a Level 1 or 2 process where standardization has not yet been achieved.

3. They help us to become more proactive. When a process is under statistical control, its normal variation can be separated and abnormal variation can be recognized. This can trigger preventive action. These series of steps are often referred to as a “Control Plan” and the Control Plan is usually the thing that auditors will look for to support the claim that a process is at level 4.
4. They enable us to find root causes of variation in processes that produce very few defects. Sometimes the source of variation and defects is subtle and to improve a process beyond a certain threshold takes a more scientific approach.

There is some debate about when level 4 has been achieved. The Six Sigma camp believes that Level 4 requires that the process achieve a defect rate of no more than 3.4 parts per million opportunities. Others believe that a process can be “in statistical control” before it achieves such a low level of defects.

The purpose of Level 4 is to achieve a state of process control. Level 5 will specify the results that accrue from a process with very low defect rates.

Level 5 – the process shows continuous positive trends and benchmarks world-class.

The focus of this level is comparison against world-class benchmarks of performance. At one time, achieving a defect rate of no more than 3.4 parts per million might have qualified anyone as an industry leader, but today, as more and more companies pursue Six Sigma to reduce process variation, it could be that a number of industry leaders have achieved this level of performance. In these cases we look for broader definitions for “world-class.”

The Baldrige Criteria introduced the concept of industry leadership by formally assigning a scoring approach and a definition for comparing processes to determine industry-leading performance.

The norm for examination was to look for five years of progressively better performance along with industry-leading comparisons. The key issue in achieving Level 5 process maturity is to establish what industry-leading performance is. The greatest difficulty is to separate and distinguish between industry-leading companies and industry-leading process performance.

A company with an industry-leading process may not always be an industry leader. And an industry leader may not have a particular process that is industry-leading. Baldrige winners typically fall into the scoring range of 600 to 900 out of 1000 points. This means they can win and still have a lot of room for improvement.

Therefore, finding Level 5 comparison metrics may not always be achieved by the most obvious comparisons. It is best to collect a range of metrics with various companies in the upper third of an industry. This can be accomplished via a benchmarking agreement or via an industry association that agrees to collect data and protect its anonymity.

SEA Roadmap

	Stage One	Stage Two	Stage Three
	Stabilization	Supply Chain Integration	Sustainability
Leadership & Culture	1.1.1 Strategic Planning Process 1.1.2 Leadership Communication Process 1.1.3 Organizational Performance Review Process 1.1.4 Continuous Improvement Management Process 1.1.5 Workforce Development Integration Process	1.2.1 Goals Deployment & Review Process 1.2.2 Values Deployment Process 1.2.3 Supply Chain Integration Process	1.3.1 Organizational Learning Process 1.3.2 Organizational Assessment Process
Workforce Development	2.1.1 Job Skills & Cross-Training Certification Process	2.2.1 Team Problem-Solving Process 2.2.2 Corrective Action Process 2.2.3 Continuous Improvement Process	2.3.1 Team Self-Management Process 2.3.2 Statistical Control Process
Operational Excellence	3.1.1 Kaizen Process 3.1.2 6S Visual Workplace Process 3.1.3 Quick Changeover/SMED Process 3.1.4 Material Management Process 3.1.5 Production Planning Process	3.2.1 Flow-Based Material Process 3.2.2 Mixed Model Cell/Line Design Process 3.2.3 Lean Suggestion Process 3.2.4 Total Productive Maintenance Process	3.3.1 Design of Experiments Process 3.3.2 Design to Cost Process 3.3.3 Six Sigma Projects Process 3.3.4 Six Sigma Design Process 3.3.5 Design for Manufacturability Process
Business Results	4.1.1 Inventory Turns 4.1.2 Sales/Employee 4.1.3 On-Time Delivery 4.1.4 PMM Average	4.2.1 Defects Per Million Opportunities	4.3.1 Rolled Yield 4.3.2 Cpk
Exit Criteria	Master Plan Strategic Goals and Champions Trained Process Owners Certified Master Trainers Work Instructions Training Guides Training Plan Balanced Scorecard Stage One Processes at Level 3	Master Plan Department & Individual Objectives Recognition Program Cell Configurations Mixed Model Lines Workforce Certifications Supplier Partnerships Stage Two Processes at Level 3	Master Plan Organization Assessment Report Organizational Learning Plan Benchmark Study Process Control Plans Corrective Action System Improvement Cycles Stage Three Processes at Level 3

The SEA Roadmap

The Roadmap defines the mature processes necessary to progress to sustainable high performance. It divides the development into three stages. Each stage can take between 6 and 18 months depending on the maturity of the processes at the beginning of the phase and how quickly the company can manage the change.

