# PROJECT WORK



## Implementation Six Sigma for process improvement
## In
## Virtusa Polaris

**Student Name*****

**Roll Number*****

# PROJECT

# ON

# Implementation Six Sigma for process improvement in VirtusaPolaris



**IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF MBA PROGRAMME OF AMITY SCHOOL OF DISTANCE LEARNING, NOIDA**

# Contents

# CERTIFICATE -1

This is to certify that the project entitled "Implementation Six Sigma for process improvement in VirtusaPolaris" is a bonafied work done by me, ***Name of the student***, under the guidance of Mr. Nikesh Jaju in fulfillment of requirement of award of MBA.

Place: (Signed)

Date: Student Name***

Reg. No.:

Countersigned

Place: (Signed)

Date: Mr. ***

(Project Guide)

# CERTIFICATE - II

This is to certify that Mr. / Mrs./ Miss …… has planned and conducted the project entitled ……. Under my guidance and supervision and the report submitted therewith was the result of bonafide work done by him / her.

Place: (Signed)

Date: Mr. ***

(Project Guide)

## Acknowledgement

In perusing and completion of my ***MBA and other commitments, I undertook the task of completing my project on "**Implementation Six Sigma for process improvement**". To this and I would like to thank and convey my gratitude to the Top management of "**VirtusaPolaris**" who allowed me to conduct my project and gave me their whole hearted support.

I also record my thanks to all the employees, ex-employees, and customers of **VirtusaPolaris** Incorporation some of whom were frank and forthright and a few who were slightly apprehensive but nevertheless gave me their full co-operation. To all those I owe a debt of gratitude.

I am fortunate in having sought and secured valuable guidance, continuous encouragement and strong support at every stage of my guide and supervisor "**Mr. ***"** and am deeply grateful to him.

Finally, I also acknowledge with deep gratitude, the immense support I received from my family members who have always enhanced me and have been a source of inspiration and help in continuing my effort.

Last but not least my special thanks to all those who have given all the secretarial support – despite all other commitments.

*****Student Name*****

# Chapter 1:

# Introduction

# Chapter 1: Introduction

Business today offers the spectacle of a succession of companies, products, and even industries reaching their peak for a short period of time and then fading away. It's like riding the wheel of fortune as consumer tastes, technologies, financial conditions, and competition change ever more quickly.

In recent years, the companies and organizations around the world are showing great interests in quality. Six Sigma approach is a structured quantitative method which is invented by Motorola in 1986 for improving the product quality. Its aim is to enhance organization's performance by using statistical analytic techniques. After two decades of successful implementation in manufacturing, Six Sigma is approved as an effective methodology for improving quality.



Nowadays, some researchers believe that Six Sigma can bring large benefits for software companies. Furthermore, software companies have already started to implement Six Sigma approach, like Ericsson, Tata Consultancy Service, etc. However, there are still some problems and misconceptions existed about the applicability of Six Sigma in software companies.

Introduction to Quality and Six Sigma

In recent decades, the companies and organizations around the world are showing great interests in quality. Especially in 1970s and 1980s, the success of Japanese industry stimulates the whole world to focus on quality issues. The experience from them proved that the requirements and expectations of customers are the key factors which decide the quality.

Definition

The word "quality" comes from the Latin "qualitas", and Cicero (a roman orator and politician, 106-43 B.C.) is believed to be the first person who used the word. Until the a few decades before, the concept of quality has been significantly extended as we know it

today. There were many popular definitions for quality concept. Table 1 lists some of them.

Table 1: Definitions of quality concept

| Year | Defined By | Definition |
|---|---|---|
| 1931 | Walter Shewhart | There are two common aspects of quality. One of these has to do with the consideration of the quality of a thing as an objective reality independent of the existence of man. The other has to do with what we think, feel or sense as a result of the objective reality. In other words, there is a subjective side of quality. |
| 1951 | Joseph Juran | Fitness for use |
| 1979 | Philip Crosby | Conformance to requirements. |
| 1979 | Genichi Taguchi | The losses a product imparts to the society from the time the product is shipped. |
| 1985 | Edwards Deming | Quality should be aimed at the needs of the customer, present and future |
| 1990 | Myron Tribus | Quality is what makes it possible for a customer to have a love affair with your |

| | | |
|---|---|---|
| | | product or service. |
| 2000 | ISO 9000: 2000 | The degree to which a set of inherent characteristics fulfills the requirements, i.e. needs or expectations that are stated, generally implied or obligatory |
| 2004 | Bengt Klefsjo and Bo Bergman | The quality of a product is its ability to satisfy, and preferably exceed, the needs and expectations of the customers |



From the above definitions, we can find some interesting common points.

1. Almost all factors are conducted around customers. In another word, it can be said as customers decide the quality.
2. According to customer, two things are commonly considered as which shall be fulfilled customer requirements and customer expectations. The requirements are what customers request and demand. These are the basics of the quality. The expectations are what the customers expect and look forward to. Sometimes, the customers do not know what they really need. So that demands developers to have a good understanding about the customer's minds.

Another identification of these differences is conducted by Gavin in 1984. Five approaches to the quality concept are claimed which include transcendent-based, product-based, user-based, manufacturing-based, and value-based as mentioned in below Figure 1. From transcendent-based view, the quality can be identified by experience. Mostly is very successful. But from this point of view, the quality is not defined very clearly. This problem can be solved by product-based approach. The quality can be exactly defined and measured. However, the cost for quality cannot be judged by customer. User-based approach’s opinion is that the quality is decided by customer. Customer’s satisfaction is

the only scale which reflects product quality. Manufacturing-based perspective relates to accomplish the requirement specification. Reducing defects is the main task of quality improvement. According to value-based approach, the quality relates to cost and price. Generally price is decided by cost. A high quality product means that the customers are willing to pay for it. In Gavin's view, an organization cannot have just one approach for the quality concept, but that different parts of organization need different approaches.

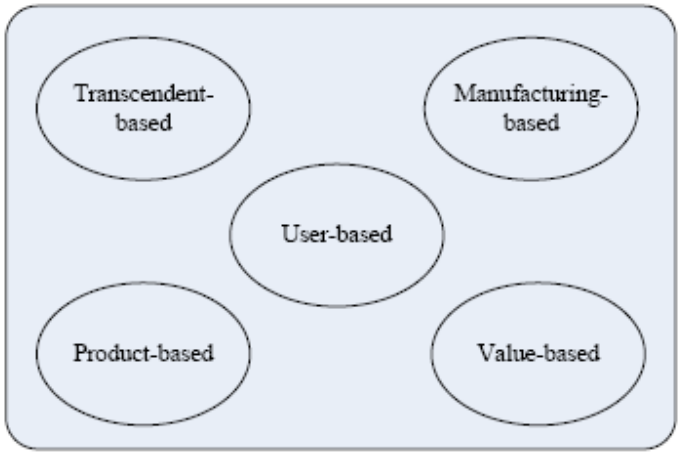


Figure 1: Five approaches of quality concept from Gavin



In quality issues, customer plays one of most important roles. A high quality product shall fulfill customers' requirements, and satisfy their expectations. Due to Gavin's theory, there are several approaches for quality concept. An organization cannot have just one approach, but it uses different approaches in different parts.

