

# **SIX SIGMA AS A MEANS TO ENHANCE QUALITY OF THE COMPANY**

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## **ABSTRACT**

Six Sigma is a means that can be used to improve quality by decreasing product defects. Many organizations have succeeded in applying Six Sigma, such as Motorola, General Electric and Allied Signal. To achieve Six Sigma, a process must reduce no more than 3.4 defects per million opportunities.

This article tries to describe the definition and process of Six Sigma. Six Sigma can be used in every part of production process. It is important for the organizations to give a big attention to quality. The best quality can be achieved if all of resources and process can be managed well. Six Sigma helps the organizations to measure whether resources and process are managed well so better quality can be achieved.

**Key Words: six sigma, quality, company**

## **1. INTRODUCTION**

Today the most important thing for the organization is how to make the organization still exists and successes. The answer basically depends on product quality. There are many factors that affect quality, such as customer opinion, employee performance, financial performance, and production process. To meet customer satisfactions, quality should be free but is not given. So, it needs effort from every party in organizations.

There are some measurement methods that can be used to measure quality. The new one is Six Sigma. Six Sigma was used by Motorola, General Electric and Allied Signal. They succeeded to apply Six Sigma in improving quality. Six Sigma makes the company possible to decrease defect products, delivery time and other activities that make customer satisfaction decrease.

## **2. WHAT IS SIX SIGMA**

General Electric gives definition for Six Sigma as a highly disciplined process that helps company focus on developing and delivering near-perfect products and services. The central idea behind Six Sigma is that if you can measure how many defects you have in process, you can systematically figure out how to eliminate them and get a close to zero defects as possible. To achieve six sigma, a process must reduce no more than 3.4 defects per million opportunities. A six sigma defect is defined as anything outside of customer specifications or customer requirements. An opportunity is defined as chance for nonconformance or not meeting the required specifications. (www.ge.com). Six Sigma refers to system in business style with high flexibility to fix leadership and business performance. Six Sigma based on the best important practices and ideas that used a long time ago and finally create the new method to get success in the 21 centuries era.

Basically, Six Sigma is focused to answer the questions such as how to make customers satisfy, what are the critical factors for customer. If customers satisfy, they will be a loyal customer and give the financial profit.

According to Pande, Neuman and Cavanagh (2003), Six Sigma is better than Total Quality Management because Six Sigma possible to overcome the weakness of total quality management. The strong points of using six sigma are :

1. Six Sigma is focused on process, recovery and measurement management into a part of management's daily responsibility.

2. There is awareness in the mind's manager that change is important for achieving continuously success. The Six Sigma uses this awareness so that success can be achieved.
3. Six Sigma try to keep the focus accurate, clear and specific by using fact and data wisely.
4. Six Sigma has clear purposes and help the organization to adapt the situation that always changes. The purpose can be achieved because six sigma focus on the way to find customer changing and customer requirements.
5. Six Sigma uses means and approaches in the proper situation. It means that company doesn't need to use deeply analysis if the situation doesn't need that.
6. Six Sigma helps company to create smoother, more effective and more efficient company by decreasing repeated job which is caused by miscommunications among every parties.
7. Six Sigma recognizes that a little recovery or a big changing is important in the business world.
8. There is a tight standard for the company that uses six sigma. They must follow the standard well and have no worry to give a big investment to meet the standard.

### **3. CUSTOMER ANALYSIS**

The organization success depends on customer. Customer opinion is very important and it will be a useful input for organization. Organization must meet customer specifications and customer requirements. Therefore, they

must identify all of customer specifications and requirements by doing some research methods such as customer surveys, focus groups, service/complaint data, warranty data and market research. Many excellent products or services failed because the organization didn't fulfill the customer specifications.

There are two types of quality. It includes basic quality and expected quality. Basic quality is quality that is inherent in a product. Expected quality is additional quality that is needed by a customer in order to make a customer satisfied. For example, basic qualities that should be noticed from a car are its wheels, its windows, its chairs, and its doors. But it doesn't mean that a customer will be satisfied with the completed car. A customer will be satisfied if they receive other additional qualities such as after sales service as well as lower indent time. Basic quality isn't sufficient to make a customer satisfied.