Stage One – the “stabilization” stage describes suppliers who do not have stable, repeatable, and highly disciplined processes. Typically in a stage one company, the scheduling process is mostly expediting and the quality process is mostly inspection and things like inventory accuracy are less than 90% if measured at all. Stage One companies do not have a process management strategy – they don’t have champions or owners for processes. They don’t have value stream champions for key value streams. They don’t have requirements for value stream mapping, training, or certification. Stage One is about accomplishing the basics of establishing a process management system with Standard Work, Process Owners, and Master Trainers.

Stage Two – the “supply chain integration” stage describes suppliers who have the basics of process management in place and can participate with their

customers and suppliers in establishing more advanced capabilities based on partnering and managing a value stream for their customers that spans two or more suppliers. Some stage two companies may prepare kits for final assembly on the customer production line, some may manage an array of piece parts using MIN-MAX or Consumption-Based Ordering, and some may integrate the functions of forging and casting, special processing, machining, and assembly to produce a final assembly or part with lead times of days instead of months, and quality levels under 200 parts per million opportunities. Stage Two is the immediate and urgent goal of SEA for small and midsize suppliers.

Stage Three – the “sustainability” stage is focused on establishing the continuous improvement system as standard work within the organization. Stage Three also advances the “Science” of process capability by establishing advanced techniques for control and reduction of process variation.

When sharpening a knife using a good quality electric knife sharpener, there will usually be three steps in the process – first the very rough wheel that grinds down the blade to ensure the right shape – second the finer wheel that burnishes the blade that removes small imperfections and brings the blade to a precise edge, and lastly the finest wheel, a softer material that polishes the blade to a smooth uniform edge. Like this process, which cannot bypass any step for expediency, the SEA Roadmap stages are designed to build one on the other to develop a world-class sub-tier supply chain.

Just like anything else, you can bypass things in the earlier stages only to find that you needed them to support your later efforts.

Consider the achievement of AS9100 certification. You could argue that because you don't have a customer demanding certification, you might escape having to adopt this quality system. And in that respect, it might seem a logical conclusion. But later on, when trying to achieve a higher level of process maturity, you would find that your workforce and management team lack the discipline of managing processes to a high level of conformance to documented standards. Achieving AS9100 turns out to be both a cultural and a technical achievement. Both are valuable in building a foundation for sustaining overall performance. The absence of either can undermine all your hard work.

Just in the same way, fully accomplishing all of the elements on the Roadmap are advisable in order to sustain improvement. The Roadmap represents the minimum development required (according to a peer group of small supplier companies) to achieve long-term sustained performance improvements.

The band called “Business Results” lists the metrics we believe to be most important at each stage for measuring overall supply chain performance.

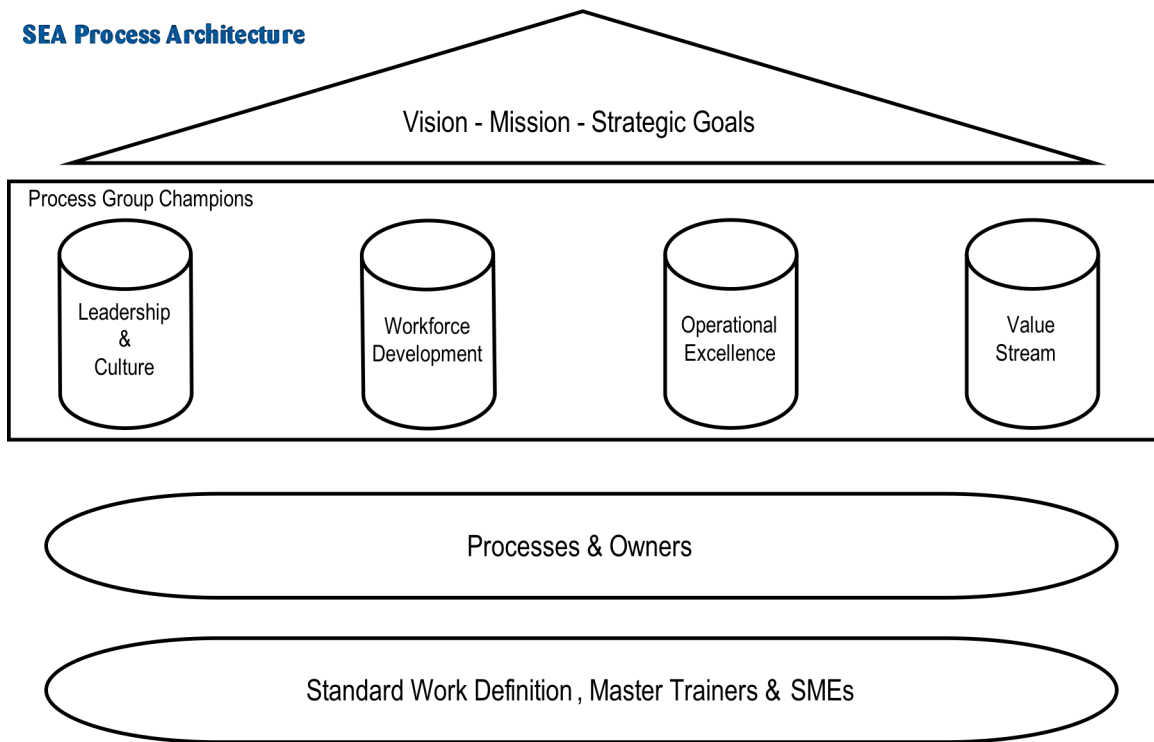
The band called “Exit Criteria” is simply the list of expected outputs from each stage. These might be minimum requirements to qualify to move to the next level.