## Reason for Quality Improvement

According to Philip Crosby, Quality is free. It is not a gift, but it is free. What costs money are in-quality things - all the actions that involve not doing jobs right the first time.

Many companies pay a lot in correction, i.e. 80% of the cost in a Software Engineering (SE) project is commonly related to after-delivery corrections. And we also found.

- Unsatisfied customers tell in average 10 persons about their bad experiences. 12% tells up to 20 other persons.
- Satisfied customers tell in average 5 persons about their positive experiences.
- It costs 5 times as much to gain new customers than keeping existing ones.
- Up to 90% of the unsatisfied customers will not make business with you again, and they will not tell you.
- 95% of the unsatisfied customers will remain loyal if their complaints are handled fast and well.

All above motivate us to improve quality. Improved quality can affect the success in many different ways:

- More satisfied and loyal customers
- Lower employee turnover and sick leave rates
- A stronger market position
- Shorter lead times
- Opportunities for capital release
- Reduced costs due to waster and rework
- Higher productivity



Figure 2 demonstrates the importance of quality which expressed by Deming in 1986. In this figure, Deming connects improved quality with company prosperity.

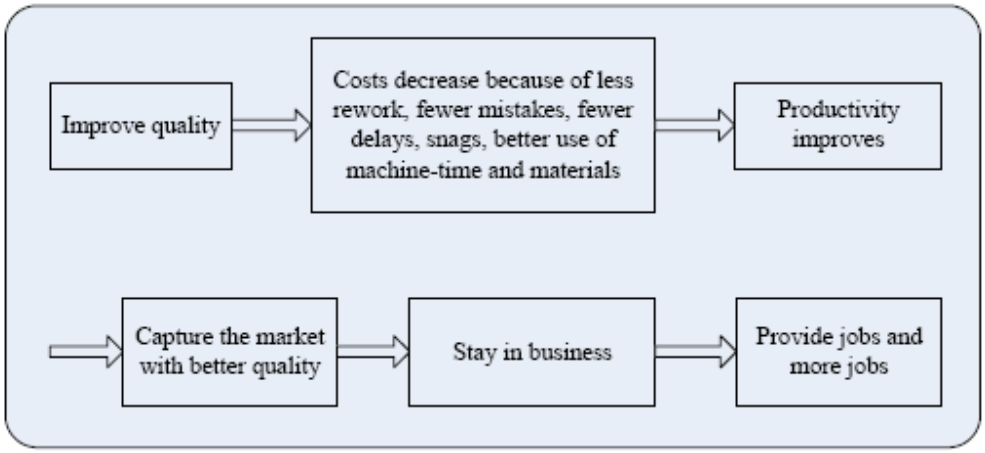


Figure 2: The importance of quality from Deming

As we seen, improving quality does not mean losing money in business. Proper improvement will bring organizations much more benefits.

**Software Quality**

Modern society is highly dependent on software products, i.e. bank system, telephone network, supermarket system, etc. As said, "the general public usually blamed the computer making no distinction between hardware and software". However, millions facts of software failures alert us to focus on software quality in everyday lives. Today, software customers are demanding higher quality and are willing to pay a higher price for it. Improving quality has become the common goal of each software development phase.

Similar with general quality concept mentioned in Section 2.1, high quality software shall have following factors:

- Developing in the right way.
- Matching the requirement specification.
- Good performance meeting customer's expectations.
- Fitness for use.



Combining with Gavin's five approach of quality concept, Kitchenham and Pfleeger describe software quality in another way:

- Transcendental view -- Software quality is thought as an ideal, but may never implement completely.
- User view--High quality software shall meet the user's needs, and have a good reliability, performance and usability.
- Manufacturing view--This view focuses on product quality during production and after delivery to avoid rework. Adopted by IS0 9001 and the Capability Maturity Model, the manufacturing approach advocates conformance to process rather than to specification. Hence, to enhance product quality, improving your process is very much essential.
- Product view--Be different with above views, product view assesses quality by measuring internal product properties. Software metrics tools are frequently used.

- Value-based view--High quality product always means a high cost. Different product purchasers always have the different value view. So that this approach puts much more efforts on considering the trade-offs between cost and quality.

Different views can be held by different groups involved in software development, i.e. customers or marketing groups have a user view, researchers have a product view, and the production department has a manufacturing view. It is not enough that only one view is identified explicitly. All views influence each other. Measuring each view clearly is one of assurances for high quality.

## Software Process Improvement

Based on five approach of quality concept, process improvement aims to have a better control in software development. Managers or organizations generally divide the whole project into smaller phases, such as requirement analysis, planning, coding, testing, releasing, etc. These phases are known as the Software Project Life Cycle (SPLC). Within each project phase, we use iterative processes to achieve phase's deliverables. Figure 3 shows a typical iterative of project processes. Project processes are distributed into five groups' initiating process group, planning process group, executing process group, monitoring and controlling process group, and closing process group.



