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Four Key Elements of an Effective Continuous Process

Advantage Series White Paper

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Introduction

Tough times call for bold actions. The manufacturing sector is going through a challenging period. So what can you do? The first step is to take a hard look at your business. Do you really know what your customers want? Are your operations capable of delivering products that delight your customers? Is your business process optimized to provide customers with a friendly and easy business transaction? If you are brutally honest, your answer is probably "no." So how do you achieve a competitive advantage?

The brutal reality is that the selling price for most products is set by the market. In many applications, price erosion has been significant. But you can compete. Look at the diagram below. What are the parameters you can control?

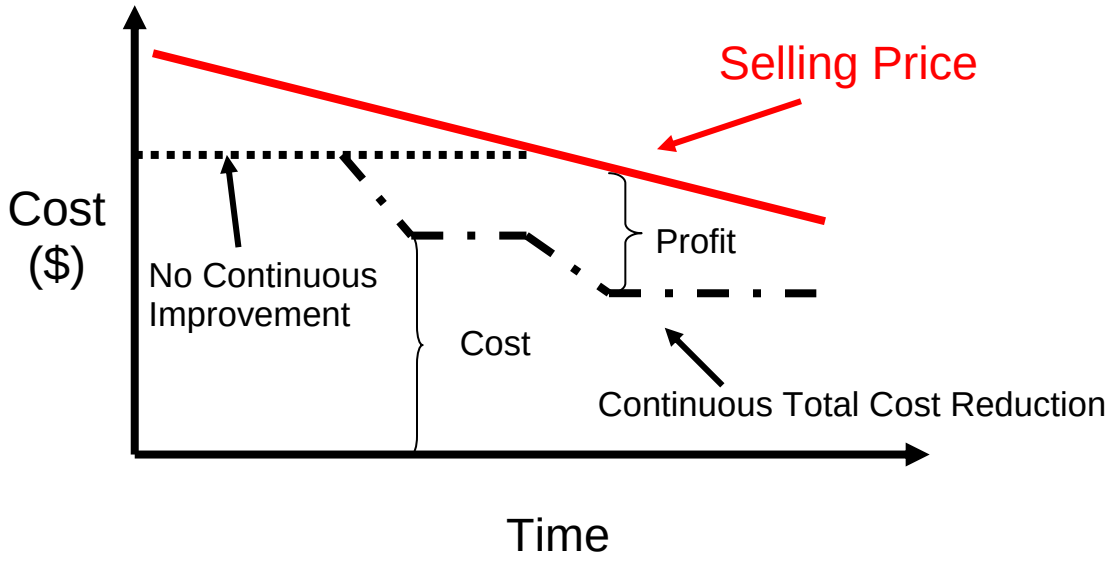
Selling Price — Cost to Produce + Profit

You usually can't influence the selling price unless you have a unique product or a niche application. In order to increase profits, you must vigorously eliminate cost in your manufacturing and business transaction processes. Time for a gut check. Do you have the courage to commit some talented resources to reduce defects and eliminate non-value added manufacturing operations? Are you willing to take a fresh look at how your customers place an order or how customer service is handled? Or how invoices are processed and you answer the phones? This won't be an easy task, but the failure to act is even more painful.

The Drive for Continuous Improvement

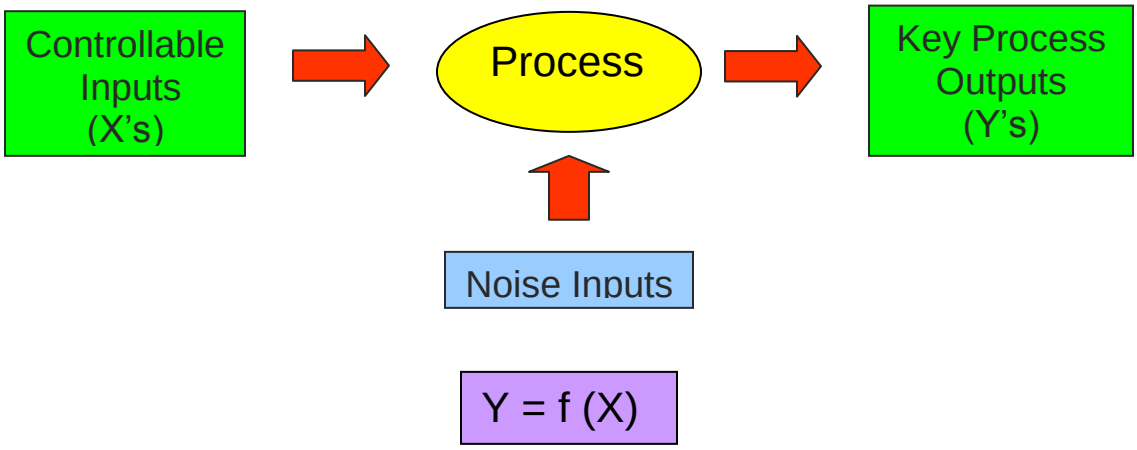
Let's look at the concept in the above figure in a different way. In Figure One, we show the selling price and total cost as a function of time. There are two possible scenarios depicted in Figure One. For both examples, the selling price decreases over time. The dashed line shows the total cost over time. Without continuous improvement, the total cost will eventually reach the selling price and subsequently exceed the selling price. Not a good situation. Moving from left to right, the dashed-dot line shows the cost over time when the business actively reduces both the manufacturing and business process costs. The company that embarks on the continuous process improvement journey will always have a profitable business unless the selling price decreases faster than the cost reduction curve. In most cases, there is a point where the total costs cannot be reduced further. In this case, if the price decrease does not stabilize, then the wise action is to get out of that product, or have an improved new product ready where you can make a good profit again.

