Vital factors for the successful adoption of Six Sigma methodology

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***Abstract* - Six Sigma is systematic methodological strategy, which is a rigorous, focused and highly effective implementation of proven quality principles and techniques. It seeks to enhance the quality of the output of a procedure by using a set of empirical and statistical techniques, identifying and expelling the reasons for defects and minimizing variability. The utilization of Six Sigma prompts a leap forward in profitability through a quantum level attention-to-detail in product quality, consumer satisfaction and efficiency. This paper presents some of the key techniques which are essential for profiting from the Six Sigma program in a manufacturing plant.**

***Index terms* – Six Sigma, Quality Management, Implementation, DMAIC, Statistics**

I. INTRODUCTION

Quality is not an act; it is a habit. Since Aristotle famously said this, throughout history, various quality management strategies have been applied to constantly provide better goods and services to satisfy the consumer. However, it would be a mistake to think that Six Sigma is all about quality in the conventional sense. Quality, defined customarily as conformance to internal necessities, has little to do with Six Sigma. Six Sigma concentrates on helping the industry profit by enhancing consumer value and efficiency. To link this objective of Six Sigma with quality requires a new definition of quality: the value added by a productive endeavour. This quality might be defined as potential quality and real quality. Potential quality is the known maximum possible value added per unit of input. Actual quality is the current value added per unit of input. The difference between potential and actual quality is waste. Six Sigma focuses on improving quality (i.e., reducing waste) by helping organizations produce products and services better, faster, and cheaper. The concept of implementation of Six Sigma methodology was pioneered by Bill Smith, a reliability engineer at Motorola in the 1980s with the aim of reducing costs that were incurred by doing things wrong the first time, costs of not meeting consumer requirements etc. Using Six Sigma, Motorola became known as a quality and a profit leader. After Motorola won the Malcolm Baldrige National Quality Award in 1988, the secret of their success became public knowledge and the Six Sigma revolution was begun. Several other companies such as GE, AlliedSignal (Honeywell), Sony, Kodak etc. have taken up the Six Sigma banner and used it to lead themselves to new levels of customer service and productivity.

II. DEFINITION OF SIX SIGMA

The term Six Sigma comes from statistics as the Greek letter σ (sigma) symbolizes the standard deviation, namely the variability of the data from the mean average. Number six expresses the accepted level of quality that is six times the standard deviation. Six Sigma is in essence a structured way of solving problems in an existing process based on analysis of real process data, i.e. facts. In practice, the term Six Sigma level means 3.4 defects per million opportunities or success rate of 99.999660%. Six Sigma's purpose is to reduce the variance-variability in processes, so to provide to the clients-consumers of the organization, products or services which are more reliable and with fewer errors.

Six Sigma is derived from a previous quality scheme in which a process was considered to be producing quality results if ±3σ or 99.74% of the products or attributes were within specification. Several reasons highlight the importance of adoption of a Six Sigma philosophy because, in some industries the three sigma philosophy is simply unacceptable. For example, the three sigma goal of having 99.74% of the product or attribute be in specification in the airline industry, implies that it is acceptable to have 2,600 unsatisfactory landings by commercial aircraft out of every million landings. In contrast, a Six Sigma approach would require that there be no more than 3.4 unsatisfactory landings per million, with a goal of approaching zero. Adopting a Six Sigma approach also forces companies that adopt it to work much harder and more quickly to discover and reduce sources of variation in processes. It "raises the bar" of the quality goals of a firm, causing the company to place even more emphasis on continuous quality improvement. Another reason is that Six Sigma dedication to quality may be required to attain world-class status and be a top competitor in the international market.

III. DMAIC PROCESS

Six Sigma contains a formalized problem-solving approach called the DMAIC process (Define, Measure, Analyse, Improve, and Control). DMAIC is used when a project's goal can be accomplished by improving an existing product, process, or service.