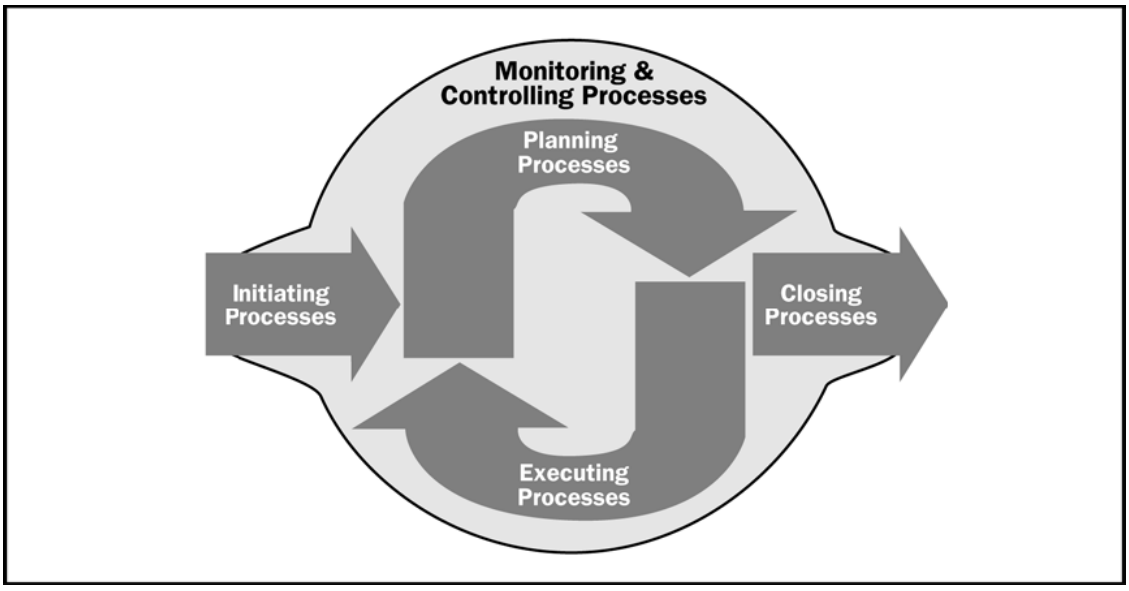


Figure 3: A typical project processes cycle

Quality in a software product can be improved by process improvement, because there is a correlation between processes and outcomes. As defined by IEEE, process is "a sequence of steps performed for a given purpose." It provides project members a regular method of using the same way to do the same work. Process improvement focuses on defining and continually improving process. Defects found in previous efforts are fixed in the next efforts. There are many models and techniques for process improvement, such as CMMI, ISO9000 series, SPICE, Six Sigma, etc.

**History - Six Sigma**

In 1980s, Bob Galvin the CEO of Motorola was trying to improve the manufacturing process. The Senior Sales Vice President Art Sundry at Motorola found that their quality is extremely bad. They both decided to improve the quality. Quality Engineer Bill Smith at Motorola in 1986 invented Six Sigma. It was applied to all business processes. In 1988 Motorola Won the Malcolm Baldrige Quality Award, as a result other organizations were also interested to learn Six Sigma. Motorola leaders started teaching Six Sigma to other organizations. Initially Six Sigma was invented to improve the product quality by reducing the defects, but later Motorola reinvented it. The new Six Sigma is beyond defects, it focuses on strategy execution. It became a management system to run the business. It was invented for an improvement in manufacturing industry but now it is applied in almost every industry i.e. Financial Services, Health care and Hospitality. Originally Six Sigma was introduced in United States but now it is in applied in many countries around the world.



**Definition**

Six Sigma is a structured quantitative method which is originally invented for reducing defects in manufacturing by Motorola in 1986. Its aim is using statistical analytic techniques to enhancing organization's performances, and to improving quality. Since Six Sigma has evolved over the last two decades, its definition is extended to three levels:

- Metric
- Methodology
- Management System

Six Sigma approach satisfies all the three levels at the same time. Those levels are discussed in the following sections.

### As a Metric

"Sigma" is the Latin symbol "σ". Here we use it to symbolize how much deviation exists in a set of data, and that is what we called standard normal distribution, or the bell curve. The normal distribution, also called the Gaussian distribution, is used for continuous probability distributions, see curves in Figure 4. The probability density function is shown as below – "μ" is the mean and "$\sigma^2$" is the variance.

$$\frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

The standard normal distribution is "the normal distribution with a mean of zero and a variance of one"(the green curve in Figure 4). From the figure, we can see that in a standard normal distribution, 50% of the values are under the mean and 50% of the values are above the mean.



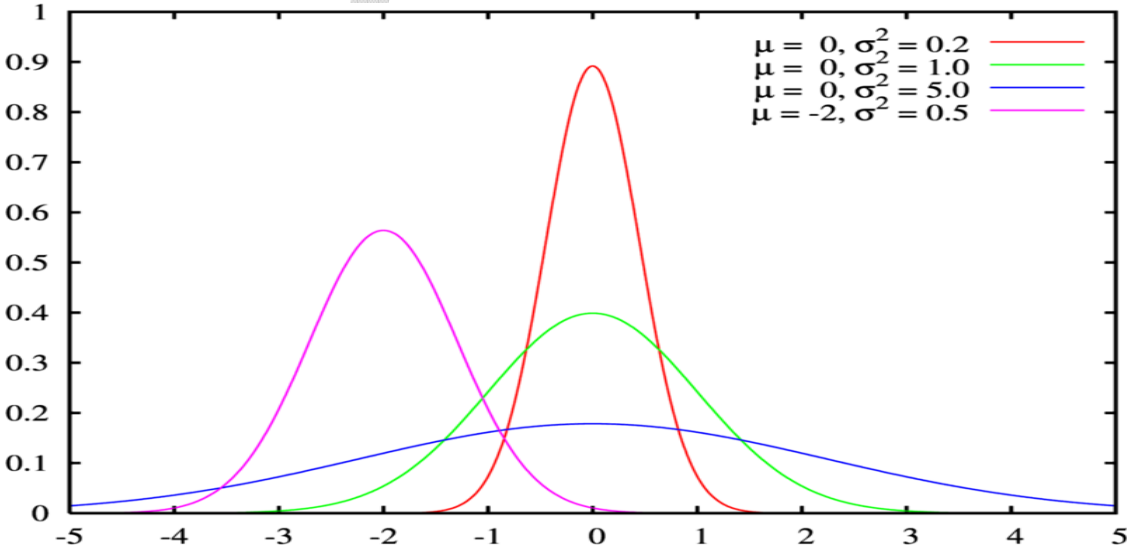


Figure 4: Normal distributions

In Six Sigma approach, “Sigma” is used as a scale for levels of process capability or quality. According to that, “Six Sigma” equates to 3.4 Defects Per Million Opportunities (DPMO). Therefore, as a metrics, Six Sigma focuses on reducing defects.

Figure 5 demonstrates how Six Sigma measures quality. In the figure, if we achieve 68% of aims, then we are at the 1 Sigma level. If we achieve 99.9997% of aims, then we are at the 6σ level which equates to 3.4 DPMO. From this point of view, Sigma level is to show how well the product is performing. It seems this level can never be achieved. However, the Sigma level is not our purpose, the real purpose is to improve quality continually. The higher Sigma level we have reach, the higher quality we get.

