Excellence in Financial Management

Course 17: Process Improvement

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This course provides an overall understanding of how to improve processes. This course is recommended for 2 hours of Continuing Professional Education. If you are seeking credit for taking this course, then you need to download and use the "exe" file version of this course. All course files and supplemental materials are posted on the internet at www.exinfm.com/training

Chapter

1

Some Good Starting Points

Everything everyone does within an organization is part of a process. So invariably if you want to improve what the organization does, then you have to focus on improving the process. By putting your emphasis on the process, you avoid the typical trap that so many business leaders seem to fall prey to – looking to cut costs, they focus on trimming payrolls or pushing people to do more with less. This short-sided approach may get a brief bump in performance. However, in the long-run you end up increasing costs, reducing value to the customer, and making it harder for the company to compete.

Process improvement is a long-term approach to improving organizational performance with substantially less risks of destroying value when compared to short-term approaches. This short course will outline many of the concepts and tools people use to improve processes. The word “quality” will be used a lot since we will learn that variations are the opposite of quality and by reducing variation (improving quality), we can embark on the road to continuously improving a process.

Two Important Pioneers

Process efficiency, especially in the name of quality, has been around for a long time. For example, back in 1950 W. Edwards Deming spoke before Japanese business leaders, outlining a roadmap for total quality management. Deming’s roadmap consisted of fourteen key points:

1. Create a constancy of purpose so that you are continuously improving your processes. This requires defining both short term and long term problems, allocating resources appropriately, and working to improve product and service design.
2. Adopt a new philosophy of quality management, constant learning, embracing change and focus on the customer.
3. Cease dependence on inspection as a means for ensuring quality. Instead, place much more reliance on statistical tools for assessing quality.
4. Don’t award simply on lowest price. Change your focus from lowest initial costs to lowest overall costs in the long run, incorporating quality, sole source, relationships, and other factors.
5. Search continuously to improve processes. Become innovative and look at the overall process flow or system in terms of design, inputs, materials, maintenance, supervision, automation, training, teams, waste, and other areas that generate innovation.
6. Invest in great training to keep your people productive and innovative. New skills bring about improvements. Therefore, you must fuel this process by empowering your people to do their best.
7. Institute leadership that goes beyond the numbers and instead, puts an emphasis on supporting and making sure people can execute. Leadership must be able to discern what’s important and what’s not to optimize how resources are applied.

8. Drive out fear and encourage people to participate and openly pursue needed improvements and change.
9. Break down the barriers with workers, suppliers, and everyone involved in the process. Promote communication across all players.
10. Eliminate slogans, exhortations, and targets that tend to be divisive and counter-productive to one group of players within the process.
11. Avoid numerical quotas since they impede quality, increase waste, and discourage productivity.
12. Allow pride of workmanship and do away with the traditional approaches of annual performance appraisals and management by objectives. Evaluate and reward performance in relation to quality.
13. Institute educational programs and self-improvement for life long learning and team building.
14. Make sure Senior Management is committed to improving quality and productivity. This may require changing the organizational structure and putting an Action Plan in place for the 13 other points.

Needless to say the Japanese took Deming very seriously, producing high quality products and capturing global markets for their products. So it is very clear that Deming was well ahead of his time and many of his principles are now widely practiced throughout the world.

A second pioneer behind the quality management movement is Joseph M. Juran. Juran, like Deming, advocated strong participation by everyone touched by the process. However, Juran took this concept one step further by including the customer. Juran argued that quality must be linked to the customer. Juran documented his principles in a landmark book, Quality Control Handbook, in which he put heavy emphasis on understanding and measuring the customer. Here is a list of Juran's ten step process:

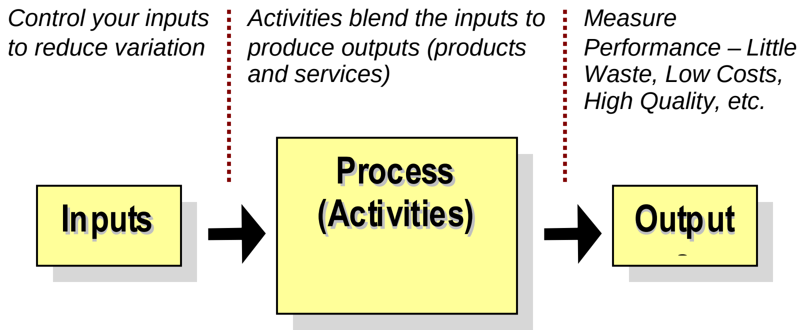
1. Identify your customers
2. Seek out and define their needs
3. Translate customer needs into your business language and requirements
4. Establish units of measure
5. Define appropriate performance measurements
6. Develop products and services
7. Optimize product and service design
8. Develop production processes
9. Optimize processes / fully capable
10. Transfer into operations

For those wanting to learn how to improve a process, W. Edwards Deming and Joseph M. Duran are two of the best sources.

> "Production technique is pretty much a level playing field. Anyone can purchase identical equipment and facilities, hire and train qualified people, and purchase raw materials required to make a product. There are certain steps required to make a particular product and everyone does them the same way. The difference appears to be in the manufacturing technique – how we manage and balance people, materials, and machines."
> – Lean Manufacturing that Works by Bill Carreira

Breaking it Down

A process is a series of activities, often repeated over and over with the basic flow of transforming inputs into outputs. The basic premise can be depicted as follows:



The activities that make up the process are not the same. Some activities add value to a process and other activities fail to add value. Therefore, one way to think "process improvement" is to think in terms of reducing non-value added activities.

The concept of value-added is not easy to pin down. We can borrow from lean thinking (which we will discuss later) to help define value added. Under lean, the activity needs to contribute in some way to adding value to the customer. So in order to understand if an activity is value-added, you must understand what adds to the customer experience. Maybe it's something that gets the product to the customer sooner or perhaps it's an after the sale phone call that makes the product or service more complete. We need to distinguish between value added vs. non value added in relation to the customer. This often boils down to getting the process to do only the right things in the right sequence at the right times and everything else is subject to the non-value added test.

The concept of Lean tends to "flag" non value added activities into seven categories:

1. Overproduction – The application of work that is not really needed.
2. Waiting – Time spent where resources are idle, not used for anything.
3. Transportation – Having to move resources from one location to another which introduces delay and inefficiency.
4. Nonessential activity – Performing an activity that makes no contribution to putting value into the hands of the customer.
5. Inventory – Holding resources until they can be used or sold.
6. Variation – Changes or deviations from the expected outcome of the process.
7. Defects – Errors or nonconformities produced during the process.

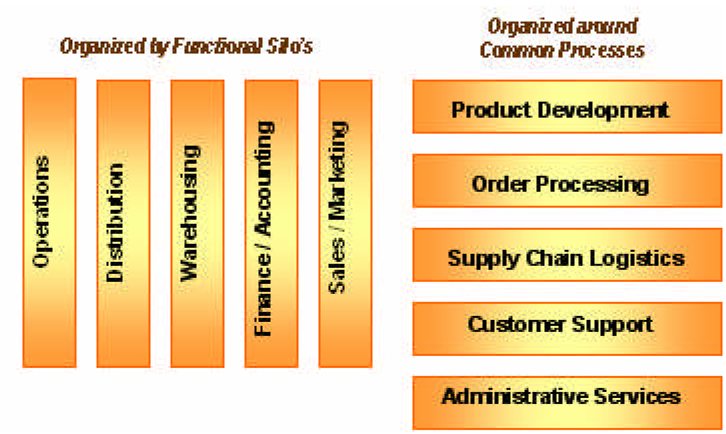
You can also flag a non value added activity by asking if the activity is a "Re" type activity; such as Rework, Reschedule, Resubmit, and so forth. Regardless of how you go about it, you need to squeeze non value activities out of a process. A few non value activities may be required, such as regulatory requirements within a process; but we want our processes to be lean and this will require very few, if any, non-value added activities.

Compress the Handoffs

One of the more common practices for improving a process is to reduce the handoffs or transfers that take place. This is usually accomplished by first understanding and mapping out the process using a flowchart. Once the process is mapped out, the trick is to compress the handoffs out of the flowchart, streamlining and making the process more efficient.

For example, large bureaucratic organizations transfer information, products, and other outputs between functions, departments, divisions, and other hierarchies that inject handoffs along the way. With each handoff, there is delay involved, not to mention the introduction of errors. Consolidating these activities around the process flow can help reduce cycle times and lower the resources consumed (costs).

The following example highlights the difference between organizing around functions vs. organizing around the processes:



Fundamental Principles

Many organizations recognize certain practices as part of improving a process. Here are some examples:

- Technology – The use of technology is often an enabler for improving a process. This is particularly important when it comes to innovation or rapid transformation of a process, commonly referred to as Business Process Redesign (BPR). For example, the use of Radio Frequency Identification or RFID's to track inventory items is transforming how company's manage high value items moving through the supply chain. Technology can often help improve the efficiency or effectiveness of a process by introducing innovative approaches for doing things differently.
- Outsourcing – Non core processes where control by the organization is not critical are sometimes outsourced. Outsourcing relies on outside expertise to take control over some non-core function, especially functions that are redundant and generic in nature. Outsourcing can quickly eliminate unnecessary activities, lower overall costs, and introduce better ways of how

things should get done. There are some downsides to outsourcing, such as loss of control, initial costs of changeover, and possible loss of jobs to those whose positions have been outsourced.

- Benchmarking and Best Practices – One of the fastest ways to gain insights into how to improve a process is to benchmark your performance in relation to best in class practices. You instantly see real world examples that highlight your strengths and weaknesses in relation to your peers. Many best practices cut across companies and industries, such as web enabled processes to service customers or procurement cards for consolidating payable processing. Additionally, best practices are often not overly complicated, such as forming teams for project based work or using an intranet web site for knowledge sharing.
- Supply Chains – For many organizations, the supply chain is at the core of major processes and since supply chains involve lots of movement and complexity, they invariably are ripe for process improvement. For example, most supply chains move things from one point to another and anytime you move something, it ends up sitting around waiting for the next activity to kick-in. Another problem is a fixation with lowest costs suppliers. There is much more to the value equation than simply price. Consequently, many supply chains are very poorly managed.