The remaining bands, Leadership & Culture, Workforce Development, and Operational Excellence contain specific processes important to the acceleration and sustainability of a high performance company.

Stage One - Leadership & Culture

Leadership Team

The Leadership Team consists of senior managers but can also consist of all those considered to be “leaders” within the enterprise. Leadership is the most influential single ingredient in the sustainability of performance improvement. Following is a discussion of the various leadership roles.



Champions

A member of the Leadership Team is made accountable for each Process Group and Value Stream. Each Process Group contains processes that are critical to continuous improvement efforts. Champions coordinate the efforts of Process Owners and clear away resistance to change.

Process Owners

Process Owners usually work in the process or are in some way a key stakeholder for the process. They are aligned with a process that exists within a process group or value stream. Process Owners will lead the improvement

efforts that often can extend to a team of peers and sub-ordinates.

Master Trainers & SMEs

Master Trainers and Subject Matter Experts are selected for their knowledge of one or more specific tasks or operations within a process. Master Trainers will be certified to create visual work instructions and conduct on-the-job training and cross-training.

These are the five processes that must be matured in the Stage One effort. Each one must achieve at least Process Maturity Level Three in order to represent standard work for the organization. This is also required in order to pass the SEA Certification.

1.1.1 Strategic Planning Process

1.1.2 Leadership Communication Process

1.1.3 Organizational Performance Review Process

1.1.4 Continuous Improvement Management Process

1.1.5 Workforce Development Integration Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage One - Workforce Development

There is one process to establish under Workforce Development. It is the most important foundational element for process control and yet many companies ignore the need for workforce development. Most companies average less than 10 hours per employee per year in training and improvement activities such as team problem solving. Award winning companies and key competitors have over 100 hours per employee. The gap is very wide.

By the same token, the urgency to establish standardization for key processes has been misunderstood and under-achieved. Consider the ISO9000 and AS9100 initiatives. Deadlines and mandates are used in order to gain compliance from suppliers. The fear of loss of business drives compliance-based action at a point almost too late. Small suppliers have a limited bandwidth from which to comply. When the "last minute" arrives, there are few choices left besides the most expedient.

When an organization becomes expedient, it worries less about institutionalization and more about external appearances. This may partially explain why organizations have not benefited from standardized work to the extent possible.

2.1.1 Job Skills & Cross-Training Certification Process

The Job Skills & Cross-Training Certification Process addresses the basic need

to have a workforce that can perform standard work.

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage One - Operational Excellence

There are five processes that make up the first stage of operational excellence. These five processes are foundational by nature. They form the basis for an every-expanding continuous improvement effort. They are seen as tools by some, but for high-performing organizations, they are processes that must be managed and improved to ensure that they function at a high level of effectiveness across the entire organization.

3.1.1 Kaizen Process

3.1.2 6S Visual Workplace Process

3.1.3 Quick Changeover/SMED Process

3.1.4 Material Management Process

3.1.5 Production Planning Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage One – Business Results

There are many indicators that mean more to individual companies in terms of their own operations. However, these metrics were selected by the SEA board as being the best indicators of readiness to function within an integrated supply chain.

At the time of this writing, our best real benchmarks in the industry for each are 12 inventory turns, \$180,000 sales per employee, 99.9% on-time delivery, and process maturity at 3 or higher.

4.1.1 Inventory Turns

4.1.2 Sales/Employee

4.1.3 On-Time Delivery

4.1.4 PMM Average

Naturally the best in class for these metrics varies by industry type. Therefore the most important use for these metrics is to gauge overall improvement trends within the company. Starting wherever you are, how much impact has your overall improvement effort produced?

Inventory Turns – this metric over time will tell you about material velocity in your operation. Lean is truly misnamed because it leads people to believe it is about less of everything when it is only about less waste. But it would have been better

understood had it been named “Speed” but of course that name is already taken. Lean is about velocity and removing all the barriers both administrative and engineering and production to velocity. The more your inventory turns moves upwards, the more lean your operations. The higher this number the closer you are to quantity one mass customization and the faster you can respond to changes in customer requirements. At the same time, the higher this number, the more progress you’re making at bringing cash back into your business so you can use it to invest and add value to your product or service. And the higher this number, the more capable you are at reducing your price and still making a profit.