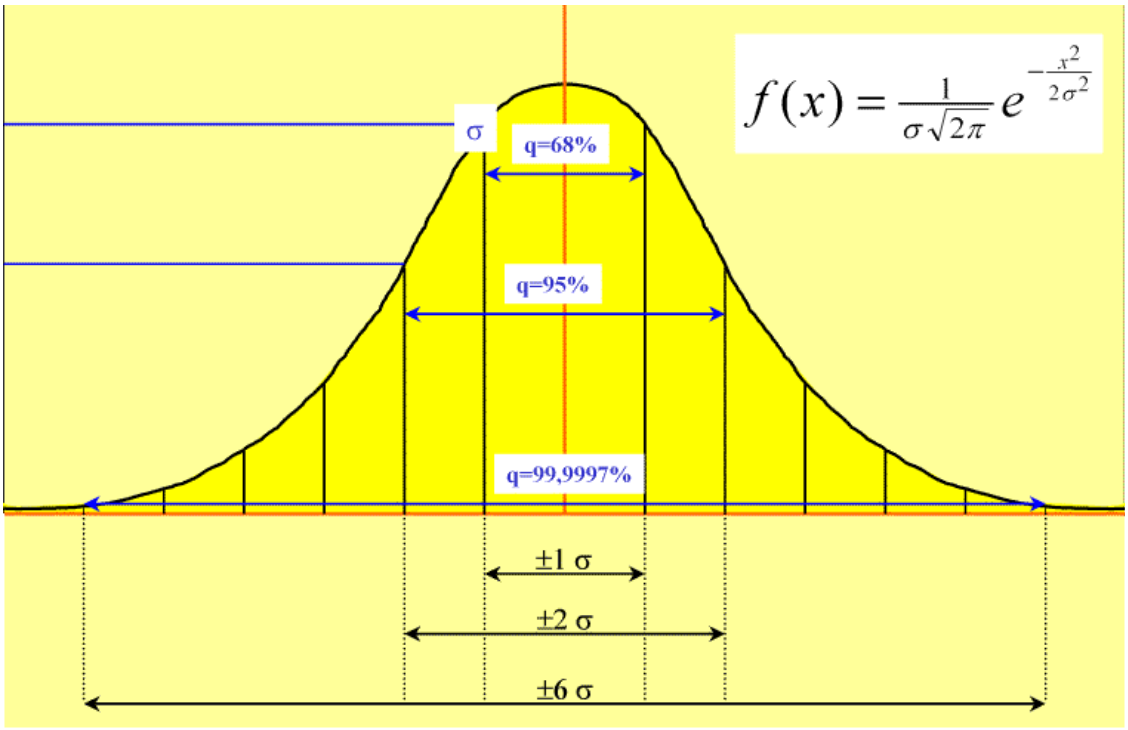


Figure 5: How Six Sigma measures quality

**Sigma Level Calculation**

The calculation of Sigma level is based on the number of defects per million opportunities (DPMO). The formula is

$$DPMO = 10^{6*} D/ (N*O)$$

Where D means the number of defects, N means number of units produced, and O is the number of opportunities per unit. For example, a software company wants to measure their software product's Sigma level. In their product, there are 200,000 lines of code (LOC). For each LOC, the company performs one check to test the quality. During the testing, 191 defects are detected. Then we have DPMO = 106*191 / (200,000*1) = 955. From Table 2

| DPMO | Sigma Level |
|---|---|
| 1,144 | 4.55 |
| 986 | 4.60 |
| 816 | 4.65 |

## As a Methodology

Six Sigma approach is not just counting defects in a process or product, but it is a methodology to improve processes. The Six Sigma methodology focuses on:

- Managing the customer requirements.
- Aligning the processes to achieve those requirements.
- Analyzing the data to minimize the variations in those processes.
- Rapid and sustainable improvement to those processes.



When we look at Six Sigma as a methodology, there are many models available for process improvement like DMADV, DMAIC, Breakthrough strategy, Roadmap, New Six Sigma, Eckes method, Six Sigma Roadmap, IDOV, and DMEDI. The most widely used models are DMAIC and DMADV. The DMAIC model is used when a process or product is in existence but is not meeting the customer requirements. And the DMADV model is used when a process or product is not in existence or is needed to be developed

### DMAIC Model

Motorola implemented the first Six Sigma model called as MAIC (Measure, Analyze, Improve and Control). It was developed by Dr. Miakel Harry. This model was used to solve the already known quality problems. GE, unlike Motorola was

unaware of their quality problem. They needed a model that can firstly map the real quality problems and then to solve them. Dr. Miakel Harry took advantage of his experience at Motorola and developed a new model DMAIC (Define, Measure, Analyze, Improve and Control). Nowadays this model is mostly in Six Sigma implementation.

**DMADV Model**

DMADV (Define, Measure, Analyze, Design and Verify) model was developed by Thomas Pyzdekis. This model is applied to the development of new processes or products. The phases of DMADV are described below:

- Define phase is to find out the customer needs and expectations and to define the project scope.
- Measure phase is to identify the CTQs (critical to qualities), process capability and risk assessment.
- Analyze phase is to develop the high level design concepts and design alternatives. To select the best design.
- Design phase is to develop plans for test verification, this may require simulations.
- Verify phase is to implement the process in operational scale.



**As a Management System**

Through experience, Motorola has found that using Six Sigma as a metric and as a methodology are not enough to drive the breakthrough improvements in an organization. Motorola ensures that Six Sigma metrics and methodology are adopted to improve opportunities which are directly linked to the business strategy. Now Six Sigma is also applied as a management system for executing the business strategy. Six Sigma approach provides a top-down solution to help the organization. It put the improvement efforts according to the strategy. It prepares the teams to work on the highly important projects. It drives clarity around the business strategy

**STATEMENT OF THE PROBLEM:**

Software Industry has a higher demand for quality. There is a Plethora of quality improvement techniques available which makes it harder for companies to decide which one to apply. They need support in this decision and in knowing how to apply the chosen techniques, if they want to improve their business and stay competitive.

Six Sigma approach is a very successful quality improvement tool. It has helped many companies to success. Recently, the Six Sigma approach was introduced in the software development industry. Some software companies have been trying to adapt Six Sigma for their business and development processes. But there are misconceptions about the applicability of Six Sigma in software. Furthermore there is no generic software quality improvement solution based on Six Sigma. So there is a demand to debunk the misconceptions related to the applicability of Six Sigma. And to develop a generic software company quality improvement solution based on Six Sigma approach.



**WHY IS THE TOPIC CHOSEN?**

The purpose of this project has been to develop a general model for six sigma implementation. This model could provide guidelines for process improvement in Virtusa Polaris. This model should be applicable in as many companies and sectors as possible.

**WHAT CONTRIBUTION WOULD THE PROJECT MAKE AND TO WHOM?**

The project starts from Six Sigma concept identification. After conducting interviews, a case study and several case studies reviews, we detail our method. We expect project result to be useful for our company when applying Six Sigma for process improvement.

For that reason, completion of my study and analysis would contribute for the project titles “Implementation Six Sigma for process improvement”.

**About Company – Virtusa Polaris**

VirtusaPolaris serves Global 2000 companies and leading software vendors in banking & financial services, insurance, telecommunications, technology and media, information & education industries. Using a combination of business consulting, cutting edge technology capabilities, and best-of-breed domain and industry knowledge, VirtusaPolaris accelerates business outcomes for its clients. VirtusaPolaris helps its clients transform their business applications to enhance customer experience, improve operational efficiencies, and lower IT costs. VirtusaPolaris helps clients accelerate business outcomes by consolidating, rationalizing, and modernizing their core customer-facing processes into one or more core systems.