Phase	Processes
DEFINE	Define the problem. Set a target. Scope the process. Obtain customer feedback.
MEASURE	Set up a measurement system. Measure historic process data. Calculate initial sigma value.
ANALYSE	Analyse the causes of defect and sources of variation. Determine the variation in the process. Prioritize opportunities for future improvement.
IMPROVE	Generate, evaluate, select and pilot test process improvements.
CONTROL	Implement improvements. Standardize and monitor the improved process. Calculate the final sigma value.

IV. RESEARCH METHODOLOGY

The main purpose of this study is to present the key techniques necessary to successfully implement Six Sigma methodology. Key techniques are those factors that are essential to the success of the implementation to any quality improvement initiatives. For the effective implementation of Six Sigma projects in organisations, one must understand the critical success factors (CSFs) that will make the application successful.

V. BENEFITS OF SIX SIGMA

Six Sigma, which is "an organised and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined rates" generates intense interest among organisations. It accentuates financial returns to the balance sheet of the organisation. It has been so successful in many organisations where productivity is drastically improved beyond that which can be obtained through other means. The following are the key benefits gained by Motorola, Allied Signal (Honeywell) and General Electric from adopting Six Sigma.

Motorola (1987-1994)

- Reduced manufacturing costs by $1.4 billion
- Reduced in-process defect levels by a factor of 200.

Allied Signal (1992-1996)

- Reduced manufacturing costs by $1 billion.
- Reduced new product introduction time by 16%

General Electric (1995-1998)

- Companywide savings of over $1 billion.

Quality performance affects business performance through two routes--the manufacturing route and the marketing route. In the manufacturing route, improved quality performance results in fewer defects, lower scrap and rework rates, less waste and more dependable processes, which lead to lower manufacturing costs, lower warranty and liability costs, higher efficiency and productivity, and increased return on assets and profitability. In the marketing route, improved quality increases consumer satisfaction that leads to increased sales and larger market share. By providing high quality products and services, the firm has less elastic demand and can charge higher prices, which brings more profits.

VI. IMPLEMENTATION OF SIX SIGMA

After more than two decades of Six Sigma methodology, there is now a solid body of scientific research that successful deployment involves focusing on a small number of high-leverage items. The activities and systems required to successfully implement Six Sigma are well documented. Implementing a Six Sigma programme begins at top management level with training in fact-based decision making and evaluation of a company's strategic goals. In order to manage and optimise the process output, it is important that we identify the key input variables which influence the output. The key ingredients play an identical role of input variables to any process. This section focuses on the key techniques that are necessary for the successful implementation of the Six Sigma programme.

1. Commitment of Management

The management's primary role is to create a clear vision for Six Sigma success and to communicate their vision clearly, consistently, and repeatedly throughout the organization. Their primary responsibility is to ensure that Six Sigma goals, objectives, and progress are properly aligned with those of the enterprise as a whole. Any successful initiative like Six Sigma requires top management involvement and provision of appropriate resources and training. This is done by modifying the organization such that personnel naturally pursue Six Sigma as part of their normal routine. This requires the creation of new positions and departments, and modified reward, recognition, incentive, and compensation systems. The Six Sigma deployment will begin with senior leadership training in the philosophy, principles, and tools they need to prepare their organization for success. Without the continuous support and commitment from top management, true importance of the initiative will be in doubt and the energy behind it will be weakened.

2. Cultural change, communication and awareness

A successful introduction and adoption of Six Sigma requires adjustments to the culture of the organisation and a change in the attitude of its employees. Simultaneously, steps are taken to "soft-wire" the organization and to cultivate a change-capable environment where innovation and creativity can flourish. Employees have to be motivated and accept responsibility for the quality of their own work. Since many employees have the misconception that Six Sigma is essentially a statistical toolset, they will at first be very uneasy at the thought of learning statistics. But today, in major companies which rely heavily on Six Sigma such as GE, Honeywell etc., Six Sigma is the way employees work every day and it is nothing more than the mindset of people with the ultimate goal of "doing things right the first time". Therefore, the success of tan organisation depends heavily on the culture of the organisation. Six Sigma initiatives require the right mindset and attitude of employees working within the organisation at all levels. The people within the organisation must be made known and be aware of the need for change. Companies that have been successful in managing change have identified that the best way to tackle resistance to change is through increased and sustained communication, motivation and education.