> "Supply chains are as old as commerce, but the opportunities they now present are without precedent. Modern manufacturing has driven so much time and cost out of the production process that there is only one place left to turn for competitive advantage. As business engineering guru Michael Hammer recently put it in his new book, The Agenda, the supply chain is the last untapped vein of business gold."
> – Supply Chains: A Manager's Guide by David A. Taylor, Ph.D.

Measurement and Control

One of the universal principles for a sustained approach to improving a process is to measure the process. And once you measure the process, you now have an opportunity to get control over the process. Measurement and control is particularly important where organizations want to continuously pursue process improvement in a very rigorous way.

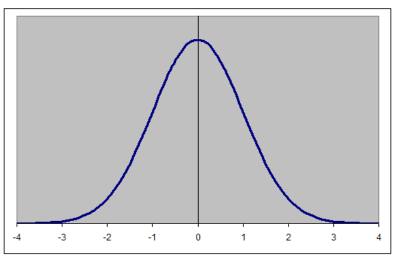
Process measurement typically takes three forms:

1. Quality – Measuring a process in relation to qualitative characteristics (reliability, appearance, color, weight, length, etc). Examples include: # of Breakdowns, # Service Requests by Product, # of Power Failures, % of Orders Rejected, # of Invoices Disputed, Write Offs as a % of Sales, etc.
2. Time – Measuring a process in relation to speed, response, turnaround, cycles, etc. Examples include Wait Time in Minutes, Round Trip Hours, Cycle Time, etc.
3. Productivity – Measuring a process in relation to actual outputs vs. what you desire in terms of outputs. Examples include % of orders shipped within 3 days, % of invoices entered within 24 hours, # of customers serviced, # of claims processed, % requests sent the same day, etc.

You can also think in terms of efficiency and effectiveness when it comes to understanding what should get measured. Listed below is a rating scale regarding process efficiency and effectiveness:

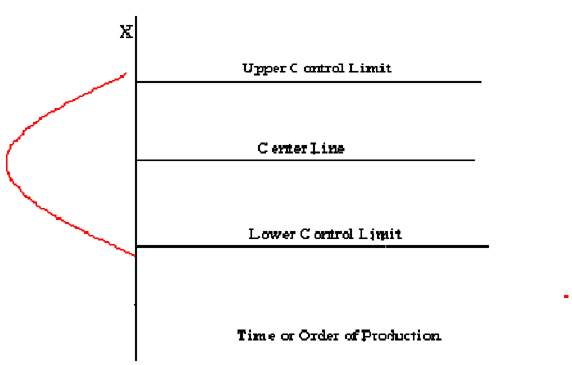
Scale	Process Efficiency	Process Effectiveness
World Class	Error Free, very short cycle times, no waste	Outputs exceed all customer requirements
Excellent	Very little waste, good cycle times, costs are low	Outputs meet all customer requirements
Good	Fairly efficient process, still has room for improvement	Outputs meet most customer requirements
Poor	Process is inefficient, needs to improve	Outputs meet some customer requirements
Broken	Major problems, long cycle times, high costs	Outputs not meeting basic customer needs

Once you know what to measure, the next step is control. Control often takes the form of a control chart. If you took statistics, you should remember something called the Normal Distribution curve:



Now flip the curve sideways and extend it out over measurable intervals. The upper and lower control limits define variation from the mean (average). This is the basic structure of a control chart for monitoring variation, sometimes described as Statistical Process Control (SPC).

Theoretical Basis for a Control Chart



We can take this one step further by experimenting with our inputs whereby we carefully alter or change the input variables to see how it changes the process and final outputs. This is one of the most common techniques for continuously improving a process – Design of Experiments (DOE). We will dig deeper into these statistical concepts (SPC and DOE) when we explore Six Sigma.

Formal Programs

Some organizations use formal programs for making process improvement happen. Two notable examples are the Malcolm Baldrige National Quality Award and ISO (International Organization for Standardization) 9000 Registration.

The Malcolm Baldrige Program was established to promote quality management and performance excellence for businesses in the United States. Malcolm Baldrige requires a business to focus on the following areas, totaling up to 1,000 points:

1 Leadership (125 points)
1.1 Organizational Leadership (85)
1.2 Public Responsibility & Citizenship (40)

2 Strategic Planning (85)
2.1 Strategy Development (40)
2.2 Strategy Deployment (45)

3 Customer and Market Focus (85)
3.1 Customer & Market Knowledge (40)
3.2 Customer Satisfaction & Relationships (45)

4 Information and Analysis (85)
4.1 Measurement of Organizational Performance (40)
4.2 Analysis of Organizational Performance (45)

5 Human Resource Focus (85)
5.1 Work Systems (35)
5.2 Employee Education, Training, and Development (25)
5.3 Employee well-being and Satisfaction (25)

6 Process Management (85)
6.1 Product and Service Processes (55)
6.2 Support Processes (15)
6.3 Supplier and Partnering Processes (15)

7 Results (450)
7.1 Customer Focused Results (115)
7.2 Financial and Market Results (115)
7.3 Human Resource Results (80)
7.4 Supplier and Partner Results (25)
7.5 Organizational Effectiveness Results (115)

From an international perspective, quality control standards have been established by the International Organization for Standardization (ISO) in Geneva, Switzerland. These standards cover eight management principles:

1. Customer Focus - Organizations depend on their customers and therefore should understand current and future customer needs, striving to exceed customer expectations.
2. Leadership - Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.
3. Involvement of People - People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.
4. Process Approach – A desired result is achieved more efficiently when activities and related resources are managed as a process.
5. System Approach in Management - Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.
6. Continual Improvement – Continual improvement of the organization's overall performance should be a permanent objective of the organization.
7. Factual Approach to Decision Making – Effective decisions are based on the analysis of data and information.
8. Mutually Beneficial Supplier Relationships - An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

Most ISO standards are very specific to products and services, such as Shipbuilding, Packaging, Mining, and Metallurgy. ISO also has a generic set of standards, grouped by certain categories: ISO 9000:2000 (vocabulary and definitions), ISO 9001:2000 (registration requirements), ISO 9004:2000 (guidelines for improving the quality management system) and ISO 14000 (environmental management system).

ISO Registration is often considered a pre-requisite for getting certain international business. Registration requires documentation of processes followed by a formal review conducted by auditors.

Although Baldrige and ISO 9000 are solid frameworks for rapidly putting a quality program together, they sometimes can be more show than substance. For example, some companies spend most of their efforts filling up notebooks with paper, documenting everything and using the right buzz words to satisfy auditors. In reality, it can be more important to apply the concepts associated with these programs as opposed to jumping through the hoops to win the award. Also, many organizations seem to get more bang for their buck by pursuing process improvement methodologies such as Six Sigma. Therefore, you should not view programs such as Malcolm Baldrige or ISO 9000 as panaceas for process improvement, but instead look to them for concepts and principles that fit and work within your organization.

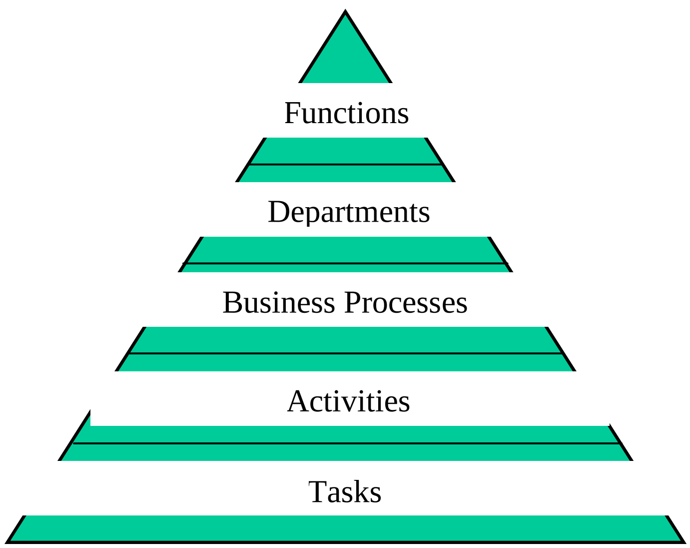
Chapter 2

Fundamental Tools of the Trade

Regardless of how you go about improving a process, you will most likely use one or more of the following tools:

Analytical Techniques	Getting to Solutions	Additional Tools
SWOT Analysis	Brainstorming	Value Analysis
Root Cause Analysis	Storyboarding	Solution Rating Matrix
Pareto Charts	Force Field Analysis	Trend Analysis
Process Mapping	Issues Analysis	Project Management

Therefore, a solid understanding of each of these tools can help almost any process improvement project. This chapter will highlight each of these tools. And some of these tools may get applied above or below the process level to get a better understanding of what takes place outside the process layer within the enterprise architecture:



> "The problems that afflict modern organizations are not task problems. They are process problems. The reason we are slow to deliver results is not that our people are performing their individual tasks slowly and inefficiently – We are slow because some of our people are performing tasks that need not be done at all to achieve the desired result and because we encounter agonizing delays in getting the work from the person who does one task to the person who does the next one. In short, our problems lie not in performance of individual tasks and activities, the units of work, but in the processes, how the units fit together in the whole."
> – Beyond Reengineering by Michael Hammer

SWOT Analysis

Where processes are impacted by both internal and external factors, it can be useful to apply SWOT – Strengths, Weaknesses, Opportunities, and Threats. SWOT Analysis is a standard tool used by all types of analyst for identifying major strategic issues. SWOT can be used at any organizational level – function, department, group, etc. SWOT is defined as:

- **Strength**: Any existing or potential resource or capability within the organization that provides a competitive advantage in the market.
- **Weakness:** Any existing or potential internal force that could serve as a barrier to maintaining or achieving a competitive advantage in the market.
- **Opportunity:** Any existing or potential force in the external environment that, if properly exploited, could provide a competitive advantage.
- **Threat:** Any existing or potential force in the external environment that could inhibit the maintenance or attainment of a competitive advantage.

You can also fast track the assessment process by simply doing a simple T list of the pluses and minuses.

Do we install new control devices?