Figure One



Process Management Solution

The solution lies in the area of process management. All work activities are a process whether they are in manufacturing or in the office. The process can be graphically described using a technique called a process map or flow diagram. For each individual process step or for the overall process, the key input and output variables are identified:



The controllable key process inputs are termed the X's and the key process outputs are termed the Y's. The outputs (Y's) are a function of the X's. In mathematical terms, Y = f (X). The process management approach is to identify and improve key Y's.

The process improvement roadmap is:

1. Identify the key process outputs critical to customer satisfaction (find the key Y's)
2. Investigate how the input variables (the X's) impact the critical Y's
3. Prioritize the key X's
4. Reduce variation and control the key process inputs (the X's)

For example, in the manufacturing of a printed circuit board, the final thickness may be a key output variable for a particular customer part. During the final lamination process, the key input variables might be layer thickness, the amount of resin to bond the layers together, the press heating rate, and lamination pressure. Design of Experiments (DOE's) are typically used to establish how the key input variables control or influence the key output variables.

In the printed circuit board case, the heating rate and pressure have a large influence on the final part thickness. These variables can be controlled using a standard operating procedure (SOP) such as a computer controlled lamination process that is set for a given part number. The key process variables are also measured and documented in a process log or traveler that accompanies the order.

Noise variables are defined as inputs that will have an impact on the output variables, but are very difficult or very expensive to control. An example of a noise variable would be relative humidity in the vicinity of a coating process. Moisture can affect the coating process by changing the viscosity and impact the curing rate if moisture interacts with the catalyst. To control noise variables, two approaches can be used:

1. Install expensive temperature/humidity controls to minimize the impact
2. Use Robust Design techniques to design the material/process to be insensitive to moisture, thus alleviating the need for expensive controls

Process Improvement Method

Six Sigma is a systematic process and management method for improving, building, and sustaining business performance. Six Sigma uses a structured approach and toolset focused on reducing variation and delivering near defect-free products and services. The Six Sigma toolkit can be used for a variety of applications, including manufacturing cost reductions, developing new products (Design for Six Sigma), and business process improvements (Transactional Six Sigma).

A balanced approach addresses both customer focused and internal process improvement projects. To maximize the potential gains, the project portfolio should contain a balance of both short-term and long-term improvement projects.

The Four Elements of a Good Six Sigma Project

1. There is a gap between current and required/desired performance in a key business process (manufacturing or transactional process). Closing the gap will have a measurable and large financial impact.
2. The cause of the problem or gap is not clearly understood.
3. There is not a predetermined solution or optimal improvement method readily apparent.
4. The performance of the process can be measured and quantified.

The following is an example of a good Six Sigma project. Acme Widgets Inc. is the manufacturer of a really cool new toy. There is tremendous market demand. To keep up with the customer demand, Acme installed two new molding machines. The engineers found that for one part of a subassembly, a critical part dimension was changing in a random way. This caused problems at final assembly, since the parts wouldn't fit properly. The part variation was traced back to the two new machines. There also was variability between the two new machines. Operators said that they had trouble keeping the new machines running in spec and hated to run the new equipment. Scrap from the two new machines is costing Acme $2,000 per day. Customers are upset because Acme can't ship enough of the cool new toys and some are defective.