3. Organisation Infrastructure

An effective organisational infrastructure is necessary to support the Sig Sigma introduction and development within any organisation. The employees in an organisation following Six Sigma are generally highly trained, have undergone stringent statistical training and lead teams in identifying, executing and managing Six Sigma projects. Using their newly acquired knowledge, senior leaders such as the CEO or vice-president, who is also known as the champion of Six Sigma direct the development and training of an infrastructure to manage and support Six Sigma. Six Sigma programme also requires project sponsors who provide advice to the project team to find and negotiate resources and budget for the project. The timing and readiness of the organisation is also important. This is because Six Sigma effort requires a great deal of resources such as staff and top management commitment, time, energy, capital etc.

4. Project management Skills

As Six Sigma is a project driven methodology, it is good practice for the team members to have project management skills to meet various deadlines or milestones over the span of the project. A large portion of the projects on Six Sigma fall flat due to poor project management skills, setting and keeping ground rules, determining the meetings roles and responsibilities.

5. Project selection and prioritisation

There have to be proper criteria for the selection and prioritisation of projects. Poorly selected and defined projects lead to delayed results and a great deal of dissatisfaction. Project selection criteria are classified into three generic categories. These are:

1. Business benefits criteria
   - impact on meeting external customer requirement
   - financial impact
   - impact on core competencies

2. Feasibility criteria
   - expertise available
   - resources required
   - complexity

3. Organisational impact criteria
   - cross-functional benefits
   - learning benefits

Project audits must be conducted on a regularly scheduled basis to drive the projects to a successful completion and closure. It is also a decent practice to have a project tracking system to track all projects which are submitted for consideration, accepted for implementation, in progress and completed.

6. Understanding the Six Sigma methodology and training

It is critical to communicate both the 'why' and the 'how' of Six Sigma as early as possible and provide the opportunity to employees to improve their comfort level through training classes before unleashing them into the world of Six Sigma. A major portion of Six Sigma training involves learning the principles behind the Six Sigma methodology i.e. DMAIC methodology. During training, employees learn three groups of tools and techniques, which are divide into process improvement tools and techniques, leadership tools and team tools. For many Six Sigma projects, usually basic statistical tools or quality tools are more than enough to tackle the problem at hand. However, for greater breakthrough improvements in business processes, advanced statistical tools and techniques such as statistical process control, regression analysis, ANOVA etc. are needed. A clear set of performance parameters or metrics are used to measure process performance against consumer requirements. Examples of metrics include defect rate, cost of poor quality etc.

7. Pairing Six Sigma with consumers

A key element of the success of Six Sigma is its ability to link up with the consumers. Projects should begin with the determination of customer requirements and before they can be met successfully, there has to be a good understanding of the organisation and its linkage to various business activities. The process of linking Six Sigma to the customer can be divided to two main steps:

1. Identifying the core processes, defining the key outputs of these processes.
2. Identifying and defining the consumer needs and requirements.

VII. CONCLUSION

Six Sigma is undeniably a business strategy that can provide a breakthrough improvement in the competitive era of organisations. It has been considered as a strategic approach to improve business profitability and achieve operational excellence through the effective application of both statistical and non-statistical tools and techniques. When all the key factors are successfully implemented in the organisation by following a correct methodology by proper combination of tools, it can lead to great benefits. This paper presents the pivotal factors for the effective introduction and adoption of Six Sigma programme in organisations. It will encourage organisations to apply the Six Sigma programme in their firms and reap huge benefits.

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