Plus (+)	*Minus (-)*
Reduces downtime	*Initial cost is not budgeted*
Better response rates	*Somewhat difficult to program*
Part of Risk Plan	*Requires upkeep and upgrades*

Root Cause Analysis

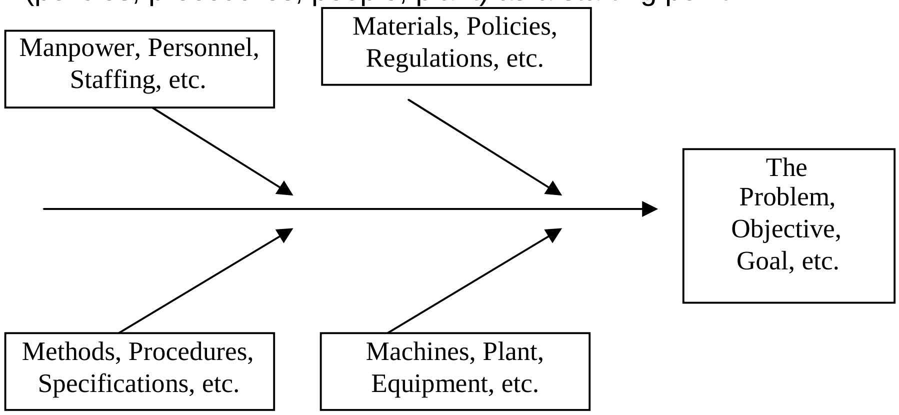
Root Cause Analysis is used to clearly understand what's driving or causing a problem. The key is to identify the factors influencing the effect you are starting with. One way to jump start the analysis is to look at:

- 4 M's: Methods, Manpower, Materials, Machinery
- 4 P's: Policies, Procedures, People, Plant

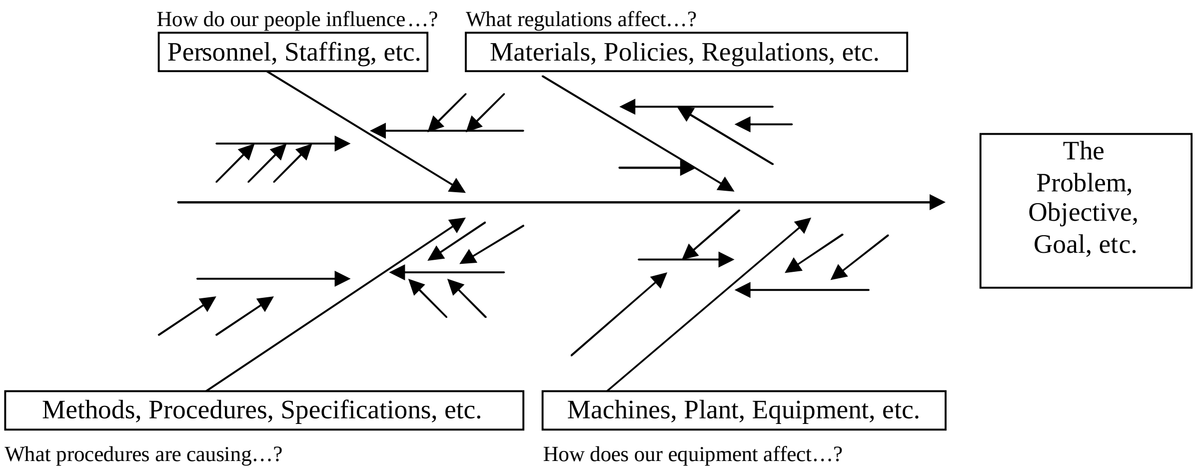
Root Cause Analysis is often expressed in the form of a fishbone diagram. The steps for doing the diagram are:

1. Specify the effect to be analyzed. The effect can be positive (objectives) or negative (problems). Place it in a box on the right side of the diagram.

2. List the major categories of the factors that influence the effect being studied. Use the "4 Ms" (methods, manpower, materials, machinery) or the "4 Ps" (policies, procedures, people, plant) as a starting point.



3. Identify factors and sub factors. Use an idea-generating technique to identify the factors and sub factors within each major category. An easy way to begin is to use the major categories as a catalyst. For example, "What policies are causing…?"



4. Identify significant factors. Look for factors that appear repeatedly and list them. Also, list those factors that have a significant effect, based on the data available.

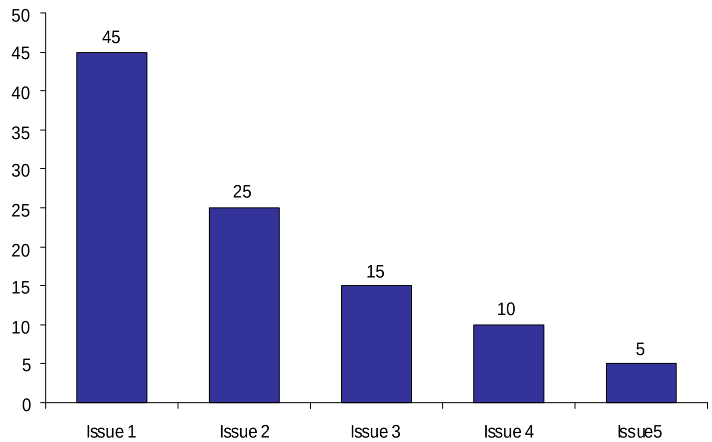
5. Prioritize your list of causes. Keep in mind that the location of a cause in your diagram is not an indicator of its importance. A sub factor may be the root cause to all of your problems. You may also decide to collect more data on a factor that had not been previously identified.

A less formal approach to root cause analysis is to simply use the Five Whys technique. With each reiteration of why (say five times), you pull out additional information that possibly helps you identify the root cause of a problem.

Pareto Chart

In order to focus on significant problems, you can rank the importance in descending order of occurrence. This is typically done using the Pareto Chart. In order to chart problems, you must:

1. Identify the problems that need to be ranked.
2. Use a standard measurement for ranking, such as frequency, costs, etc.
3. Determine the time frame for evaluating the problems.
4. Collect the data from existing reports or use new data.
5. Label the units of measure on the left vertical axis and label the problem areas on the horizontal axis.
6. Plot the data, showing the descending order from left to right.



Process Mapping

Process Mapping is regularly used to depict the flow of major activities within a process. Process maps range from simple block diagrams to more elaborate swim type diagrams showing the “swimming” flows to and from major functional or organizational units that play a role within the process.

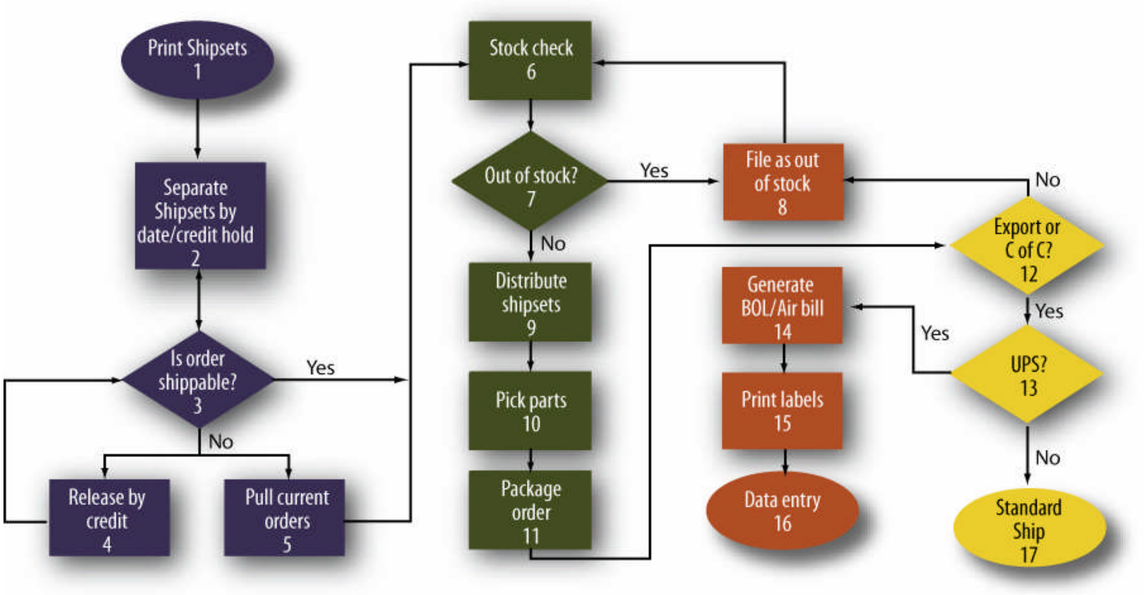
In order to flowchart or map a process, you will need to understand the activities, what triggers the activity (inputs), who is involved, the sequential steps, and the outputs associated with the steps. This will require interviewing people assigned to doing the activities. You will also need to examine documents, such as desk procedures, work flow diagrams, and other documents that help describe how the process works.

Process maps allow you to see the big picture, clarifying sub-processes, sequences, and activities. Process maps should be prepared showing critical information flows and different players involved. Where possible, it is useful to document cycle times in different steps; especially wait times. Once completed, you can use the process map to answer certain critical questions:

1. Can we eliminate or reduce certain activities?
2. Can we complete the process in less time by changing the process?
3. Can we improve how we meet customer requirements by changing the process?

Finally, if you are unsure what processes to map, start with those processes that have high impact in terms of costs, time, resources consumed or waste. Core processes are sometimes easier to map due to existing documentation and easy access to the internal players as opposed to external players.

Sample
Current Shipping Process



Brainstorming

Brainstorming is used to generate ideas without any real regard for the merit of the ideas. You can evaluate the ideas after the brainstorming session is over. Here are some basic guidelines to follow:

1. Start with a clear definition of what it is you are trying to solve.
2. Make sure everyone understands the problem or issue.
3. Write down all ideas and don't judge anything submitted.
4. Give everyone a chance to participate and express opinions.
5. Try not to be too formal, but impose some structure to ensure the brainstorming session is productive.
6. Don't get discouraged if the brainstorming session starts off slow – the best ideas usually get generated at the end of the session.
7. Try to write down all ideas exactly as they are submitted by participants.
8. Make sure you have a broad mix of people in the brainstorming session – process owners, customers, vendors, subject matter experts, etc.

One of the biggest misconceptions about brainstorming has to do with group brainstorming. Some of the best ideas come out of individual brainstorming where each individual has time to think about the problem and submit comments separately. It's also useful to have a "culture" that nourishes ideas. This provides a natural environment for highly productive brainstorming.