Organization not only thinks for short time success but also for long time success. Therefore, they should identify customer changing, customer specifications and customer requirements continuously. It will be the basic for organization to create innovation. Innovation is the result of creative activities. It makes organization ready to face customer changing and to achieve long term success.

After organizations have identified customer specifications and customer requirements, they should integrate them to internal process. It uses a means that called Quality Function Deployment (QFD). QFD is a structured methodology and mathematical tool used to identify and quantify customer requirements and translate them into key critical parameters. QFD supports Six Sigma because it shows the importance of design criteria and conflict between design criteria (ReVele,1999). QFD helps to prioritize actions to

improve the process or product to meet the customer requirements. QFD provides a structured approach to determine the product and service specification needed to satisfy key customer requirements. The customer requirements and their relative importance are listed along the left hand side of the QFD matrix. Key product or service characteristics are listed along the top of the matrix. A multi functional team evaluates the effects of each product / service function on satisfying each of the customer requirements. The total of each row assesses how well the customer requirements are being met. The highest column total determines the most important product or service performance requirements including Critical to Quality Specifications (CTQs). (Brecker Associates, 2001).The QFD can also be used to compare the products of company against the competitors which can be shown in graphical or tabular form to the right of the matrix.

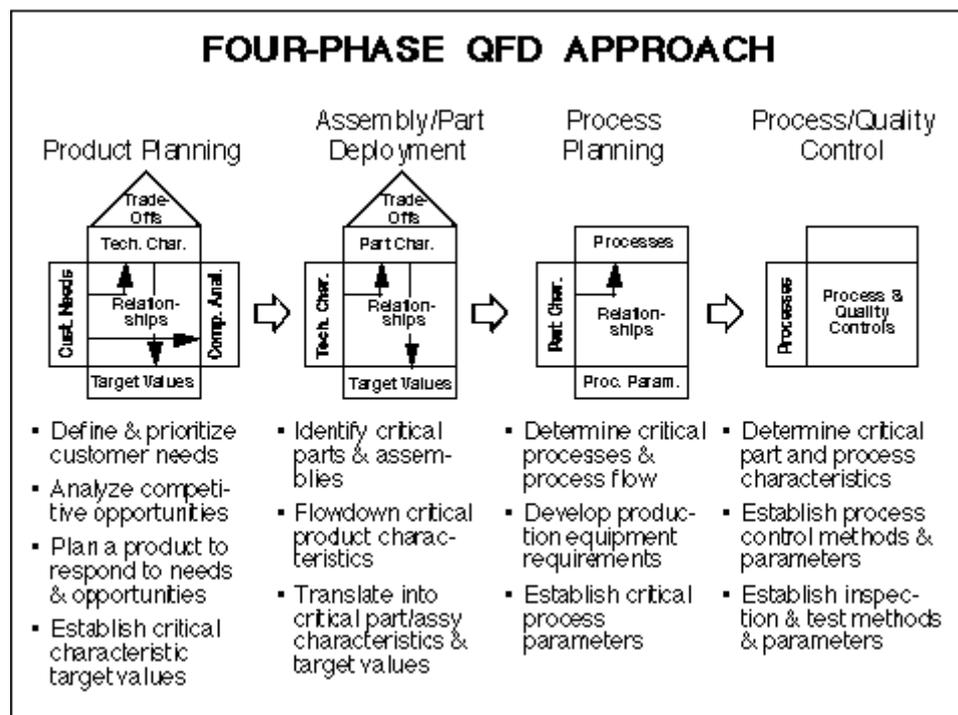


Figure 1 : QFD Methodology Flow (Crow,2002)

#### 4. PROCESS ANALYSIS

A process can be defined as a set of ordered actions that lead to an output. In any business function, a goal is achieved through a process -- paychecks are printed, orders are taken, employees are hired.