VirtusaPolaris delivers strongly differentiated solutions to its clients, with a formidable reputation in global consumer banking, treasury, capital markets, and GRC segments within banking & financial services. VirtusaPolaris consistently executes large, business transformation programs, leveraging best of breed domain expertise, including the world's largest P&C claims modernization program, one of the world's largest banking portal for corporate customers, lead-to-cash transformation for a global telco, digital transformation programs for banks and media companies, among many others.



VirtusaPolaris delivers cost-effective solutions through a global delivery model, applying advanced methods such as Agile and Accelerated Solution Design to ensure that its solutions meet the clients' requirements. As a result, its clients simultaneously reduce their IT operations cost while increasing their ability to meet changing business needs.

With offices and development centers across North America, Europe, Middle East, India, Sri Lanka, South-east Asia, Japan and Australia & New Zealand, and a workforce of approximately 19,000, VirtusaPolaris is strongly placed to become the IT services partner of choice for global clients in the industries it serves.

# Chapter - 2
# Objective and Scope

# Chapter 2: Objective and Scope

## Objective:

- Identify the state-of-art of Six Sigma in software.
- Discuss the acceptance of Six Sigma in software companies.
- Compare the academic research results with the reality of software companies.
- Screen out the suitable Six Sigma tools and techniques for software companies.
- Discuss the future work for Six Sigma in software companies.

## Scope:

The work of this project began with purpose Six Sigma. The main aim of this paper is to provide Steps for software companies who want to implement Six Sigma for process improvement.

# Chapter 3:
# Theoretical perspective

# Chapter - 4

# Methodology

# Chapter 4: Methodology

It describes the underlying philosophy and approach used for conducting the research. It also explains the strategy and methodology used for collecting primary and secondary data. The data collection process and the sampling techniques used have also been discussed.

The underlying philosophy for this research project is Positivism. Positivistic approaches are founded on a belief that the study of human behaviour should be conducted in the same way as studies conducted in the natural sciences. Positivistic approaches seek to identify measure and evaluate any phenomena and to provide rational explanation for it. This explanation will attempt to establish causal links and relationships between the different elements (or variables) of the subject and relate them to a particular theory or practice. There is a belief that people do respond to stimulus or forces, rules (norms) external to themselves and that these can be discovered, identified and described using rational, systematic and deductive processes.



Some of the advantages of Positivistic approach are as follows:

- Suitable for research projects that require a structured and qualitative approach
- Good for research projects, for example, that are descriptive in nature, i.e. identifies and quantifies the element parts of any phenomena: the 'what' aspects of research
- Standardization makes collation and codifying of gathered data easier
- Research methods easier to reproduce and for other researchers to test your conclusions

RESEARCH APPROACH

The approach used for this research project is Inductive. The inductive research moves from particular situations to make or infer broad general ideas/theories, as shown in Figure

# Chapter - 5

# Data Collected

# Chapter 5: Data Collected

To collect data for the research project in quantitative terms, a research questionnaire was designed and then distributed to the companies. The questionnaire (APPENDIX) included different sections seeking information on various aspects of Six Sigma. Multiple-choice and scale-type questions were used to collect response in an objective manner. In addition, open questions were used to collect subjective information. Lickert scale of 1 to 7 was used to rate the critical success factors and the benefits of Six Sigma implementation.

The various sections of the questionnaire are outlined as follows:

- **About Six Sigma Program** – this part included questions regarding the history of Six Sigma program in the company, such as, the starting year of Six Sigma program, the reasons for initiating Six Sigma program, other improvement initiatives being implemented, etc.
- **Six Sigma Implementation** – this part included questions regarding the status of Six Sigma implementation, such as, the implementation stage of Six Sigma program, number of Six Sigma projects implemented, number of Six Sigma qualified persons, percentage of people involved in Six Sigma projects, etc.
- **Problems in Six Sigma implementation** – this part included questions regarding the problems faced in implementing Six Sigma and the level of organizational resistance to Six Sigma program
- **Critical Success factors** – this part included a list of critical success factors for Six Sigma, identified through review of literature and previous researches on Six Sigma. Lickert Scale was used to rate the factors in the order of this significance.
- **Benefits of Six Sigma** – this part included a list of potential benefits of Six Sigma, identified through literature review. Lickert scale was used to rate the significant benefits achieved through Six Sigma implementation.

# Chapter - 6

# Data Analysis

# Chapter 6: Data Analysis

This chapter covers the analysis of data collected through research questionnaire and the discussion of the results. The analysis of data has been done by compiling the data and presenting the findings using graphs and tables. The findings have then been discussed by comparing with literature review and similar researches. Some best practices have also been identified through review of case studies.

The respondents were asked about the events that triggered the initiation of Six Sigma program. Figure 7 shows the graphical presentation of the results received from the respondents.

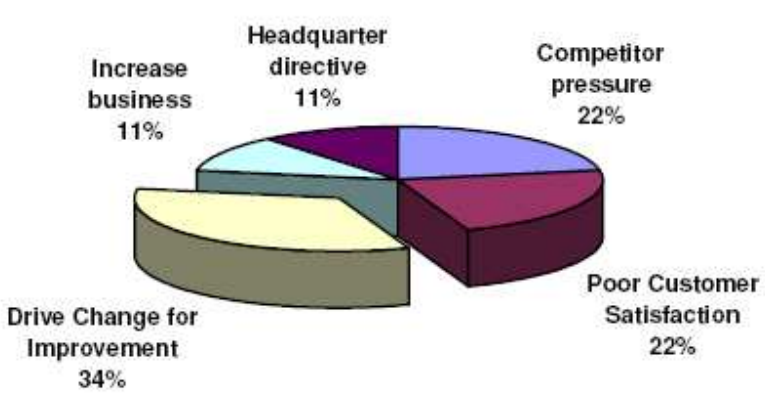


Figure 7: Drivers for Six Sigma Program

Figure indicates that the biggest trigger for Six Sigma Program in organizations was the need to drive change for continuous improvement. The much publicized successes of Motorola, GE, and other leading US companies presented Six Sigma as a successful tool for driving change in the organizational culture and striving for continuous improvement. Other significant drivers were competitors' pressure and poor customer satisfaction. These findings can be compared with a similar finding for BPR where the major drivers were found to be an intense need to cut cost and competitor pressure.

In the next question, the respondents were asked as what other quality initiatives had been implemented or were being implemented at the time of initiation of Six Sigma program. Figure 8 shows the results of the responses.