Storyboarding

Storyboarding is a visual approach to brainstorming. Like brainstorming, it attempts to organize multiple ideas and concepts. Unlike brainstorming, it tends to be less structured, allowing for more open participation by anyone who can help get the group to a common idea. Storyboarding will also require that you group and categorize ideas since you want to visually show how things work. For example, you might show initial events or activities off to the upper left on a large white board and then work your way down, visually showing how things flow downward.

To make sure you can storyboard, you'll need large white boards or butcher paper as well as markers, cards, and other supplies to help illustrate your concept. Use different colors to group and organize common elements. You can take a digital photo of the output and refer back to it for later development.

> "A process cannot be changed unless all the supporting elements are changed as well. Therefore an essential early step of a reengineering effort is to clearly identify and quantify all of the resources in a corporation that are dedicated to each specific process."
> – The Reengineering Handbook by Raymond L. Manganelli and Mark M. Klein

Force Field Analysis

Force field analysis is used to visually show relationships that help or hinder a solution to a problem. Force field analysis provides a quick list of factors that influence your objective. Here are the basic steps:

1. Define the problem or objective that you are analyzing.
2. List the forces that impact or influence your problem. Use an idea generating technique like brainstorming.
3. Assign weights or priorities to each force on your list. Place heavier weights on those forces that have the highest impact.
4. Manage based on the list – try to reduce the negative forces and maximize the positive forces to solve the problem.

Focus your efforts on those forces that are easy to implement and yet at the same time, they produce high results. Listed below is an example of how force field analysis is used to help someone stop smoking:

Promoting Forces			Inhibiting Forces
Better health	→	←	Habitual behavior
Save money	→	←	Need for nicotine
Won't have to leave building every half hour	→	←	Need to have fingers occupied
Family won't breathe smoke	→	←	Need to have something in mouth
Food will taste better	→	←	Gain weight every time I try to quit

Value Analysis

One of the most important techniques for improving a process is to make a distinction between value added and non value added activities. Value analysis summarizes all activities between value added and non value added. This distinction is made as follows:

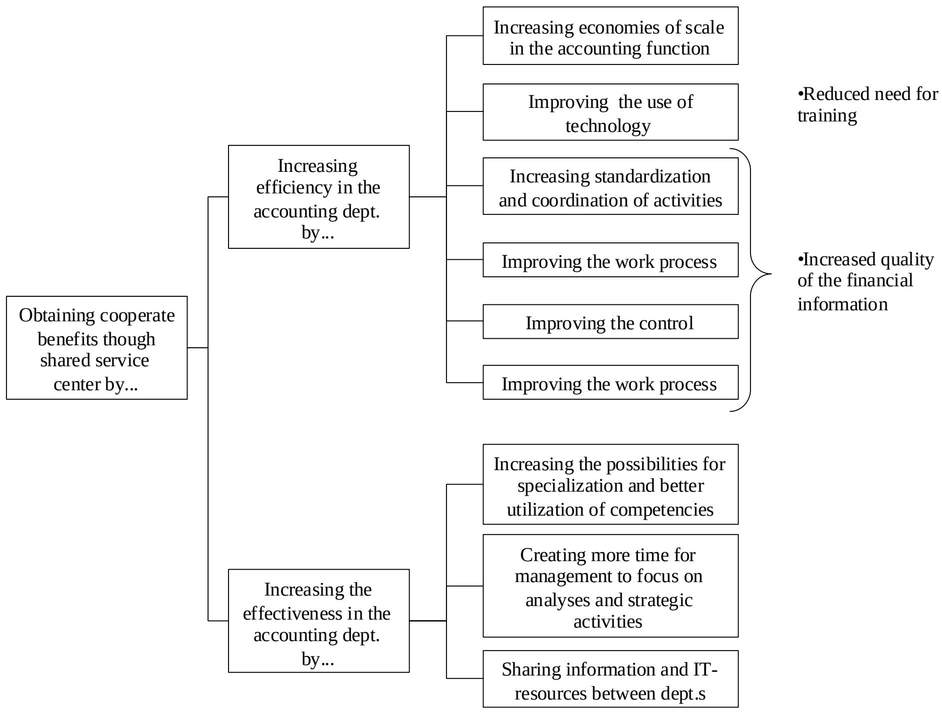
Value Added Activities	Non Value Added Activities
Necessary to meet customer requirements	If eliminated, would not impact the product or service to the customer
Helps or assists in the production of the product or service	Creates waste, extra time, rework
Represents an output that the customer is willing to pay for	Performed because the output failed to meet customer requirements
Critical to making sure the process works	Is preformed because of inefficiency elsewhere within the process
Improves quality or resolves problems that impacts customer satisfaction	Represents a duplicative effort or adds unnecessary steps to the process

In order to organize your analysis, construct a table with three columns – listing your activities in column 1, denoting the activity as Value Added or Non-Value Added in column 2 and a description or comment on why the activity was classified as Value Added or Non-Value Added in column 3. If possible, try to estimate the costs of each activity so you can prioritize your analysis for further action. The goal is to optimize the value-added activities so they are lean and reduce or eliminate the non-value added activities. Listed below is an example for a Receiving Department:

Activity	V or NV	Value $	Non-Value $	Total
Accept Material	V	$293,578		$293,578
Distribute Material	NV		$302,845	$302.845
Manage Material	NV		$183,342	$183,342
Perform Personnel Duties	V	$139,578		$139,578
Perform Admin Duties	V	$ 54,733		$ 54,733
TOTAL		$487,889	$486,187	$974,076
		50%	50%	100%

Issues Analysis

It is often useful to break a problem down into components. Issue analysis is used to define the elements of a problem and show these elements in some logical way. This is often accomplished by using an issue tree:



You can use the issue tree to show sub-processes at different levels with the process or activity above flowing into the lower one. Some key points to consider:

- Use the Issue Tree to guide you into underlying root causes.
- Look for duplication between the activities within the Issue Tree.
- Validate relationships between problem components by involving process owners and other stakeholders.

Solutions Rating Matrix

The solution rating matrix is a process for weighing all the possible solutions against a predetermined set of criteria or rules. Examples of criteria or rules for weighting include:

- Ease of implementation
- Effectiveness of solution
- Probability of success
- Resistance to solution
- Cost

Make sure your weights total up to 100%. Now organize your solutions into a matrix and rate each solution on a scale from 1 to 10. Finally, you can multiply the rating scores by the weighting percentages to arrive at the total score. Listed below is a simple example of a solutions matrix for deciding which automobile you should purchase. Based on five criteria, Car "B" is the selected choice:

Solution Rating Matrix
(10 = High, 1 = Low)

		Solutions					
Five Criteria	Weight	Car "A"		Car "B"		Car "C"	
Functionality	40%	3	1.2	7	2.8	9	3.6
Initial Cost	30%	9	2.7	8	2.4	5	1.5
Maintenance Cost	20%	8	1.6	7	1.4	5	1.0
Quality	5%	10	.5	7	.35	3	.15
Size	5%	5	.25	7	.35	1	.05
TOTAL POINTS	100%	6.25		7.3		6.3	

Trend Analysis

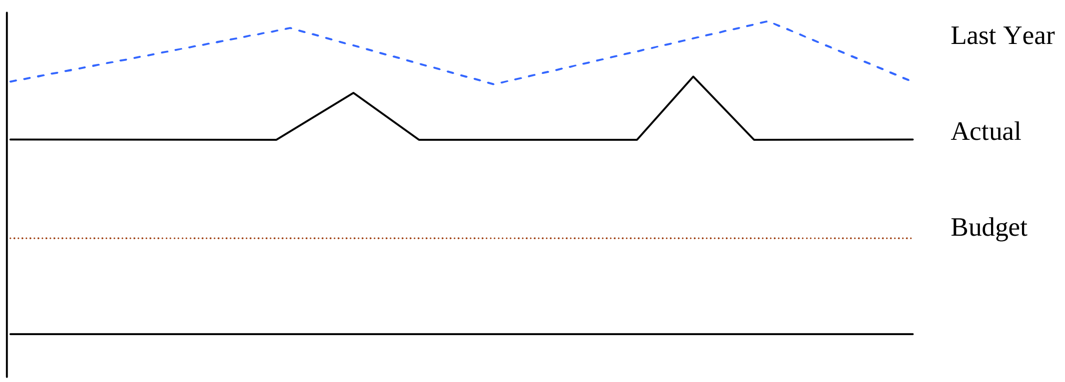
One of the basic tools in evaluating a process is to look at trends. Most trends are reported in a time series graph. This allows a comparison, prompting action on unfavorable trends and recognizing the need to adjust targets on constant favorable trends. The basic steps for trend analysis are:

1. Select a specific process, sub-process or activity with outputs.
2. Collect the measurement data on the outputs over consistent time intervals.
3. Monitor performance and see if you need to adjust the process, sub-process, or activity to change performance.

A few tips to consider when doing trend analysis:

- The best outputs or measurements are usually linked to customer needs.
- Collect your measurements at good time intervals that facilitate the right degree of management control. Measurements that are too late are useless to managers. Constantly measuring the same things over and over with no corresponding action is also useless.

Simple Example of Trend Line Analysis



Project Management

Much of the work that goes behind improving a process has to do with good project management practices. Larger type initiatives take the form of a formal project, especially Six Sigma type projects. Therefore, sound project management practices are extremely important for major process improvement projects. Here are some important concepts to consider:

- Define your scope for improving a project by breaking the scope down into workable elements that you can manage. This is usually accomplished in the form of a Work Breakdown Structure, allowing you to delegate activities and tasks to other team members. You need this structure for managing all of the components that make up the project.
- Develop a work schedule for major milestones throughout the expected life cycle of the project. This work schedule should include your expected costs as well as anticipated start and completion dates.
- Where the stakes and costs are high, consider including a risk management plan as part of how you manage the project. The Risk Plan should address the “what if” situations that may arise during the course of the project.
- Another useful plan to include is a quality assurance plan. You need to have control checks in place to make sure things are getting done right.
- Although it can be somewhat subjective, many executives will probably want some form of cost benefit analysis, showing the Return on Investment for the project. It’s also useful to include a Net Present Value in your business case for the project.
- After you complete the project, you need to conduct a post implementation audit, determining if the project met its original objective and goals. You also want to flush out lessons learned for executing future projects.