The processes are assembled as customer experience them, and they are measured as the customer 'feels' the process, not as the business decides to measure their own performance.

The GE Company define The Six Sigma as a highly disciplined process that helps us focus on developing and delivering near-perfect products and services. It means, an organization that achieves Six Sigma is required to have, at the most, 3.4 defects for every one million customer requirements. Because the central idea behind Six Sigma is that if you can measure how many "defects" you have in a process, you can systematically figure out how to eliminate them and get as close to "zero defects" as possible.

The fundamental objective of the Six Sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction through the application of Six Sigma improvement projects. This is accomplished through the use of two Six Sigma sub-methodologies: DMAIC and DMADV.

1. The Six Sigma DMAIC process (define, measure, analyze, improve, control) is an improvement system for existing processes falling below specification and looking for incremental improvement.

- a. **Define** out of tolerance range.

- The definition of the project/ assignment, using process map, application area, desired improvement, likely benefits etc. The

importance lies of having the chance of a high successful delivery of better quality and saving costs in totality. Here in the academic strata, the failures include the definition of the problem in as an identity. The others may include projects like real life problems pertaining to “*Distractions in the Class Room*” for example.

b. **Measure** key internal processes critical to quality.

This involves the analyses of the process to determine its present state and the future, as obtained. The data collection is a well suited frame for this.

c. **Analyze** why defects occur.

This involves the data analysis for identification of parts of process which affect the quality of the problem.

d. **Improve** the process to stay within tolerance.

This adds to the process to find a permanent solution to the problem. This may involve better forecasting, better scheduling, better procedures or better equipment, specifying, teaching techniques, work environment for the teachers and school campus quality life.

e. **Control** the process to stay within goals.

Involves the process of closing the problem by putting in the right procedures and management statistics.

A partial list of specific tools to support each of these steps is shown in Figure

2.



Figure 2 : Six Sigma Improvement Framework and Toolkit (Jeannine Siviy, 2001)

2. The Six Sigma DMADV process (define, measure, analyze, design, verify) is an improvement system used to develop new processes or products at Six Sigma quality levels. It can also be employed if a current process requires more than just incremental improvement.
  - a. **Define** the process and where it would fail to meet customer needs.
  - b. **Measure** and determine if process meets customer needs.
  - c. **Analyze** the options to meet customer needs.
  - d. **Design** in changes to the process to meet customers needs.
  - e. **Verify** the changes have met customer needs.

Both Six Sigma processes are executed by Six Sigma Green Belts and Six Sigma Black Belts, and are overseen by Six Sigma Master Black Belts.

Certainly, the process of implementing Six Sigma is a challenge for any organization. The implementation process introduces a huge time of adjustment which is one of the primary challenges of Six Sigma. Many of the Six Sigma organizational implementations that don't stick have to do with these companies not being fully committed to the process.

Six Sigma strives to remove variability in all facets of an organization and challenges each member of the company to become committed to this culture. Six Sigma is much more than a way of removing flaws in the manufacturing process and the product. For Six Sigma companies, process improvement needs to be included in every business practice, including those jobs that are considered indirect labor or non-revenue producing.

## **5. FINANCIAL ANALYSIS**

It is important for the organization to analyze cost and benefit in a production process and a project. This analysis should be communicated to every party in organization. There are some methods that can be used in cost and benefit analysis, such as break point analysis and quality cost analysis.

### **Costs of Quality Analysis**

Cost of Quality (CoQ) is all of the attributable to the production of quality that is not 100 % perfect. It also means as costs that are the difference between what can be expected from excellent performance and the current costs that exist. (Chase, et al., 1998). It is good for the company to achieve 15 % - 20 % costs of quality of every sales dollar. Crosby ( in Chase, et al., 1998) states that the correct costs for a well-run quality management program should be under 2,5 %. There are tree basic assumptions justify an analysis of the cost of quality:

1. That failures are caused
2. That prevention is cheaper
3. That performance can be measured

CoQ includes prevention costs, appraisal costs, internal failure costs and external failure costs. Prevention costs are sum of all the costs that used to prevent defects before they happened and to prevent the events that are inappropriate with the future. Appraisal costs are sum of all the costs that are used to assess and control production in order to meet the customer requirements. Internal failure costs are sum of all costs that happened because of the defects of a product or service before it has been sent to the customer. External Failure costs are sum of all costs that happened because of the defects of a product or service after it has been received by the customer.