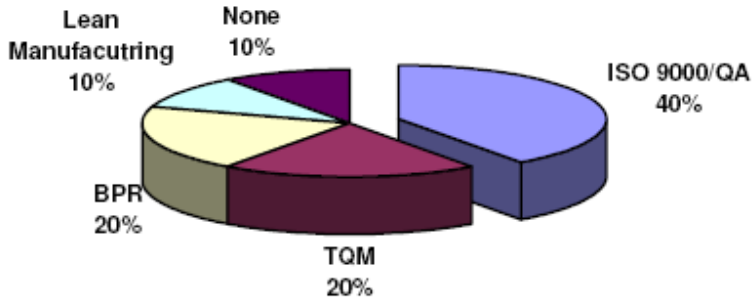


Figure 8: Other Quality Initiatives

It can be seen that 40% companies had adopted ISO 9001 before implementing Six Sigma. This finding reinforces the arguments made by Pfiefer that ISO 9000 can serve as the stepping stone for Six Sigma and can be integrated with Six Sigma to achieve maximum benefits from the two approaches. 20% of companies had either implemented TQM or BPR in addition to ISO 9000 before embarking on the Six Sigma program. These results suggest that all these quality initiatives help in developing a quality-oriented culture in the organization which emphasizes customer orientation, teamwork, employee development and involvement, and continuous improvement – all essential components of Six Sigma. Thus they pave the way for implementing Six Sigma.

The next question asked the respondents as who was the primary sponsor of Six Sigma Program in the organization. Figure 9 shows the results of the responses from the companies.

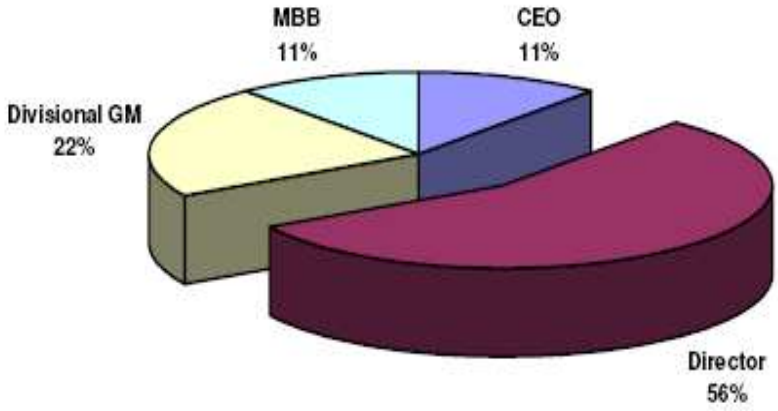


Figure 9: Primary Sponsor of Six Sigma Program

The figure indicates that in more than 50% cases the Director was the primary sponsor of the Six Sigma Program, followed by GM in 22% cases. CEO was the primary sponsor in only 11% cases. Thus, it reinforces the concept that Six Sigma initiative should be driven from the top with active management support and involvement. The findings suggest that sponsor must be from the executive management but not necessarily the CEO of the organization.



**Six Sigma Implementation**

In the initial two questions about Six Sigma implementation, the respondents were asked about the number of Six Sigma projects started/implemented and the average cycle time of a Six Sigma project. Figure 10 and Figure 11 show the findings of the survey.

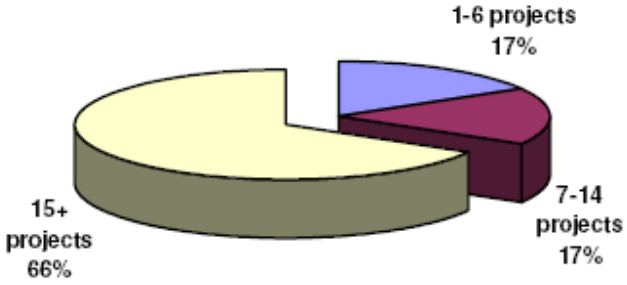


Figure 10: Number of Six Sigma Projects

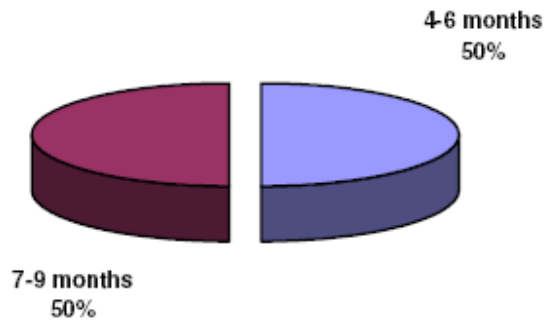


Figure 11: Average Time of Six Sigma Project

It can be seen that more than 15 Six Sigma projects have been initiated and implemented in 66% cases, thus indicating that Six Sigma program was started and implemented on a wider scale in most organizations. Regarding the average project time, equal proportion of respondents reported the average project time of 4-6 months and 7-9 months. This suggests that the average Six Sigma project spans between 4 to 9 months, depending on the nature and scope of project and the experience of Six Sigma team. This finding is in agreement with the project duration proposed for Six Sigma projects which is 4-6 months. The Six Sigma project duration is much shorter than that for BPR which was found to be between 2 years to 3 years. The finding reinforces the argument that Six Sigma projects should be of shorter duration to ensure continuous management support and consistent commitment of resources.

In the next two questions, the respondents were asked about the percentage of employees involved in Six Sigma projects and the percentage of time devoted by Six Sigma team members for Six Sigma activities. Figure 12 and Figure 13 show the findings of the survey.

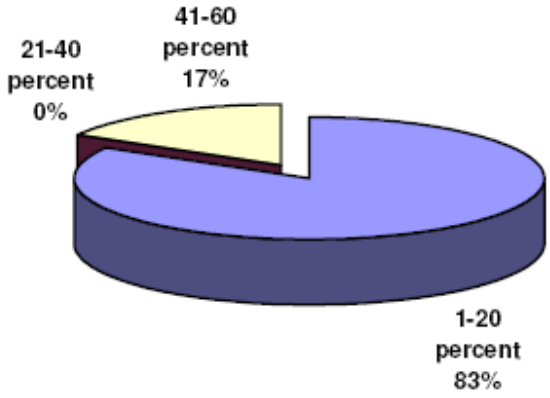


Figure 12: Percentage of employees involved

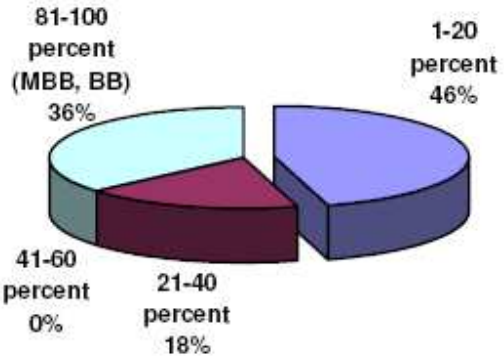


Figure 13: Percentage of time spend on Six Sigma

The figure indicates that in 83% cases, 1-20 percent of employees were involved in the Six Sigma projects while in 17% cases, 41-60% employees were involved. Regarding the percentage of time devoted by Six Sigma team members to project activities, it varies from role to role. While MBBs and BBs spend almost 100% of their time in Six Sigma project activities, other roles devote from 1-20% to 21-40% of their time in project activities. These findings are totally in agreement with the descriptions of roles given in the literature.

The next question asked respondents about the contribution of top management towards Six Sigma program. Figure 14 gives the results of findings.