NOTE: Short Course 19 provides much more in-depth coverage on project management, including information on how to build a detail project plan and measure project performance.

Chapter
3

Capability Maturity Model (CMM)

For larger organizations, it might be useful to view all processes from a single organizational context. One of the best frameworks for doing this is called the Capability Maturity Model or CMM. The concept of CMM was developed through the Software Engineering Institute or SEI. SEI was created by the Department of Defense to reduce failures with software application projects. Therefore, CMM is rooted in software development processes. However, the concepts associated with CMM can be useful for all types of process improvement projects since CMM provides a framework regarding process maturity.

One of the great advantages of using the CMM approach is that it “positions” the organization for process improvement on an enterprise-wide basis. This can be important since you ultimately want all parts of the organization working together or at least progressing to the same level of maturity. For example, an organization may not be ready for major change or transformation of its processes. By applying CMM, you superimpose an overall discipline across the entire organization – similar to physical workouts for a sports team where everyone runs through the same drills. This gets the entire team in shape so that everyone can execute on the field.

Five Levels of Maturity

CMM looks at the maturity of your business processes in terms of five levels:

Level 1 – Initial: For organizations just starting out, processes are not well established and defined. There is deep fragmentation across the organization – one area does it one way and another unit is following a different process for getting the same thing done. There is poor integration and alignment across functional areas by process. Things get done through individual effort as opposed to a standard process.

Level 2 – Repeatable: A basic level of process management where you can apply a process to various units within the organization. You start to plan as opposed to react by using certain management controls.

Level 3 – Define: Now that you have processes that you can repeat across the organization, you can define them and apply them across the organization using standards of performance.

Level 4 – Manage: Given standard performance baselines, you can now measure, benchmark and evaluate your performance.

Level 5 – Optimize: This is the final phase where you get your processes lean and operating at peak performance. The organization is now ready for applying Six Sigma since the workload data required to use Six Sigma has been established in Level 4.

As organizations move from a lower level to an upper level within CMM, process capabilities increase and this in turn improves process performance. The initial observation by pioneers of CMM, such as Watts Humphrey of IBM, was that the quality of software products was very much related to the quality of processes. Additionally, the ability to predict results goes up with increased maturity and when you increase your predictability, you lower your risks.

Under CMM, all organizations default to Level 1 where there is inconsistent management of processes. For larger type organization, the management approach tends to change with each successive level:

Level 2 – Managing projects to get things done
Level 3 – Managing processes to get things done
Level 4 – Managing capabilities to grow the organization
Level 5 – Managing change to continuously improve

Key Process Areas – Improvement Domains for CMM

In order to move past Level 1 under CMM, you will need to define Key Process Areas. Key Process Areas (KPA) represent a cluster of activities that when grouped together share a common final outcome critical to organizational success. Once you define each KPA, you need to establish performance goals or objectives for each KPA. CMM typically assigns two to four goals per KPA. Understanding the intent of a KPA is usually a good basis for defining a performance goal; i.e. is the organization effective (such as customer satisfaction) and efficient (such as cycle times) at meeting the goal of the KPA?

Since each CMM Level has its own KPA's, the challenge is to meet the two to four performance goals of each KPA in your current level. Therefore, you need to have well established KPA's in one level before you get to the next level. One the best ways to build this KPA maturity structure is to think in terms of managing for defined outcomes along the way. For example, suppose you just opened a pizza restaurant. To produce pizza's, you need key process areas (KPA's) that make pizza dough, add fresh ingredients, and bake the pizza. These are the basic "repeatable" key process areas or issues you must have for level 2 of your pizza restaurant. Now let's move up to level 3 – Clearly defined processes may involve more mature processes, such as getting the right kind of ingredients and mix to make good consistent dough. At level 3, we might have a KPA related to making sure our cooks follow a standard recipe each time they prepare the pizza dough. Our processes are now better defined after meeting certain KPA's for Level 3. We can now "manage" the processes at Level 4 – things like faster delivery of pizza's or giving our customers more choices of how they want their pizzas. We now start to do a lot more measuring of final desired outcomes – customers like our pizza's and our processes are now mature enough that we can expand opening another pizza restaurant. At level 4, our processes are highly predictable using best practices and we know exactly how to make great pizza's every time. At level 5, we work to tweak and optimize how we make our pizzas. Perhaps each time a pizza is baked in the oven, the crust comes out slightly different. Level 5 looks for defects using very analytical tools and attempts to remove these defects from our processes. For example, maybe we can use a special texture probe to test our pizzas for inconsistent crust. Next we look at the variables that create inconsistent crust. This might include baking times, oven conditions, and the mix of ingredients. We need to analyze what's causing the inconsistent pizza crust. Once we identify the cause, we will change this input variable and see how it impacts our pizza crust. Level 5 is continuous – analyzing defects, identifying sources and using this knowledge to prevent defects in all of our processes across the entire organization.

The Baseline for Improvement Begins at Level 2

Since key process areas at Level 1 are not defined, getting to level 2 is often the big hurdle in moving through CMM. To get to Level 2, an organization needs to have processes that begin to experience repeatable success and likewise, you begin to remove your failures. Processes are not expected to be highly efficient and effective at Level 2, but you do want to have a series of processes to produce outputs (such as pizzas in our pizza restaurant). Level 2 represents the baseline of core processes and from this baseline we can begin to improve how we do things. It is at level 2 where the organization becomes aware of the need to improve and thus, level 2 is sometimes called the "learning level" of CMM. This is where process improvement begins to kick-in and this is why getting to level 2 is so important.

> According to Motorola, an organization that moves from CMM Level 2 to 5 will experience an eightfold reduction in defects, an eightfold improvement in cycle times, and a threefold increase in productivity.

CMMI

One of the fastest growing maturity models is Capability Maturity Model Integration or CMMI. The issue of integration is a major hurdle in getting processes to work. Typically, processes are defined around functions or departments. The big issue is getting processes to work across all functions and departments. CMMI takes a "systems" view of things; i.e. organize and build around a system to integrate your processes and this will produce the best possible service or products for your customers.

The five levels of CMMI are very similar to the original CMM:

- 1: Performed – Process is unpredictable, poorly controlled, and reactive.
- 2: Managed – Process characterized for projects, and is often reactive
- 3: Defined – Process is characterized for the organization, and is proactive
- 4: Quantitatively Managed – Process is measured and controlled
- 5: Optimizing – Focus is on continuous process improvement

In order to take a systems approach, CMMI tends to focus on process infrastructure and most KPA's are focused on five areas: Goals, Commitment, Ability, Measurement, and Verification. Finally, CMMI follows a life cycle approach to process improvement, known as IDEAL:

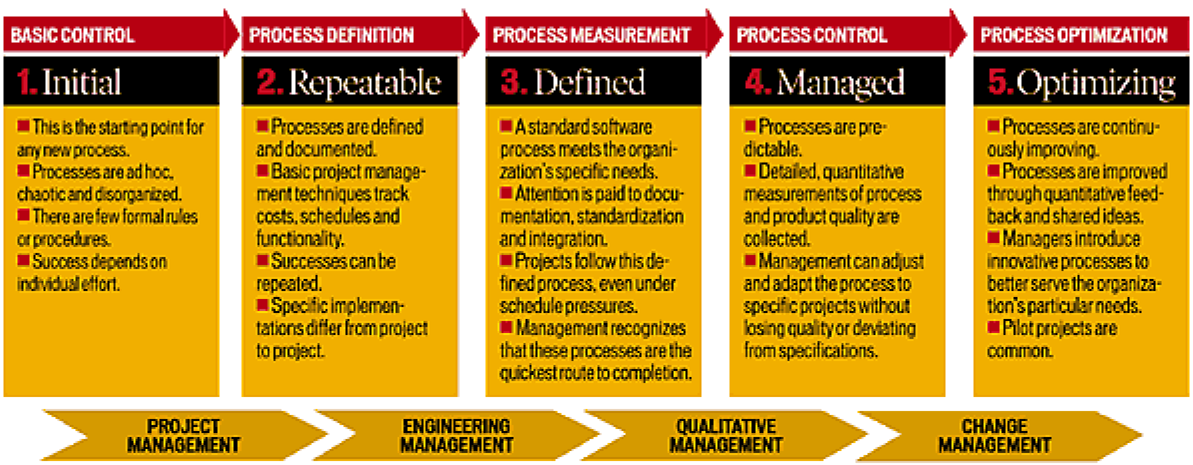
I – Initiate: Establish the groundwork for enabling process improvement. This includes making the business case for process improvement and securing key sponsorship to make process improvement happen.

D – Diagnose: Determine where you are relative to where you want to be. This sometimes takes the form of a concept paper, outlining the current organizational state, the desired future organizational state and recommendations for moving forward.

E – Establish: Quantify the specifics of how you will reach your destination, including a work plan for process improvement that includes which areas should get the highest priority.

A – Act: Doing the work per your process improvement plans, such as development of solutions, testing your solutions, and putting final solutions into production.

L – Learn: Improve your ability to manage the future based on what is taking place now and what was originally planned. This requires that you look back at your process improvement efforts and make adjustments going forward.



CMM Reality Check

Organizations often seek formal certification of CMM Levels, somewhat similar to how Malcolm Baldrige and ISO 9000 work. As a result, CMM may encounter the same fallacy of Baldrige and ISO 9000 – organizations are too busy trying to satisfy the "certification" requirements, but in reality the organization has not improved its processes.

Like Baldrige and ISO 9000, CMM should be more about producing real measurable results and not satisfying pre-conceived requirements that may or may not fit the organization. Consequently, all organizations should look to CMM as a broad framework to assist with process improvement and not lose sight of what you are really trying to accomplish – things like higher customer satisfaction, increased productivity from end users, less time and costs to perform activities that comprise a process, and expanded organizational capabilities.

Chapter 4

Six Sigma

Probably the most popular approach to process improvement is Six Sigma. Since this short course is very limited in scope, we cannot address all of the Six Sigma tools and techniques, but will highlight the basic concepts behind Six Sigma. As we discussed earlier, we want to reduce variation (improve quality) to continuously improve our processes. Six Sigma provides a methodology for getting to the root cause of variation and reducing it. Despite what some might say, Six Sigma is not about forcing you to obtain perfection at any costs. It's more about giving you a wide range of tools, applied in a discipline way for improving a process on a project by project basis. When applied to the right kinds of projects, Six Sigma can yield significant results.