Sales/Employee – this metric tells you about your progress in building productivity. Now you can purchase a new machine and improve productivity. You can also reduce your scrap and rework and increase productivity. In fact, there are perhaps a thousand ways simultaneously that you can improve productivity and the only way to capture the organization’s ability to do them all is to harness the resources of the entire organization to make improvements simultaneously. In other words, involve everyone in the improvement effort. Increases in this number will tell you quickly to what extent you are harnessing that total employee involvement energy.

On-Time Delivery – this metric tells us about the end result of all your investment in lean. It is impossible to use inventory to achieve ever-higher levels of on-time delivery. Inventory will help with on-time delivery up to a point, but then progress will slow while costs soar including obsolescence and overhead. The requirement from customers with a moving production line is 100% on-time. If you have an aircraft that is moving down a production line that will produce a finished unit daily, then any shortage of supply will stop that aircraft and the cost of that can be millions per day. Therefore the acceptability of 85% or 90% as in the old days is rapidly disappearing. Your progress toward 100% on-time without expediting or inventory increases is a good measure of your progress toward a lean business system.

PMM Average – PMM stands for Process Maturity Model and this metric refers to the processes that your company has selected to manage. Managing a process means that you have chosen a process as critical to your mission and performance and decided to assign resources such as Process Owners and Master Trainers to carry out the tasks associated with increasing the maturity of that process. Not every process warrants such investment so selecting processes is usually an executive decision. Measuring the overall maturity of these processes tells you how much progress you are making towards higher maturity levels and therefore lower costs. Process Maturity is directly related to cost savings and sustainability.

Stage One – Exit Criteria

The idea of an “Exit Criteria” was developed to answer the questions about the type of physical indications that would be used to establish the completion of a

stage. These are some of the major accomplishments in Stage One although not a comprehensive checklist for documents supporting Stage One.

Master Plan – a written plan that incorporates the accomplishment of at least the Stage One elements usually includes a Strategic Plan and a Change Plan that defines how the culture will be changed to support the new levels of performance.

Strategic Goals and Champions – SEA recommends a process architecture that includes the three Process Groups in the roadmap and one or more Value Streams with senior executive champions assigned for each. Champions set specific process improvement goals and metrics for each Process Group and Value Stream.

Trained Process Owners – Process Owners are assigned for each numbered process within the Roadmap Stage being address (Stage One has eleven processes) and those Process Owners are trained using the Roadmap and Process Maturity Model. Process Owners are also assigned to Value Streams selected by the company as critical to overall business performance. Processes are carefully selected for “Process Management” and not all processes are selected to be managed by a Process Owner.

Certified Master Trainers – Certified Master Trainers are assigned for each process selected for management. Process Owners can be trained as Master Trainers and Master Trainers can serve multiple operations with a process.

Work Instructions – Work Instructions are developed for each process being managed.

Training Guides – Training Guides are developed by Master Trainers to support training and certification.

Training Plan – A Training Plan sets out, at a minimum, those to be trained and certified by Process Owners.

Balanced Scorecard – A Balanced Scorecard includes financial, operational, customer, and employee measures to be reviewed by management.

Stage One Processes at Level 3 – The eleven Stage One processes are at a Process Maturity Model level 3.

Stage Two – Leadership & Culture

These are the processes that must be established under process management for Leadership & Culture in Stage Two.

- 1.2.1 Goals Deployment & Review Process
- 1.2.2 Values Deployment Process
- 1.2.3 Supply Chain Integration Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage Two – Workforce Development

- 2.2.1 Team Problem-Solving Process
- 2.2.2 Corrective Action Process
- 2.2.3 Continuous Improvement Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage Two – Operational Excellence

- 3.2.1 Flow-Based Material Process
- 3.2.2 Mixed Model Cell/Line Design Process
- 3.2.3 Lean Suggestion Process
- 3.2.4 Total Productive Maintenance Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage Two – Business Results

4.2.1 Defects Per Million Opportunities

Defects Per Million Opportunities – There are often multiple opportunities for defects in a single part. Counting those opportunities and then comparing the actual number of defects provides a much better picture of defect rates than the traditional line item defect rate calculation where any defect renders a part defective. We recommend tracking this metric long before a company seeks to achieve Stage Two certification.

Stage Two – Exit Criteria

Master Plan – The Master Plan is updated to include specific goals related to Stage Two.

Department & Individual Objectives – The Strategic Plan deployment results in objectives for departments and individual performance plans.

Recognition Program – A Recognition Program supports the continuous improvement effort.

Cell Configurations – Work areas have been reconfigured into cells or flow lines depending on the needs of the customer and product type.

Mixed Model Lines – Mixed Model flow lines are designed to support the need for low volume, high mix operations.

Workforce Certifications – Master Trainers have certified a significant portion of the workforce.

Supplier Partnerships – Supplier Partnerships have reach the level of integration that is appropriate to your business type.

Stage Two Processes at Level 3 – The numbered processes for Stage Two (there are ten numbered processes on the Roadmap for Stage Two) are at a minimum of Process Maturity Level 3.