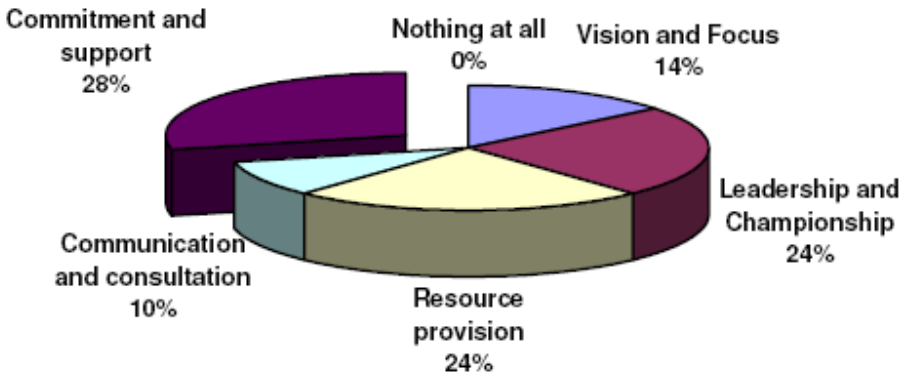


Figure 14: Contribution of Top Management



As we can seen in the above figure that the biggest contribution of the top management. Six Sigma has been in the form of commitment and support, followed by leadership and championship as well as resource provision. As mentioned in the literature, all these elements are desired from the top management to ensure that the Six Sigma program is started on the right footings and is not dismissed by employees as the flavour of the month.

The next question asked respondents whether or not external consultants were used in the planning and implementation of Six Sigma. Figure 15 gives the results of findings.

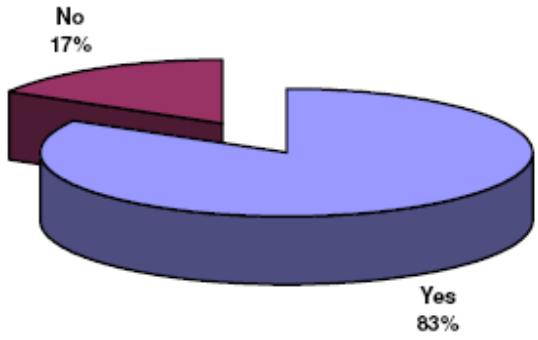


Figure 15: Use of Consultants

The data results indicate that an overwhelming majority (83%) of companies used external consultants to assist them in implementing Six Sigma. The consultants were mainly involved in training the Six Sigma teams and, in some cases, project planning and implementing Six Sigma methodology.



**Implementation Problems in Six Sigma**

In the first question in this section, the respondents were asked as what was the level of organizational resistance to the Six Sigma initiative. The Figure 16 gives the results of the responses received from the companies.

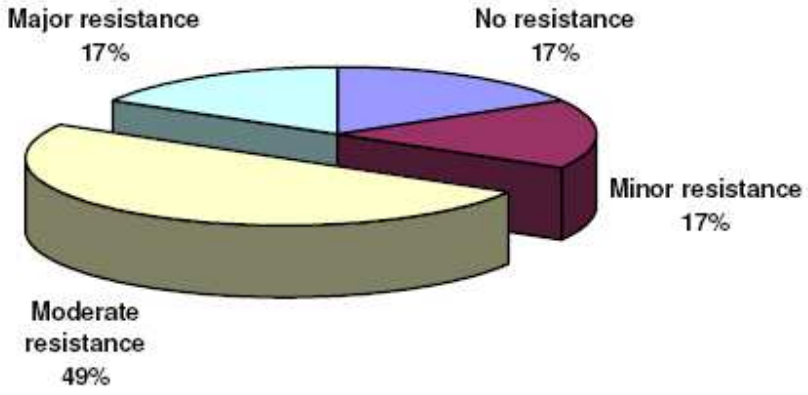


Figure 16: Level of organizational resistance

# CHAPTER - 7

# FINDINGS

# Chapter 7: Finding

Six Sigma program is championed by the executive management which contributes through commitment and support, championship and leadership, and focus and vision. The major problems faced in Six Sigma implementation include lack of resources, poor data collection and analysis, lack of management commitment, and organizational resistance to change. The significant benefits gained through Six Sigma implementation include cost reduction, elimination of defects, and minimization of non-value added activities. The research's findings showed that the critical factors of Six Sigma include management commitment and support, an effective change culture, teamwork, effective communication, and suitable use of Six Sigma methodology.

# Chapter - 8

# Recommendations

# Chapter 8: Recommendations

In light of the research findings, following recommendations are being proposed for effective Six Sigma implementation:

- Top management commitment and support for Six Sigma program is vital and crucial. Top executives must be part of Six Sigma and should contribute towards its implementation through visible commitment and support, leadership and championship, resource provision, and communication and consultation. They should support the Six Sigma initiative by personally spending time in every Six Sigma training, speaking and answering questions raising by employees, dropping in on Six Sigma reviews, making site visits to observe at first-hand the degree to which Six Sigma is ingrained in the culture; and monitoring Six Sigma project progress.



- An effective Six Sigma organizational infrastructure of Champions, Master Black Belts, Black Belts, and Green Belts should be established. Champions should come from the top executives ensuring that Six Sigma initiative has the top management support and appropriate resources are made available for projects. Master Black Belts will be the Six Sigma leaders acting as coaches and mentors for Black Belts and other team members and, hence, should be competent in terms of experience, training and skills related to project management, process improvement, and statistical analysis. Black Belts are the frontline project leaders, facilitating the planning and implementation of Six Sigma projects in collaboration with Green Belts and team members. Black Belts should be selected based on their knowledge of organizational processes and their command on application of statistical and project management tools and techniques.

- Effective communication is critical to overcome resistance to Six Sigma and maintain enthusiasm for quality initiatives within the organization. A communication plan addressing the importance of Six Sigma quality and how the

method works should be developed and implemented to drive out two basic fears at individual levels: fear of change and fear of not measuring up to the new standards. The most commonly used communication media are kickoff meetings with managers, workshops, and individual meetings with employees.

- Six Sigma is an advanced quality initiative and should be preceded by other simpler quality initiatives such as ISO 9000 Quality System. This will help in developing a quality-oriented culture in the organization and prepare the employees to adopt more complex initiatives like Six Sigma.

- The effective use of DMAIC Methodology is a key to successful implementation of Six Sigma. To affect this, the Six Sigma team should be fully conversant and trained on the application of certain tools and techniques, the most critical of which include project management, statistical analysis, and process management. A balanced combination and smart application of these tools is a recipe for successful Six Sigma results.



- The most significant benefits of Six Sigma are achieved in terms of cost reduction and elimination of defects/errors to maximize customer satisfaction. Based on these factors, project selection criteria for Six Sigma projects should be established. Each proposed Six Sigma project should be evaluated against the criteria and those projects should be selected which create the maximum impact on the customer satisfaction and ultimately the bottom line.