Project Selection

Six Sigma is executed through projects and since Six Sigma is very precise, it's often better to start with smaller projects that have limited scope as opposed to large, organizational wide projects that are too difficult to manage. Additionally, projects need to have some justification behind being selected. So in the world of Six Sigma, it is very common to see a series of toll-gates or a formal business case to justify the project. For example, projects will consume resources and time. There needs to be a clear payoff or return for doing the project. Additionally, it is useful to clearly define the expected impact of projects and match these impacts against critical issues confronting the organization. For example, a high level of customer complaints or product returns is a critical issue that might be ripe for a Six Sigma type project.

Five Phases - DMAIC

The life cycle of six sigma work consists of five phases:

1. **D**efine Opportunities: What must we do to meet VOC – Voice of the Customer. In this phase, you must clearly identify your customers and analyze customer related information, translating this into Critical to Quality (CTQ). CTQ's are requirements that your processes must perform up to if you expect to meet customer expectations. Once you understand this, then you can initiate six sigma projects to address the specific performance issues.
2. **M**easure Performance: How much variation is taking place in our processes? In this phase, you will measure your variation in relation to an acceptable level of performance or specification limit. This is driven by the characteristics of your CTQ. Certain statistical tools are used, such as sampling, frequency distribution, and control charts.
3. **A**nalyze Opportunities: What are the root causes behind this variation? In this phase, you identify the sources of variation. A good place to start is with a non-statistical tool: Root Cause Analysis, including the Five Whys. Then you can begin to use certain statistical tools, such as Analysis of Variance, to better understand the sources of process variation.

4. Improve Performance: What can we do to reduce this variation? The vital few or root sources of variation are now identified. One of the more popular tools used for improvement is called Design of Experiments (DOE).
5. Control Performance: How can we design the process so that we never cross the Upper or Lower Control Limits? This is where you sustain your desired performance levels and where practical, seek to improve it by removing more variation from the process.

Common Tools Used by Project Phase on Six Sigma Projects				
Define	**Measure**	**Analyze**	**Improve**	**Control**
Voice of Customer	Measurement of Inputs, Process, and Outputs	Root Cause Analysis	Risk Analysis - FMEA	Statistical Process Control (SPC)
Process Mapping (as is process)	Measure Frequency Distribution	Analysis of Variance (ANOVA)	Proto-type testing	Design for Six Sigma (DFSS)
Project Management	Check Sheets	Affinity Diagrams	Solutions Matrix	Change Management Process
Brainstorming	Control Charts	Regression Analysis	Design of Experiments (DOE)	Standard Operating Procedures (SOP)

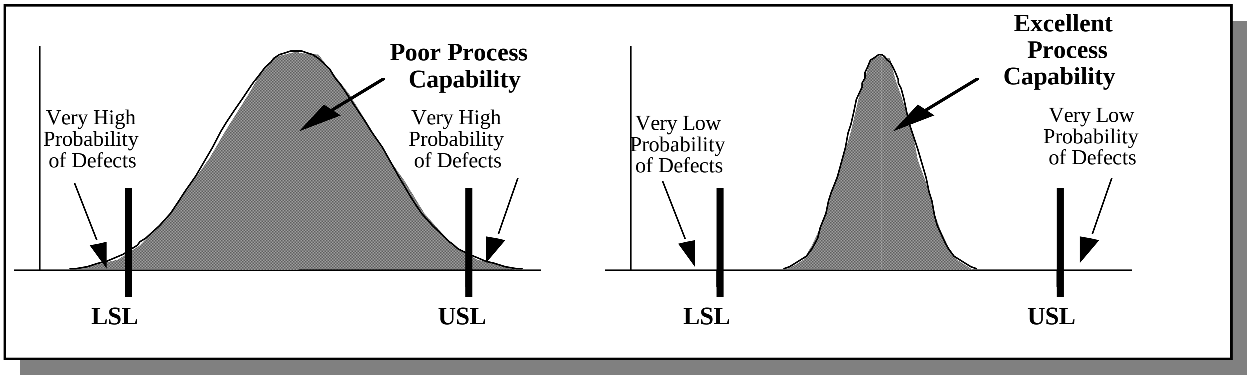
The Basics

Sigma is a statistical measure of process capability in relation to how much deviation takes place in the population of data. It measures the variability of the data. For every opportunity, there is a chance we might have a defect. This is typically expressed as Defects per Million Opportunities or DPMO. Defects represent the failure to meet customer requirements. The higher the sigma, the more process outputs are able to meet customer requirements given fewer defects. The following DPMO scale is used to express the different sigma levels:

Sigma Value	DPMO	% Defects	Cost of Poor Quality *
1	691,462	69%	> 40% of Sales
2	308,537	31%	30-40% of Sales
3	66,807	6.7%	20-30% of Sales
4	6,210	.62%	15-20% of Sales
5	233	.023%	10-15% of Sales
6	3.4	.00034%	< 10% of Sales

* per Allied Signal

For various processes, we set targets which we will call "critical to" such as Critical to Quality (CTQ). This might be making pizzas in our pizza restaurant that are produced in 8 minutes. Each time we bake a pizza, there is some variation from this target of 8 minutes. If we plot each of these bake times, we can show the distribution on a graph. Additionally, our customers are willing to accept pizzas baked in 10 minutes, but likewise it takes us at least 6 minutes to put all the ingredients together for baking the pizza. These limits represent the Upper Specification Limit (USL) and Lower Specification Limit (LSL) within our distribution. The goal is to "control" what happens within this range and when we bake the pizza at exactly 8 minutes, we have Six Sigma quality – zero deviation from standard. As we get better and better at our baking process, we start to narrow the range, USL and LSL, so that the normal distribution curve becomes tighter. This is how we express continuous improvement in the world of Six Sigma.



CTQ and VOC

Critical to Quality is customer driven and so we have to tap into the customer to understand our requirements (CTQ). Six Sigma (as well as lean) requires that you are listening to the Voice of the Customer or VOC. In the world of Six Sigma, you are "in-sync" with VOC when you:

1. Provide a 100% solution to the customer's problem.
2. Minimal effort involved – not wasting the customer's time and efforts.
3. Giving the customer exactly what they need – no compromises.
4. Provide the value where the customer wants it.
5. Provide the value when the customer wants it.
6. Compress the decision making process for the customer – make it easy for the customer to reach the decision.

This is perhaps one of the biggest reasons why Six Sigma and Lean have become so popular – the bar has been raised in terms of customer satisfaction. Additionally, any variation from the target increases costs. So Six Sigma is not just about improving quality and lowering costs, but also about customer satisfaction. Finally, there are two dimensions to CTQ – Customer driven CTQ's coming from our external customers and process driven CTQ's coming from our internal customers.

> "There is a parable of the three blind men and the elephant. Each is asked to identify what they are touching. The first touches the tusk of the elephant and identifies he is touching a spear. The second touches the torso and claims what he is touching is a wall. The third touches the tail and think it's a snake. This parable parallels Six Sigma. As its popularity has grown, different experts have marketed Six Sigma to fit their needs, not necessarily that of their customers. Of course, Six Sigma includes significant amounts of statistical tools. But many see Six Sigma as only statistics. They are wrong. Touch part of the work that constitutes Six Sigma and it will look eerily similar to other quality approaches. Touch another part of Six Sigma and it only vaguely resembles a quality approach at all."
> – Six Sigma Execution by George Eckes

Some Common Sources of Critical to Quality (CTQ):

Quality	Product or Service Features, Attributes, Dimensions, Characteristics Relating to the Function of the Product or Service, Reliability, Availabity, Taste, Effectiveness — Also Freedom from Defects, Rework, or Scrap
Cost	Prices to Consumer (Initial Plus Life Cycle), Repair Costs, Purchase Price, Financing Terms, Depreciation, Residual Value
Delivery	Lead Times, Delivery Times, Turnaround Times, Setup Times, Cycle Times, Delays
Service & Safety	Service Requirements, After-Purchase Reliability, Parts Availability, Service, Warranties, Maintainability, Customer-Required Maintenance, Product Liability, Product/Service Safety
Corporate Responsibility	Ethical Business Conduct, Environmental Impact, Regulatory and Legal Compliance

The Six Sigma Equation

Six Sigma begins with a simple equation that says – All outcomes are the result of inputs and the process that acts on these inputs may introduce errors. Errors create variation and in the world of Six Sigma, variation is everything. This equation is expressed as:

$$Y = f(X) + E$$

Y: Desired outcome
f: Activities and Functions that convert inputs to outcomes
X: Inputs that are needed to produce the desired outcome
E: Errors

If we go back to our pizza example, we bake pizzas with different outcomes or Y's. Several different inputs are required before we can bake the pizza – preparing the pie crust (input material), having cooks put all of the ingredients together (input labor) and using an oven (input equipment) to bake the pizza. All of these inputs are the X's in our equation and we must measure these inputs (X's) to get a profile of how our process performs in relation to our targeted performance.

Statistical Concepts

One of the attractions behind Six Sigma has to do with statistics. Statistics removes much of the subjectivity that often plagues other forms of analysis. Opinions and speculation are replaced by applying statistical concepts to data. Some of these statistical concepts include:

1. Mean and Standard Deviation: Expressing process performance begins with the Mean and Standard Deviation. Mean represents the average of your sample values; sum of all values divided by the number of observations in your sample.

   Standard Deviation is the spread of data around the mean.

   Standard Deviation is calculated by going through the following steps:
   a. Calculate the difference from the mean for each observation.
   b. Take the square of each difference.
   c. Sum all of your square values and divide by the number of observations less 1. NOTE: When calculating the standard deviation for a sample (as opposed to the entire population), the number of observations is reduced by 1. This tends to improve the calculation so that the standard deviation of the sample is as close to the entire population as possible. It is rare that we will be measuring the entire population.
   d. Take the square root of your value from step c (variance). This gives you the standard deviation.