Stage Three – Leadership & Culture

1.3.1 Organizational Learning Process

1.3.2 Organizational Assessment Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage Three – Workforce Development

2.3.1 Team Self-Management Process

2.3.2 Statistical Control Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage Three – Operational Excellence

3.3.1 Design of Experiments Process

3.3.2 Design to Cost Process

3.3.3 Six Sigma Projects Process

3.3.4 Six Sigma Design Process

3.3.5 Design for Manufacturability Process

Refer to the detailed Criteria at the end of this section for more detailed requirements for each process.

Stage Three – Business Results

4.3.1 Rolled Yield

4.3.2 Cpk

Rolled Yield – A metric designed to combine yield at each step of a process or value stream in order to expose the “Hidden Factory.” This metric can be used across supply chains to identify overall integration issues as it applies a very rigorous statistical standard to the entire process. Our suggestion is that this metric be tracked long before a company seeks to achieve Stage Three certification.

Cpk – A metric or indicator of process capability, Cpk is an alternative to reporting process performance in sigma levels. Cpk is an index that measures how close a process is to running at its specification limits. In today’s market you must have a Cpk of at least 1.33 (four sigma) to satisfy most customers. The higher the number the better the quality and the lower the variation. A Cpk of 2.0 (equivalent to six sigma) means that the process variation can double before hitting the specification limits. Some believe that a Cpk of 2.0 will be an absolute entry requirement for most aerospace and defense applications in the near future.

Stage Three – Exit Criteria

Master Plan – Again, the Master Plan should be updated to include specific objectives related to Stage Three.

Organization Assessment Report – The emphasis in Stage Three is on organizational assessment using either the SEA Certification Criteria, the Baldrige National Quality Award Criteria, or similar vehicles.

Organizational Learning Plan – A plan for maximizing the learning gained from customer and supplier interactions, employee and process performance.

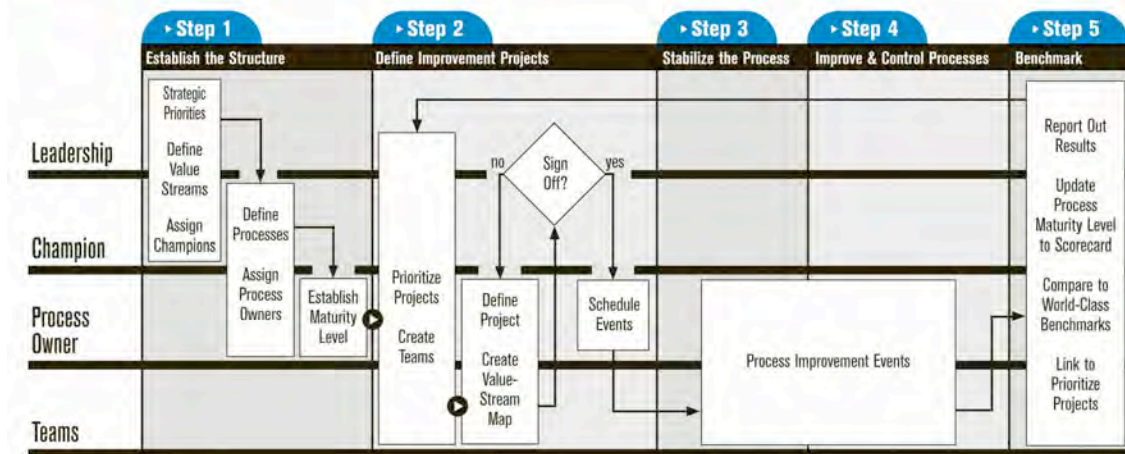
Benchmark Study – A body of benchmark information by which comparisons are made to establish process performance.

Process Control Plans – Plans that set out how statistical tools will be used, what control limits will be applied, and what actions will be taking to reduce variation.

Corrective Action System – A system by which corrective actions are planned and followed throughout the organization. The corrective action system empowers the workforce at the lowest possible level to take action to prevent errors and mistake from moving to the next step in the process.

Improvement Cycles – The presence of measured improvement cycles and trends in process performance characteristic of a high-performing company.

Stage Three Processes at Level 3 - The numbered processes for Stage Three (there are nine numbered processes on the Roadmap for Stage Three) are at a minimum of Process Maturity Level 3.



Blueprint for Operational Excellence

The cornerstone of Operational Excellence is the improvement system. Organizations can't wait until things are right to turn their attention to improvements. When improvements are needed, there is never enough time to focus on them. Making improvements needs to be like payroll: you do it weekly like clockwork, or the whole system falls apart. What stands in the way? Survival. If you create an organizational context that you're always in survival, then everyone is excused to go spend twelve hours a day putting out fires. The time to dig your way out is always immediately. Later could be too late.

Examinations of some of the best companies find that world-class companies not only do all of the right things, but they also link their activities and operate them as a coherent system: a step by step process where roles and responsibilities are clear and required actions have been defined.