All of the costs of quality should be managed. It helps company to determine what kind of recovery tasks must be done. Most of companies use pareto analysis and cause and effect diagram to determine recovery tasks. They can identify the cause of quality problems that make internal failure costs and external failure costs increase.

There are guidelines to determine what kind of basis that can be used to analyze CoQ (Pyzdek, 2002) :

1. The basis should relate to quality cost in the meaningful way
2. Manager who receives a report of CoQ should understand that basis
3. The basis can be used to assess business volume
4. The basis can be used to present the complete explanation of quality cost

According to Campanella (1999), some basis that can be used to analyze cost of quality are :

1. Labor (total labor, direct labor)
2. Cost (material cost, operation cost)
3. Sales

#### 4. Unit (production unit)

Campanella states that the best basic that can be used to analyze long term planning is sales. If sales are constant in every year, cost of quality analysis can be done in the short term. Costs of quality should be related to sales in the same period.

#### **Break Even Point Analysis**

Most of organizations use break even point analysis to determine how many units that can be sold to cover fixed costs and variable costs. Break even is the number of unit that must be sold in order to achieve the zero profit. Break even point analysis depends on the following variables : i) the fixed production costs of a product, ii) the variable production costs of a product, iii) the product's unit price, iv) projected sales. ([www.connection.cwru.edu](http://www.connection.cwru.edu))

Because it is important for the organization to establish break even point, many organizations use break even point analysis, from a new business to a mature one. A new business usually predicts volume of gross sales before they establish break even point. Then, they assess how accurate the prediction and determine whether the organization is on the way to achieve profit or not. A mature business tries to lower break even point in order to increase profit.

There are many steps in analyzing break event point. They include:

1. Establish all of fixed costs
2. Change every fixed cost in the same basis, example : monthly basis
3. Establish the percentage of gross profit margin that must cover fixed costs
4. Compare the actual result with the BEP projection

For the example: Total fixed costs : \$ 4500

Gross profit margin : 30 %

BEP : \$ 1350

It means that the company should make sales at least \$ 1350 in order to get zero profit.

Another way to analyze break even point:

1. Establish all of fixed costs (F)
2. Determine variable cost per unit (V)
3. Total Cost ( TC) is the sum of fixed cost and variable cost

$$TC = F + ( V \times q ) ; q = \text{production unit}$$

4. Determine total revenue (TR).

$$TR = P \times q ; P = \text{price per unit}$$

5. Establish BEP

$$TR = TC$$

$$P \times q = F + ( V \times q )$$

$$( P - V ) q = F$$

$$q = \frac{F}{P - V}$$

There are three ways to lower the BEP:

1. Lower direct costs, which will raise the gross margin. Be more diligent about purchasing material, controlling inventory, or increasing the productivity of labor by more cost effective scheduling or adding more efficient technology.
2. Exercise cost controls on your fixed expense and lower the necessary total dollars. Be careful when cutting expenses with an overall plan in mind. Don't cut too deeply as well as too little and cause distress among workers.
3. Raise price. Most entrepreneurs are reluctant to raise price because they think that overall business will fall of. More often than not that doesn't happen

unless they are in a very price sensitive market and if they really have already become volume driven. ([www.businessstown.com](http://www.businessstown.com))

Although it is very important to establish break event point, we should remember that the goal of most organizations is to get profit, not only break event point. The company can accomplish a good bit:

1. They can allocate the sales and marketing effort to get them to the point they need to be.
2. Most companies have slow months, so if they project volume below break even, they can watch expenses to minimize losses. A few really bad months can wipe out a good bit of previous profit.
3. Knowing the elements of break even allows them to manage the costs to maximize the bottom line. ([www.businessstown.com](http://www.businessstown.com))

## **6. EMPLOYEE ANALYSIS**

In business, employees are thought to be an essential and good component of all business processes. In the past, employees were hired for the physical effort; to push the product through operations either to the stockroom or for shipping. But today's is the increase of automation, computer network and other productivity tools make businesses need more informed and alerts employees.