   Let's go back to our pizza example. Suppose we made 6 observations of how long it takes to bake pizza. Our upper control limit is 8 minutes; i.e. we don't want to take more than 8 minutes to bake pizzas. The results of our six observations are:

Observation	*Baking Time*	*Avg Baking Time (Mean)*	*Variance from Mean*	*Square the Variance*
1	*7.50*	*7.96*	*-0.46*	*0.21*
2	*7.75*	*7.96*	*-0.21*	*0.04*
3	*8.50*	*7.96*	*0.54*	*0.29*
4	*8.25*	*7.96*	*0.29*	*0.09*
5	*8.50*	*7.96*	*0.54*	*0.29*
6	*7.25*	*7.96*	*-0.71*	*0.50*
Total	*47.75*			*1.43*

   Sum of all baking times / number of observations or 47.75 / 6 = 7.96
   Variance = 1.43 / 5 or .286
   Square root of Variance = Standard Deviation of .5342

2. Sigma Value: After calculating the Mean and Standard Deviation, you need to express this performance related to CTQ – customer requirements. This is done by calculating the Sigma Value (sometimes called the Z-Score) which represents the number of standard deviations from the mean. However, in order for this to work we need a normal distribution of data. So it's useful to do a histogram and plot your data, observing the curve or frequency distribution of your observations.

3. t test: Since we use samples to represent populations, we will most likely not know the standard deviation of the population. And when our sample size is small (less than 30 observations), we can use the t test to help us with a hypothesis test about the characteristics associated with the population.

4. F test: We may want to take samples from different segments of the population, such as sampling only cheese pizzas, then sampling deluxe pizzas to see if this yields different results. You can use the F test to help understand differences in standard deviations between samples taken from different populations.

5. ANOVA: Used to conduct hypothesis testing when you have two or more groups of data. Like the t-test, the purpose of ANOVA is to test the equality of the means between the data groups. When you test and analyze only one variable (such as oven temperature in baking our pizzas), this is a One-Way ANOVA. If we tested two factors (such as oven temperature and dough texture of pizzas), this would be Two-Way ANOVA. The testing of a combination of factors simultaneously in one test is referred to as a factorial experiment.

Design of Experiments (DOE)

The number of inputs can be numerous (people, materials, equipment, technology, practices, methods, applications, etc.), making our six sigma equation look like:

$Y = f (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}, X_{14}, X_{15}, X_{16}, X_{17}, X_{18}, X_{19}, X_{20})$

What we really need to do is find out which of these inputs (X) is having the most influence on our outcome (Y). By focusing on the "vital few" input variables, we gain control over the process. A series of different controlled experiments will get us to the vital few. Experiments are managed based on:

1. Factors: The possible X's in our equation
2. Levels: The range of values for each factor
3. Main Effects: The change in Y from our experiment as we change our factor (X) from the lowest level to the highest level.

Factors are the independent variable and we want to quantify the impact on Y (response variable). In our pizza example, we might include these factors to help us understand variation in baking pizzas:

Oven Temperature (X_1)	Dough Texture (X_2)	Pizza Type (X_3)	Baking Time (Y)
350 Degrees	Medium	Cheese	7.4 minutes
400 Degrees	Coarse	Pepperoni	11.8 minutes
375 Degrees	Smooth	Cheese	6.2 minutes
400 Degrees	Medium	Cheese	6.8 minutes
350 Degrees	Coarse	Pepperoni	13.1 minutes

Each combination is an equation, contained within a matrix for all factors in our experiment. In order to get the most information, a full matrix is needed which contains all possible combinations of factors and levels. If this creates too many experimental runs, fractions of the matrix can be taken.

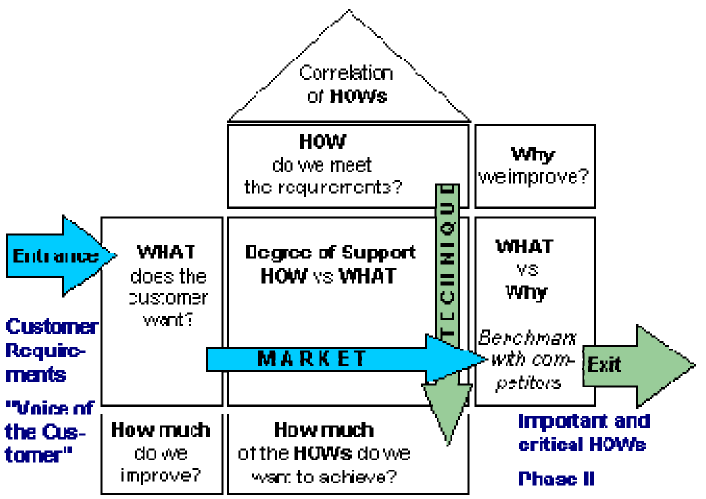
> "Probably few people know exactly what is meant by quality. Quality actually has different dimensions, which are all considered by consumers purchasing products. Although we as consumers may not know precisely what we mean by quality, we all recognize quality when we see it."
> – The Myths of Japanese Quality by Ray and Cindelyn Eberts

Design for Six Sigma

The “DMAIC” approach to Six Sigma seeks to improve existing processes. However, this is only half of the six sigma management process. The other half is to design and develop new processes to improve how we meet customer expectations. This is called Design for Six Sigma (DFSS). DFSS is used under two circumstances: Existing processes cannot be improved or a process to meet CTQ does not exist.

Some of the tools used in DFSS type projects include:

1. Quality Function Deployment (QFD): A methodology for identifying and categorizing customer requirements into a matrix. The matrix prioritizes customer expectations on a scale from 1 (least important) to 5 (most important). Cause-effect requirements are also ranked; i.e. what is the correlation between a customer requirement and customer satisfaction. This is the “roof” matrix that sits on top of the main house matrix. Depending upon your approach, QFD may include several matrixes for capturing important relationships:



2. Failure Mode Effects Analysis (FMEA): Analytical approach directed toward problem prevention through which every possible failure mode is identified and risk rated. The basic steps for FMEA are:

    a. Identify various failure modes (spoiled materials, labor input mistakes, flawed method, equipment failure, etc.)
    b. Identify the effects
    c. Determine the impact
    d. Identify the causes
    e. Determine the probability of occurrence
    f. Assess current control processes in place
    g. Evaluate the ability to detect the failure mode
    h. Assign a risk rating (**A** x **B** x **C**) relative to:
    A: Severity of Impact – On a scale of 1 to 10, rate the seriousness of the effect from the failure mode with 10 as catastrophic and 1 no impact.

B: Probability of Occurrence – The likelihood that a cause and failure mode will occur with 10 as failure is certain and 1 is highly unlikely.
C: Ability to Detect – Rating your ability to detect the failure mode before putting the product into production or delivering it to the customer. A rating of 10 indicates that you cannot detect the failure and 1 is where you have good controls in place to pickup the failure.

i. Take corrective actions on those failure modes with high risk ratings.

The results of your FMEA can be summarized on a worksheet. The following example is taken from www.betterproductdesign.net:

FMEA worksheet

Project: Product: System: ①					Date: Prepared by: ②					FMEA Number:: Reference documents: ③	
System / Component / Function	Potential failure mode	Potential effect(s) of failure	Severity	Critical?	Potential cause(s) of failure	Occurrence	Current design controls	Detection	Risk Priority Number	Recommended action(s)	Responsibility & completion date
④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮

3. Poka Yoke: Mistake proofing a product or service. Errors lead to defects and if you can catch the errors earlier, then you reduce the defects. Certain work conditions tend to introduce errors: Adjustments, Infrequent Activities, Rapid Repetition Involved, and High Volume Loads with Compressed Time Frames. Once you've identified the error prone conditions, drill down to the root causes and see if you can design an error proof way of doing the work.

> "A very few American companies are counted among the world-class leaders in quality management. But thousands upon thousands of other companies have yet to take that all important first step to ensure their products and services deliver to each customer a dependable high level of quality. The American economy will either fully integrate itself into new and evolving global markets, or large parts of it are likely to be left behind as foreign competitors absorb greater and greater shares of the only market that really matters anymore: the global market."
> – Quality in America: How to Implement a Competitive Quality Program by V. Daniel Hunt

Chapter
5

Lean Thinking

Six Sigma is to variation what Lean is to waste. By removing waste, we make our processes lean – very value added in terms of the customer. Unlike Six Sigma which is driven by highly focused projects, Lean takes a broader view, looking at the entire value stream – all the steps required to produce goods and services that the end user wants, when and where the end user wants it. In the past, we simply thought of the process as stopping once we shipped the product to the customer. Under lean, you have to manage the entire value stream. This value stream is the baseline from which we will apply our lean tools. And some of the tools used in lean are the same as Six Sigma. Thus, Lean and Six Sigma tend to be complimentary of one another.

> "Value is a moving finish line and any satisfaction felt at delivering the very best value should be tempered by the knowledge that the race is unending and those who do not improve are losing ground. Getting managers and employees to buy into the concept of high value, long haul management is critical to establish a well-spring of value-driven ideas and actions. Value is a cause that unites and strengthens any organization, supplier or customer, small venture or large, high growth or no growth industry."
> – Value Directed Management by Bernard Arogyaswamy and Ron P. Simmons

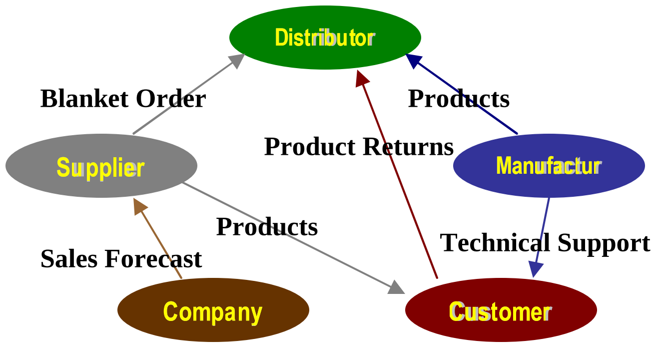
Map the Value Stream

A good place to start is to map out the value stream. In order to prepare a value map, you must first identify all entities that are directly involved in the value stream. If you have several entities or domains within your value map, you might want to assign weights to each in relation to their influence or impact across the entire value stream.

The Value Map should define overall flows or exchanges between the various entities or domain owners that comprise the value stream. This involves the movement of materials and information across the value stream – from the resource inputs that go into making products and services to the final consumption of the product or service. Once you understand these relationships, you begin to identify problems and challenges that take place in the exchanges throughout the value map.