Analysis:

- There clearly is a defined manufacturing problem with a large financial impact.
- The root cause of the problem is not clearly understood, but early data suggests the two new machines are involved.
- There is not a readily available solution to the problem.
- The yield of the molding process can be measured and quantified.

Six Sigma Projects are led by Black Belts who are highly trained in all aspects of the DMAIC process. Green belts are project team members and have training in most of the Six Sigma tools and approaches.

Six Sigma utilizes a five step process called DMAIC:

Define: Select the appropriate customer-focused defect or problem. Document the business impact and the project deliverables in the project charter. Form a multidisciplinary team.

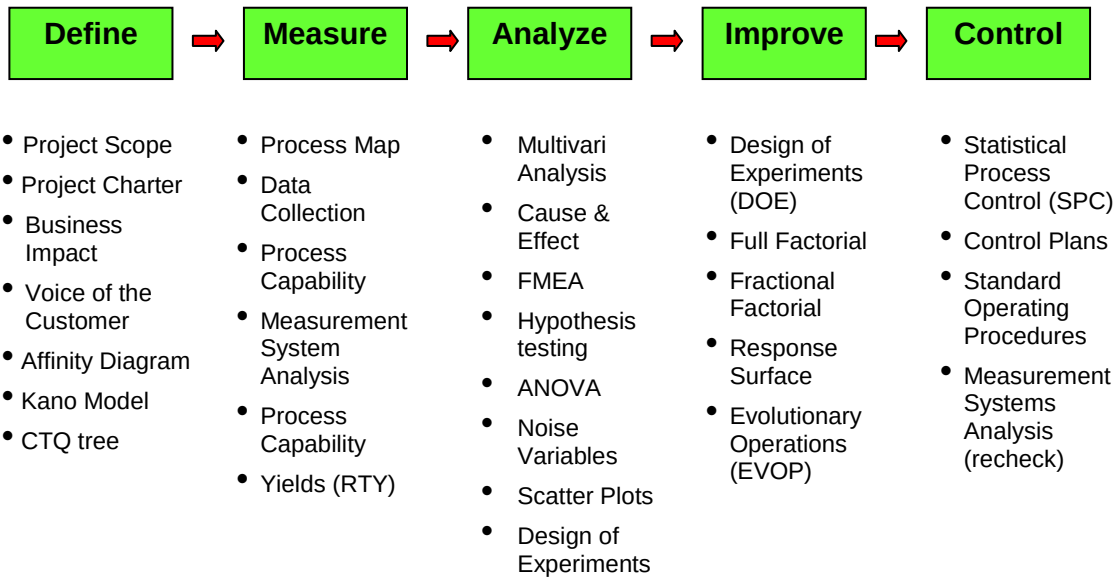
Measure: Develop a factual understanding of the current process and locate sources of problems. Establish "as-is" process map, measure process capability, and collect data to give a baseline of the current process.

Analyze: Identify potential root causes of defects or sources of variation. Investigate the causes of defects using experiments (and statistical analysis). Verify the root cause(s) of the problem.

Improve: Eliminate the verified root cause(s) or reduce sources of variation. The goal is to demonstrate with data that the problem is solved and leads to a measurable improvement.

Control: Implement methods to hold the gains such as standard operating procedures and statistical process controls (SPC).

The following diagram shows the tools used in the various phases of DMAIC:



Six Sigma was developed at Motorola and has been successfully deployed AlliedSignal (now Honeywell), General Electric, and many other companies with reports of total savings in the billions of dollars. The key to the success is top management buy-in, data-driven decision making, and a focus on achieving bottom-line results. Deployment of Six Sigma requires strong leadership and a commitment to continuous improvement from the whole organization.

Reasons for Six Sigma success include:

- Focus on customers and processes
- Achieves bottom-line results
- Clearly defined measures of success and financial returns
- Well defined project selection criteria
- Uses a disciplined project approach (DMAIC)
- Manageable project completion times (3-6- months per project)

Benefits of Six Sigma projects include:

- Increased customer satisfaction
- Improved profitability by eliminating defects (reduced cost of poor quality)
- Enhanced productivity
- Reduced cycle times
- Improved product and service offerings

Summary

With the economy in a state of uncertainty, it is time to act. Take a close look at your business and locate the problem areas and opportunities to improve. Use your internal resources or seek outside help to get the ball rolling. There are several tools available for process improvement. The Six Sigma toolkit described in this article provides a structured roadmap to eliminate defects, reduce variation and delight customers, leading to a measurable bottom line impact. Before it's too late, work hard to reduce your total costs. This won't be an easy task, but the failure to act will be even more painful.