The SEA Blueprint for Operational Excellence embodies the best practices of Baldrige award-winning companies but more importantly, practices of small suppliers who have achieved world-class excellence in their everyday operations. The aerospace prime members of SEA, tier ones, and lead sub-tier suppliers contributed to this model and validated parts that have already worked for their own operations.

Step 1 – Establish the Structure

This step is often skipped by organizations and it is common to see process improvement activities that are not well-linked to goals and top-level measures.

Setting the structure establishes sponsorship and ownership. It lays the groundwork for accountability for process improvement. It is the structure for establishing a broad range of employee involvement activity linked to key improvement efforts.

Establish Improvement Priorities

All improvement efforts are also learning efforts. You set a goal to improve time-to-market on new products. You assign a Champion and a Process Owner. They map the process and believe that they can achieve a 20% reduction by implementing several new ideas. They try it. Sometimes it works right away. More often it doesn't and they learn things. Many improvement priorities rely on Kaizens for implementation. These speed up the learning because they often take the form of a 4-5 day intensive project. The idea is to speed up the experimentation and learning.

The leadership team establishes the Improvement Priorities that will drive overall improvement efforts.

Assign Champions

As important as developing Improvement Priorities is assigning a champion to take on the initiative. Most initiatives are cross-functional and therefore champions are challenged to work outside their normal functional boundaries. Champions are most often members of the leadership team. Their job is to provide resources and clear away barriers to improvement.

Define Processes

The first step in establishing a process improvement effort is the development of a high-level value-stream map. This map defines the key elements of the process and helps to ensure that duplication doesn't occur. The Champion and Process Owner work together on this step.

Assign Process Owners

The Process Owner is the day-to-day driver of improvement. While the Champion's job is to clear the way and provide resources, the Process Owner builds a team and sets the pace of improvement. The Champion selects the Process Owner with the agreement of the leadership team.

Establish Maturity Level

The first time a process maturity level is set, it is self-evaluated by the Process Owner and Champion. Later, a more rigorous process of auditing and inspection can be established. The main purpose of using a process maturity system is to provide a method by which improvement efforts can be accurately categorized and used in the performance management system. Process Owners should have incentives for achieving higher levels of process maturity and goals in their performance plan related to process maturity.

Step 2 – Define Improvement Projects

Project definition is often a haphazard affair and can often be executed by one person in a vacuum. Careful consideration of projects can lead to less wasted effort and more usable output.

Prioritize Projects

Prioritizing projects is an important activity for leadership, champions, and Process Owners to collaborate on. Dedicating people's time to process improvement is an investment decision because it allocates significant resources and therefore deserves leadership attention.

And yet decisions about project priorities are often made poorly, without any criteria, or without input from all individuals affected.

Project priorities should be set in light of key customer priorities and a good estimate of the return on investment.

Create Teams

Team selection should occur after project prioritization. The team should be made up of at least 50% of the people who work in the process, 25% of those who either supply the process or are customers of the process, and the rest are those from outside the process altogether. The reason for including people who are outside the process and know nothing about it is that people inside the process often cannot see solutions outside the prevailing paradigm.

Define Project

The Process Owner and the team define the project. Two areas that are very important about defining a project are (1) setting the scope, and (2) establishing the measurable goals.

The scope of the project should be intentionally "tight" so as to ensure that the project is achievable within the timeframe allowed – usually no more than 5 days. The best improvement projects are those where 80% of the improvements are made during the project itself. Walking away from a project with a long list of action items is the kiss of death for most improvement efforts. People have work to catch up on when they leave an improvement project. Generating a long list of things to do sets the team up to experience failure. Teams should be engineered to experience success.

The measurable objectives of a project are derived from the concept of the improvement project as a scientific experiment. Improvement projects are not searches for the unknown. Rather, they are scientific experiments well thought-out and planned before they begin. In an experiment, we have a theory – if I believe that I can achieve A, then I have a theory that by doing B and C, I will achieve A. Thus the best improvement projects proceed as an experiment where we know that we will be doing B and C, and we expect to achieve A within the specified time of the project.

Create Value-Stream Map

Start with understanding. It is a well-established fact that most teams do not agree initially on how a process actually works. Even worse, they truly do not know. The task of mapping the As-Is process establishes how the process is actually performed and often uncovers an unbelievable amount of variation in how the process is actually performed.

Sign-Off?

With the basics completed to define the project, leadership is asked to sign-off on the project or projects. Most improvement efforts consist of a series of short projects and therefore the best approach is to seek sign-off on the plan and schedule for the next year.

Schedule Events

The decision about what approach to use is often easy for those who understand the process and its level of maturity. The lean approach involves one or more short improvement projects called Kaizen Events. These events are typically five days or less.

The Six Sigma approach involves projects that are often longer in duration. Although they can be shorter, they are most often in the range of 13 to 26 weeks.

In general, the guidelines for selecting the lean approach suggest that if a process is Level 3 or below, the lean approach is best. As well, the lean approach is indicated if a process has not been through 6S or if a major layout change is planned.