# Chapter -9

# Conclusion

# Chapter 9: Conclusion

Regarding the problems faced in Six Sigma implementation, the study indicated that most common problems faced by the organizations included lack of resources, poor data collection and analysis, lack of management commitment, measurement problems, and organizational resistance to change. Most of the organizations faced moderate level of resistance to Six Sigma initiative. To overcome this resistance, the most common communication media used included kick off meetings with managers, workshops, and individual communication with employees.

Regarding the potential benefits achieved through Six Sigma implementation, the survey results showed that the most significant benefits attained through Six Sigma implementation were cost reduction, reduced defects/errors, cycle time reduction, and minimization of waste and non-value-added activities. Another significant finding of the research was that most of the companies are satisfied with the implementation results of Six Sigma.



Based on the literature review and the analysis of results of the survey, a Six Sigma framework has been proposed incorporating the key elements for effective implementation of Six Sigma. At the core of the framework is the DMAIC methodology which is supported by interlinked hard factors and soft factors. The critical hard factors include organizational infrastructure for Six Sigma, project management, process management, and statistical tools. The soft factors impacting on them are top management support and commitment, effective culture of change, education and training, effective communication, and teamwork.

# APPENDICES

**Appendix 'A'**

Dear Friend,

As you know with Liberalization and Globalization our economy is appearing up to severe competition both internally and externally. In its wake completions assumes immerse importance.

As part of my MBA*** I have chosen the project objectives as "**Implementation Six Sigma for process improvement in VirtusaPolaris**". For this, I am interested in getting your valuable responses to the questionnaire that follows.

All responses to the questionnaire are to be utilized only for this project and also in an aggregated form. It is not necessary for you to reveal your identity should you so desire. However it is of almost importance that your responses are frank, forthright and reflect your true opinion. Specifically, I seek your kind co-operation in adhering to the following points:



1: Please give your responses to all questions/statements and do not leave any of them blank.
2: Please tick mark (✓) your response in only one of the columns against each Question/statement.
3. There are not right or wrong responses to the question/statements that follow in the questionnaire. What is important is your own personal frank and forthright opinion on various aspects

**Yours Sincerely**

***Name***

# Questionnaire

Hi,

The paper is about Implementation Six Sigma for process improvement. We would be grateful if you could answer a few short questions.

Your answers will of course be treated anonymously if you wish.

Thank you in advance!



Please tick where possible, if necessary motivate your answer:

1. What triggered or served as driver for the Six Sigma Program in your organization?

□ Competitive Pressure

□ Loss of Market Share

□ Management Changes

□ Mergers/Acquisitions

□ Poor Customer Satisfaction

□ Intense need to cut costs

□ Headquarter directive

□ Any other, please specify_____

2. What other quality improvement programs had been implemented or were being implemented at the time of initiation of Six Sigma program.

□ ISO 9001

□ Total Quality Management

□ Business Process Reengineering

□ Benchmarking

□ Lean Manufacturing

□ Any other, please specify: _____

3. Who are the Primary Sponsors of Six Sigma Program in the organization?

□ CEO

□ Director

□ Division General Manager

□ Functional Manager

□ Any other, please specify: _____

4. At which stage of Six Sigma Program is your organization in?

□ Planning

□ Start-up

□ Define & Measure

□ Analyze

□ Improve

□ Control & Review



5. How many six sigma projects have been started and implemented so far?

□ 1-3

□ 4-6

□ 7-9

□ 10-12

□ 13-15

□ 15+

6. What has been the average project time for the implementation of Six Sigma Project?

□ 1-3 months

□ 4-6 months

□ 7-9 months

□ 10-12 months

□ 13-15 months

□ 15+ months

7. How many Six Sigma qualified or certified people are there in your organization?

□ Master Black Belts _____

□ Black Belts _____

□ Green Belts _____

8. What percentage of employees is involved in Six Sigma Programs?

□ 1-20%

□ 21-40%

□ 41-60%

□ 61-80%

□ 81-100%



9. What percentage of time is devoted by team members for Six Sigma activities?

□ 1-20%

□ 21-40%

□ 41-60%

□ 61-80%

□ 81-100%

10. How many man-hours of trainings were conducted for Six Sigma at different levels of organization?

□ Top Management _____

□ Middle Management _____

□ Workers _____

11. What was the top management's contribution towards Six Sigma Program?

□ Vision and Focus

□ Leadership and championship

□ Resource provision

□ Communication and consultation

□ Commitment and support

□ Nothing at all

□ Any other, please specify: _____

12. Were external consultants involved in the planning and implementation of Six Sigma Program?

□ Yes

□ No



13. What was the level of organizational resistance to Six Sigma Program initiative?

□ No resistance

□ Minor resistance

□ Moderate resistance

□ Major resistance

□ Great resistance

14. What type of communication media were used to overcome the resistance and create Six Sigma buy-in?

□ Kick off meetings with managers

□ Q&A sessions

□ Conducted workshops

□ Individual comm. with employees

□ Newsletter

□ Videos/Visits of other companies

□ Any other, please specify: _____

15. What type of implementation problems were experienced within Six Sigma Program?

□ Lack of management commitment

□ Lack of resources

□ Insufficient training

□ Organizational resistance

□ Poor project management

□ Lack of team culture

□ Measurement problems

□ Poor data collection & analysis

□ Lack of communication

□ Any other, please specify: _____

16. Based on your Six Sigma implementation experience, please rate, in order of their significance, the critical factors for successful implementation of Six Sigma Program.

| S/ No. | Success Factors | Rating | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Does not matter | | | | | | Critical |
| 1. | Creating an effective change culture for Six Sigma | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. | Top management support and involvement | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. | Effective communication on Six Sigma Program | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. | Employee training & education on Six Sigma | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. | Teamwork | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. | Organizational infrastructure for Six Sigma | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. | Linking incentive system with Six Sigma Program | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. | Understanding and effective use of Six Sigma tools | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. | Project Management Skills | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. | Effective use of Six Sigma Methodology (DMAIC/DFSS) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. | Role of Information Technology | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. | Use of external consultants | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Any others, please specify | | | | | | | | |
| 13. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 15. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

17. How do you rate the satisfaction with the results achieved through Six Sigma Program?

□ Highly satisfied

□ Satisfied

□ Neutral

□ Dissatisfied

□ Highly dissatisfied

18. Please rate the organizational benefits that your organization achieved from Six Sigma?

| S/ No. | Benefits | Rating | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | None | | | | | | Significant |
| 1. | Customer satisfaction | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. | Defects/Errors reduction | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. | Cost reduction | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. | Reduced cycle time | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. | Better employee efficiency | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. | Minimization of waste/non-value added activities | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. | Sales & Marketing promotion | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Any others, please specify | | | | | | | | |
| 8. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

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