The company's management has a duty to maximize the contribution of employee in terms of physical and intellectual productivity in order to bring out the best on the job every day at every job. It will challenge the employee to be more creative and innovative. To do so, the company's management has to

effective job planning, incentives for extra efforts, recognition for prevention of problems and reward for innovations.

Many people like their jobs when they accomplished something in them. Sustained accomplishment is produced through continual learning like cross functional training, skill development and empowerment.

The continuous development of our employees' know-how is a prerequisite for reaching our quality goal with the Six Sigma methodology. In addition, there are many employees who participate in special Six Sigma training and some who are given expert training in the respective Six Sigma tools and methods. Quality therefore has to be a matter of a personal attitude and discipline for each employee. Each quality improvement produces a benefit spiral. An improvement in quality brings about lower costs and increases productivity. Better quality and lower costs lead to increased market shares, ensure long-term business relationships and ultimately bring about improved development opportunities for our employees.

As employees go through Six Sigma training they earn belts, similar to those earned in the martial arts. These belts signify the employee's Six Sigma skill and knowledge.

1. **Yellow belt:** The yellow belt is the starter level of Six Sigma. When an employee goes through yellow belt training they are taught the essentials of Six Sigma and discover how the process works. Yellow belt training normally takes one week to complete. Upon completion of yellow belt training, the employee can serve as an organizational leader in simple projects or support green and black belts in implementation of more complex projects.

2. **Green belt:** Green belt training can normally be completed during a two-week seminar. In this training program, potential green belts learn about various methods of measuring data, including many quantitative models that can be used to diagnose organizational inefficiencies. Most Six Sigma projects are led by green belts. Green belts are six sigma team leaders capable of forming and facilitating six sigma teams and managing six sigma projects from concept to completion. Typically, green-belt training consists of five days of classroom training and is conducted in conjunction with six sigma team projects. Training covers facilitation techniques and meeting management, project management, quality management tools, quality control tools, problem solving, and exploratory data analysis. Usually, six sigma black belts help green belts choose their projects prior to the training, attend training with their green belts and assist them with their projects after the training.
3. **Black belt:** Whereas green belts fully understand the concepts of data collection and interpretation, black belts have an equal or greater knowledge of these statistical tools in addition to the knowledge of how to lead many groups of Six Sigma projects simultaneously. Black belts serve as leaders and points of reference for green and yellow belts. Green belts will need to report to black belts regarding the status of their Six Sigma projects. Candidates for technical leader (black belt) status are technically oriented individuals held in high regard by their peers. They should be actively involved in the organizational change and development process. Candidates may come from a wide range of disciplines and need not be formally trained statisticians or engineers. However, because they are

expected to master a wide variety of technical tools in a relatively short period of time, technical leader candidates will probably possess a background in college-level mathematics, the basic tool of quantitative analysis. College-level course work in statistical methods should be a prerequisite. Six sigma technical leaders work to extract actionable knowledge from an organization's information warehouse. Successful candidates should understand one or more operating systems, spreadsheets, database managers, presentation programs and word processors. As part of their training they will be required to become proficient in the use of one or more advanced statistical analysis software packages.