Step 3 – Stabilize the Process

A stable process is one that produces fewer errors and has a higher level of predictability. Stable processes have fewer special causes of error. A special cause might be someone performing the process slightly differently than the normal method. This might result from a training deficiency or a lack of training altogether.

Process Improvement Events

Lean projects often remove steps that don't add value, re-arrange work areas and process flows, and generally work to optimize effectiveness within a particular work area.

In this step, lean projects focus on lean methods that help to improve stability such as standard work, job certification and cross-training, visual workspace, and pull signals.

Six Sigma projects generally seek to reduce variation in a process that is stable and highly mature. The distance from three-sigma to six-sigma is one that is often a result of changing the metrics and analytical approach used to manage

and improve the process. For instance, a process that formerly used “yield” as a measure might change to using “rolled throughput yield” in order to uncover the hidden operations and the lack of “first pass” quality throughout the process. Lower numbers of errors require new and more advanced approaches to analysis and improvement.

The DMAIC model stands for Define, Measure, Analyze, Improve, and Control. In this step, this model is used to promote better process stability and predictability.

Of course, the overall goal of Six Sigma is equally as important and somewhat of a culture change that must be managed by leadership. The goal of uncompromising quality throughout the enterprise can continue the reduction of cost of quality throughout the enterprise long after most visible methods for identification of improvement projects has disappeared from leadership’s view.

Whether using lean methods, six sigma, or other problem-solving approaches, these events can be as formal or informal as the organization requires. They can include a few people or many. They can include the company’s suppliers and customers.

Step 4 – Improve & Control Processes

In this step, lean and Six Sigma projects begin to focus on process control more than stability because stability, for the most part, has been achieved.

Process Improvement Events using Lean Principles

Lean improvement projects activities focus on self-management and team control of processes. Statistical process controls can be used in appropriate areas. Capability studies lead to control charts as a foundation for the process control system.

Regular “stand-up” reviews of work areas and cells give the team the opportunity to demonstrate their self-management skills.

Process Improvement Events using DMAIC

In this step, the focus of projects begins to turn to process controls as processes gain more and more stability.

Step 5 – Benchmark

Highly mature processes often get classified as “world-class” and improvement stops. But when world-class benchmarks are identified and compared to current levels of performance, improvement starts again.

Report Out Results

As important as the improvements themselves are the report-outs. Building enthusiasm and giving recognition for improvement efforts is a key role for leadership. Teams should be assisted in the development of their presentations.

Report-outs occur on the final day of the project and focus first on measurable results.

The bigger the audience, the better, but it is absolutely essential that the management team attends report-outs and is highly visible. Report-outs are an opportunity for senior leaders to re-enforce the role of improvements in the bigger picture of the division and company.

Update Process Maturity Level to Scorecard

Although overall scorecards are more likely to show change and improvement more slowly, it is important to keep a running picture of progress against process maturity goals. Goals are most often expressed as a percentage of processes at Level 1-5. The Champion for a particular process area or initiative can manage specific targets for each process.

Compare to World-Class Benchmarks

Progress is gauged to world-class standards rather than the standard of how we did yesterday.

Link to Prioritize Projects

The process repeats itself continuously.

Engagement Model

When supplier companies lack the internal resources to accelerate their own improvement, it is often advisable to engage the SEA Authorized Service Provider "ASP". When this choice makes sense, the ASP must follow the "standard work" for SEA implementation.

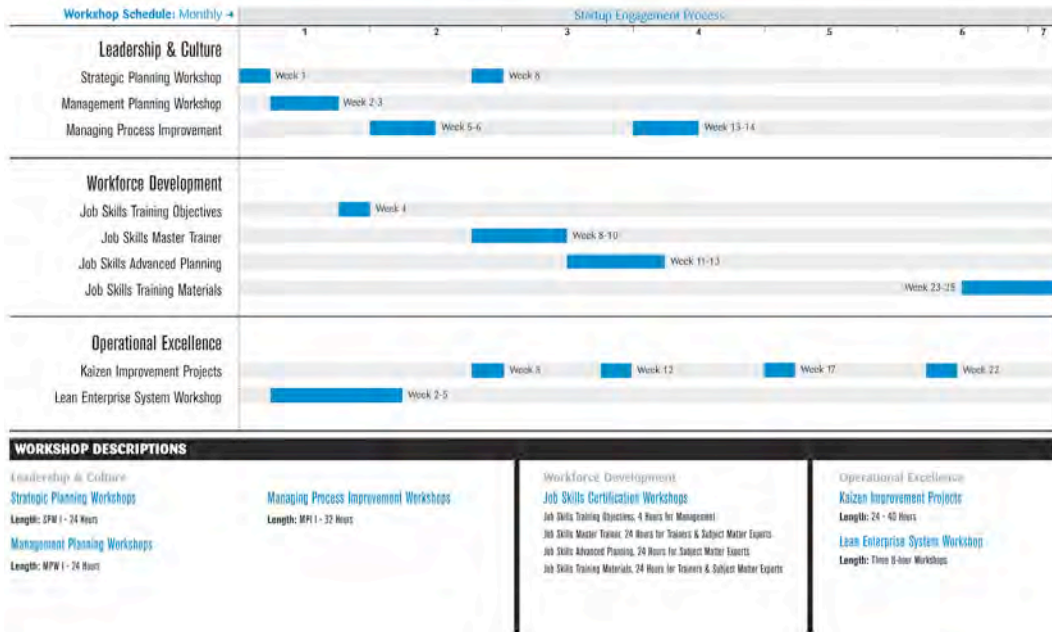
This Conversion Plan shows the process utilized by ASPs to begin an engagement. A SEA engagement will usually involve a minimum of two years or more depending on the ability of the supplier to utilize the assistance to become self-sustaining.