Most value maps are constructed by following some simple rules:

1. Use ovals for each entity. Try to keep the number of entities to ten or less. You can vary the size of the oval to indicate influence or impact in the value chain.
2. Connector lines between entities should be labeled as to the input or outputs involved. Here are some simple examples:



Five Lean Principles

Lean is often characterized by the 5 S Principles:

1. Sort – Put things in the proper order and remove those things not required for the process to work.
2. Straighten – Arrange things in such a way that minimal effort is needed between each part of the process.
3. Shine – Keep all parts of the process clean and in good working order to prevent any break downs.
4. Standardize – Maintain all lean principles with any design changes related to the process.
5. Sustain – Make a commitment to following the lean principles in how we manage our processes.

Depending upon the nature of the process, there are the "usual" suspects when it comes to waste:

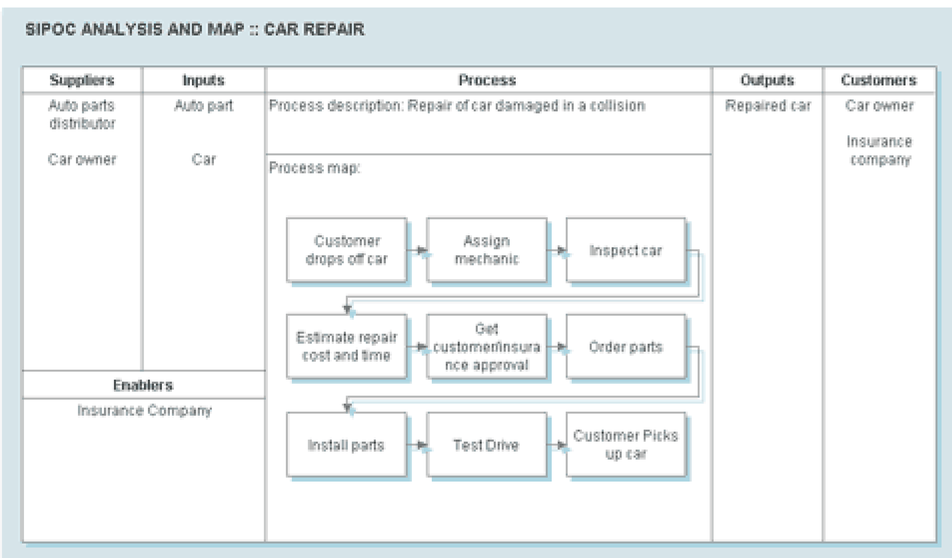
Manufacturing Operation	Administrative Process
Excessive production	**Excessive Hand Offs**
Holding inventory	**Multiple Systems Involved**
Transporting or Moving Items	**Process is Very Manual**
Waiting	**Numerous Approvals and Reviews**
Unnecessary Activity or Process	**Research and Wait Times**
Correct and Rework	**Batch processing**
Flaws and Defects	**Queues**

Process Modeling

Many of the tools in lean are the same as Design for Six Sigma – things like mistake proofing (poka yoke) and Quality Function Deployment. Lean also uses many of the "fundamental" type tools, such as root cause analysis and brainstorming – not to mention the main-stay tool of value mapping. One of the more serious tools used in lean is process modeling. Process models provide a simulation of how a process works, allowing the user to trigger events and identify possible bottlenecks and inefficiencies within the process. Process models are not easy to build; requiring a computer model of interdependencies between entities, resources, drivers, and other components.

Process models should start with a high level map or diagram of your core process. The SIPOC Method can be used to create a high level diagram of your core process:

Suppliers – All entities involved in providing resources consumed by the process.
Inputs – The actual resources (labor, materials, information, equipment, etc.).
Process – The activities that convert inputs into outputs.
Outputs – Products or services produced and distributed to customers
Customers – All entities, groups, and individuals who are recipients of the outputs.



"The concept of quality management, developed since World War II, does not involve technology, it involves thought. You have to stop thinking about quantity and start thinking about quality. What makes that more difficult is that quality isn't a convenient list you can consult or even anything you can look at. If people operated on a factual basis, everyone would have adopted a quality method by now. The fact is that quality methods provide better results. Another fact is that people who work in quality companies are happier, better trained, and more dedicated employees. An even bigger fact is that quality is the standard of competition in the global market."
– Thinking About Quality by Lloyd Dobyns and Clare Crawford-Mason

Lean Life Cycle Methods

Depending upon the organization, there are different life cycle approaches for doing lean. For example, Japanese organizations typically use the Kaizen approach:

1. *Identify and clarify the objective*
2. *Grasp the current situation*
3. *Visualize the ideal situation*
4. *Develop targets*
5. *Create a strategy for kaizen implementation*
6. *Make a plan - who, what, when*
7. *Implement*
8. *Check Effectiveness*
9. *Document your activity*
10. *Confirm results*

Another approach is 8D (eight disciplines):

1. *Use Team Approach*
2. *Describe the Problem*
3. *Implement and Verify Interim Actions*
4. *Identify Potential Causes*
5. *Choose / Verify Corrective Actions*
6. *Implement Permanent Corrective Actions*
7. *Prevent Recurrence*
8. *Congratulate Your Team*

Another basic way of looking at lean is to view it as a continuous program cutting across the entire value stream, following a repetitive method of: Plan (Analyze the process) → Do (Test your improvement ideas) → Check (Evaluate test results) → Act (Adjust and go back to Plan). When coupled with various tools, such as Root Cause Analysis, Poka Yoke, and Quality Function Deployment, lean becomes integrated into all of the work that goes into the value stream. The ultimate goal of managing the value stream is to have a single piece flow where products move from one operational point to another only when needed with the lowest increment in resources consumed.

> "The key point to remember is that customers care about and react to the end product that is the sum of all functional products. For example, customers visiting Disney World care little about what goes on behind the scenes to create the magic. A hotel guest should not be concerned with the process that gets the right room clean and ready for a stay. A frequent flyer remembers on-time arrivals, not the fuel load or pilot schedules. Consumers instinctively focus on the ultimate outcome they desire."
> – Focused Quality: Managing for Results by Harvey K. Brelin, Kimberly S. Davenport, Lyell P. Jennings and Paul F. Murphy

Course Summary

Improving performance is not about cutting people. It's about cutting waste and inefficiency from the process so people can do their jobs better. The tools for process improvement have exploded in recent years thanks to Six Sigma. But even if you don't have a team of Six Sigma Black Belts, you can still apply many fundamental concepts for improving a process. This can include things like reducing handoffs within a process, eliminating "Re" type activities, and organizing around process flows as opposed to functional silos. Additionally, many of the fundamental tools for improving a process are not overly complicated – things like root cause analysis, affinity diagrams, and brainstorming.

You can also embark on broad approaches to process improvement by using Capability Maturity Models and Lean. Several programs are available for making quality a part of the company's culture. Examples include the Malcolm Baldridge National Quality Award and ISO 9000. Given the wealth of resources now available, there's no excuse for any company not to improve its processes.

Quality is now a given for the customer. When people buy products and services, they expect high quality. Voice of the Customer recognizes that customers have silent expectations that you can no longer ignore. Therefore, understanding the voice of the customer is paramount for addressing quality and improving your processes. The road to process improvement must pass through the customer. And as customer expectations rise, the need to improve organizational processes will grow. Process improvement is now a fundamental part of managing any organization and if you fail to improve your processes, then sooner or later you will be forced to do so in order to survive.

> "Astute managers at all levels – in all industries – realize that the success of their organizations in today's world depends upon flexibility and responsiveness in meeting customer needs, achieving ever higher quality levels, a high degree of internal efficiency, and cost effectiveness. The key to success is to maximize value to the customer and successfully implement the changes that make maximum customer value a reality for any organization in any industry."
> – Breakthrough Process Redesign: New Pathways to Customer Value by Charlene B. Adair and Bruce A. Murray

Final Exam

In order to receive credit for this short course, you must correctly answer at least 7 of the following 10 questions correctly. You can take this exam on-line by clicking on the "take exam" hyperlink located over the internet at www.exinfm.com/training. If you want a Certificate of Completion for taking this course, then you must download and use the "exe" file version of this short course.

1. A process is essentially a series of activities that:

    a. Converts time and materials into finished products
    b. Converts resources into some form of output
    c. Decomposes products into their source inputs
    d. Assembles products using automation

2. An effective process is a process that:

    a. Measures and monitors waste in the value stream
    b. Functions with no intervention of manual labor
    c. Meets or exceeds customer requirements
    d. Never requires improvement

3. Which of the following tools is useful for visually depicting the flow of a process?

    a. Process Map
    b. Affinity Diagram
    c. Pareto Chart
    d. Solutions Matrix

4. Which of the following tools is useful for prioritizing and ranking problems that have the highest impact on costs?

    a. Process Map
    b. Affinity Diagram
    c. Pareto Chart
    d. Solutions Matrix

5. A process improvement team needs to select the best solution from three alternatives (Alt). Three criteria have been applied to each of the three alternatives using a 5 point scale with 5 as the highest rating:

    Selection Criteria . . Weight . . Alt A . . Alt B . . Alt C
    1. Life Span . . . . . . 30% . . . . 4 . . . . .3 5
    2. Quality Rating . . .50% . . . . 3 . . . . 3 2
    3. Scalability . . . . . .20% . . . . 2 . . . . 3 2

    Using a solutions matrix, which alternative should the team select?

a. Alternative A
b. Alternative B
c. Alternative C
d. Alternative B or C

6. At what level within Capability Maturity Models can someone begin to manage a process using measurement and control?

a. Level 1
b. Level 2
c. Level 3
d. Level 4

7. Most of the CMM levels will need to have a set performance goals for each:

a. Cross-Over Function
b. Responsibility Center
c. Key Process Area
d. Risk Layer

8. As a process converts inputs into outputs, errors are introduced into the process, creating:

a. Normality
b. Variation
c. Value Skewness
d. Leveling

9. Using Six Sigma, we need to make sure that a process is meeting its:

a. DPMO
b. CMMI
c. DMAIC
d. CTQ

10. A process team would like to identify all possible problems that could arise with its new image processing equipment. The team would like to determine any corrective actions needed based on a risk rating system. Which of the following techniques would be the most helpful for completing this task?

a. Poka Yoke
b. FMEA
c. QFD
d. SPC

Process Improvement Cartoon