4. ***Six Sigma champions (Master Black Belts)***: The highest level of Six Sigma training is the Six Sigma champion. These employees are those who have proven to be effective as black belts. The champion training differs from the black belt training in that the employee focuses on organizational leadership and the strategic decision making process. A Six Sigma champion is often times connected with a member of the organization's senior management in order to identify and lead projects of vital importance. Because master black belts train black belts, they must know everything the black belts know, as well as understand the mathematical theory on which the statistical methods are based. Masters must be able to assist black belts in applying the methods correctly in unusual situations. Whenever possible, statistical training should be conducted only by master black belts. If it's necessary for black belts and green belts to provide training, they should only do so under the guidance of master black belts. Because of the nature of the master's duties, communications and teaching

skills should be judged as important as technical competence in selecting candidates.

People create results. The GE Company, for example, believes that involving all employees is essential to quality approach. GE is committed to providing opportunities and incentives for employees to focus their talents and energies on satisfying customers. All GE employees are trained in the strategy, statistical tools and techniques of Six Sigma quality. Training courses are offered at various levels:

1. Quality Overview Seminars: basic Six Sigma awareness.
2. Team Training: basic tool introduction to equip employees to participate on Six Sigma teams.
3. Master Black Belt, Black Belt and Green Belt Training: in-depth quality training that includes high-level statistical tools, basic quality control tools, Change Acceleration Process and Flow technology tools.
4. Design for Six Sigma (DFSS) Training: prepares teams for the use of statistical tools to design it right the first time.

Because quality is the responsibility of every employee; Every employee must be involved, motivated and knowledgeable if we are to succeed.

Surveys reveal that employee's loyalty improves when they accomplish a lot; that happens when employees are intellectually challenged and recognized for their accomplishment. To implement the Six Sigma Business Scorecard and an appropriate strategy to improve profitability, people must be challenged and recognized. To empower people, five things must be done:

1. Define roles and match people appropriately to those roles

2. Delegate ownership of goals
3. Establish a framework for performance and accountability
4. Enable employees to develop or acquire necessary skills
5. Recognize employee's efforts as well as results

Employees must clearly relate the consequences of marginal performance and the rewards of excellence. Leadership must create the sense of urgency to achieve results. Good companies maintain the same level of urgency in good as well as though economics times. Good work ethics motivate people to perform in a long-term way; incentives that are short-lived investigators do not (Gupta, 2004:98).

Gupta (2004:153) said that, the employee performance review is not necessarily a human resources management issue; instead, it is a process that must be aligned strategically to achieve the business objectives. It must be used dynamically to achieve business goals. Figure 3 shows how employee reviews can be linked to ongoing employee performance.

<b>Employee Performance Review</b>
<b>Excellence Expectations</b> Leadership Practices Value Added (including Six Sigma Projects) Innovation
<b>Demonstrated Excellence (Measurable Value Added)</b> Innovation (including breakthrough solutions) Direct Value-Added Leadership Practices
<b>Areas of Improvement</b> Behaviors Skills
<b>Growth Plans</b> Training New Assignments Incentives for Extraordinary Performance
<b>Value Plans (Including Six Sigma Projects)</b>

<b>Plans for Innovation</b> Thought Leadership New Areas of Interest
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Figure 3 : Employee Performance Evaluation Elements

## 7. CONCLUSION

Six Sigma can be used to help organizations on developing and delivering products and services in order to meet customer satisfaction. By using Six Sigma in every part of production process and every party in organization, the defects of products or services will be no more than 3.4 defects per million opportunities.

To meet customer needs and expectations, organizations must use a measurable critical to satisfaction data, such as customer surveys, focus groups, service/complain data, warranty data and market research. The data should be integrated to internal process by using Quality Function Deployment.

The process in Six Sigma includes two sub-methodologies: DMAIC (define, measure, analyze, improve and control) and DMADV (define, measure, analyze, design, and verify). To achieve customer needs and expectations, Six Sigma should be understood by every party in organizations. Six Sigma training should be done to improve the knowledge and skill for all employees.

Costs of Quality and Break Event Point analysis are needed to support the using of Six Sigma in financial department. Cost of Quality (CoQ) is all of the attributable to the production of quality that is not 100 % perfect. Break even is the number of unit that must be sold in order to achieve the zero profit.

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