The goal of the SEA Conversion Plan is to build the structure for long-term acceleration of improvement. Passing the Stage One SEA Certification is the evidence that the supplier has established that structure.

SEA's membership process for suppliers supports this goal. The Conversion Plan follows the step-by-step proven best practice process for ensuring that every step is the right step at the right time for success.

The Startup Engagement process usually takes as many as 4,000 trainee-hours, 41 on-site instructor days, and a significant amount of management time. The average return on investment is 5 to 1 with one year values of 10 to 1.

Lean Enterprise Conversion Plan



In Summary

The Lean Enterprise System is a powerful and yet simple business system that addresses the entire enterprise. It is designed specifically with small to mid-size supplier companies in aerospace, defense, and space supply chains.

There are many case studies that already establish LES's return-on-investment for the supplier.

The Roadmap provides a step-by-step process that can be followed to proven success. It can be supported by SEA Authorized Service Providers, followed by companies with their own internal resources, or adopted as a project by do-it-yourselfers.

SEA is an unprecedented industry collaboration. SEA is supplier-led and prime-empowered. There will never be a better effort on the part of an industry to accelerate improvement.

SEA is about accelerating supply chain performance. The more you invest in this mission, the more visibility, recognition, and opportunities will open up for your company. We invite you to join today.

	Stage One Stabilization	Stage Two Supply Chain Integration	Stage Three Sustainability
Leadership & Culture	1.1.1 Strategic Planning Process 1.1.2 Leadership Communication Process 1.1.3 Organizational Performance Review Process 1.1.4 Continuous Improvement Management Process 1.1.5 Workforce Development Integration Process	1.2.1 Goals Deployment & Review Process 1.2.2 Values Deployment Process	1.3.1 Organizational Learning Process 1.3.2 Organizational Assessment Process
Workforce Development	2.1.1 Job Skills & Cross-Training Certification Process	2.2.1 Team Problem-Solving Process 2.2.2 Corrective Action Process 2.2.3 Continuous Improvement Process	2.3.1 Team Self-Management Process 2.3.2 Statistical Control Process
Operational Excellence	3.1.1 Kaizen Process 3.1.2 5S Visual Workplace Process 3.1.3 Quick Changeover/SMED Process 3.1.4 Material Management Process 3.1.5 Production Planning Process	3.2.1 Flow-Based Material Process 3.2.2 Mixed Model Cell/Line Design Process 3.2.3 Lean Suggestion Process 3.2.4 Total Productive Maintenance Process 3.2.5 Supply Chain Integration Process	3.3.1 Design of Experiments Process 3.3.2 Design to Cost Process 3.3.3 Six Sigma Projects Process 3.3.4 Six Sigma Design Process 3.3.5 Design for Manufacturability Process
Business Results	4.1.1 Inventory Turns 4.1.2 Sales/Employee 4.1.3 On-Time Delivery 4.1.4 PMM Average	4.2.1 Defects Per Million Opportunities	4.3.1 Rolled Yield 4.3.2 Cp/K
Exit Criteria	Master Plan Strategic Goals and Champions Trained Process Owners Certified Master Trainers Work Instructions Training Guides Training Plan Balanced Scorecard Key Processes at Level 3	Master Plan Department & Individual Objectives Recognition Program Cell Configurations Mixed Model Lines Workforce Certifications Supplier Partnerships Key Processes at Level 3	Master Plan Organizational Assessment Report Organizational Learning Plan Benchmark Study Process Control Plans Corrective Action System Improvement Cycles Key Processes at Level 4-5

There is no doubt that improvement must be accelerated in order for America to stop the drain of manufacturing jobs to offshore suppliers. The only certain solution to keeping work onshore is to become more competitive fast!

The key element of the SEA strategy is to get started now. To get moving is the most important thing. Suppliers need to learn the SEA system and how they fit. SEA schedules briefings and orientations so that suppliers can learn more and decide where to get started.

We estimate that 50% of the suppliers in the U.S. won't be around in 5 years. If you accelerate your improvement efforts, you certainly have a chance to be among the ones that survive.