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Success of six sigma in indian companies- an over view

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Abstract- Globalization and instant access to information of products and services continue to change the way customers conduct business. Today's competitive environment leaves no room for error and products and service providers relentlessly look for new ways to exceed the customers' expectations. Hence, Six Sigma quality has become a part of any business culture. Customers Value consistent, predictable, business processes that deliver world-class levels of quality. Six Sigma is a problem-solving venture delivering the world class quality. Every project has process or design problem in search of solution. Six Sigma directs the people's energies for finding the solutions and improving the bottom lines.

Keywords- Six Sigma, DMAIC

1. Introduction

As a means of reaching the goal of becoming world class companies, Indian companies have been implementing various innovative and advanced techniques and managerial philosophies. Among all these, six sigma approaches has started to get the attention of captains of Indian companies.

Six sigma (www. ge. Com) is defined as a highly disciplined process that helps industries to focus on developing and delivering near-perfect products and services. Six sigma is a vision of quality, which equates with only 3.4 defects per million opportunities for each product or service transaction. It is first and foremost business process that enables companies to increase profits dramatically by streamlining operations, improving quality and eliminating defects or mistakes in everything a company does.

Because of these tremendous benefits, Indian companies are curious to implement six sigma programme. However, very few Indian companies have started to exercise practical implementation. It is presumed that at this critical juncture of competitive situation, Indian companies prefer to examine the compatibility of six sigma programme in Indian company culture.

In this context, this project is being brought out, which reports the successful implementation of a six sigma project.

In order to manage and optimize the process output, it is important that we identify the key input variables which influence the output. The key ingredients of six sigma play an identical role of input variables to any process. This section briefly reveals the key ingredients that are necessary for the effective implementation of six sigma program. It would also assist people in organizations to gain a better understanding of the process of six sigma implementation (Jiju Antony and Ricardo Banuelas, 2002).

2. Management involvement and commitment

Any successful initiative like six sigma requires top management involvement and provision of appropriate resources and training. The underlying principles of six sigma must be taught to senior managers within the organization. Jack Welch, the CEO of GE, has strongly influenced and enabled the restructuring of the business organization and changed the attitude of the employees towards Six Sigma (Henderson and Evans, 2000). Without the continuous support and commitment from top management, the true importance of the initiative will be in doubt and the energy behind it will be weakened.

2.1 Cultural change

A successful introduction and implementation of six sigma requires adjustments to the culture of the organization and a change in the attitudes of its employees. Employees have to be motivated and accept responsibility for the quality of their own work. It is worthwhile to note that when Six Sigma was initially rolled out at GE, employees were at first very uneasy at the thought of having to learn statistics. This was due to the misconception that six sigma is essentially a statistical toolset. Today six sigma within GE is the way employees do their job in everyday life and it is nothing more than the mindset of people with the ultimate goal of "doing things right first time''. The success of an organization in both the local and overseas markets depends heavily on the culture of that particular organization. Six Sigma initiatives require the right mindset and attitude of people working within the organization at all levels. The people within the organization 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.

2.2. Organization infrastructure

In addition to top-management, there also needs to be an effective organizational infrastructure in place to support the six sigma introduction and development program within any organization. The employees in an organization practicing six

sigma are generally highly trained, have undergone rigorous statistical training, and lead teams in identifying, executing and managing six sigma projects. In many multinational corporations (such as GE, Motorola, Honeywell, etc.), six sigma initiatives are led by the CEO or vice-president, who is considered as the six sigma champion. This will be followed by the formation of Master Black belts, black belts, green belts and other team members who are individuals who support specific projects in their area. Apart from the belt system, six sigma program also requires project sponsors (or champions in some organizations) who provide guidance to the project team and find and negotiate resources and budget for the project. The timing and readiness of the organization is also important. This is because six sigma efforts require a great deal of resources such as staff commitment, top management commitment, time, energy and costs, etc.

2.3. Training

It is critical to ``communicate both the `why' and the `how' of six sigma as early as possible, and provide the opportunity to people to improve their comfort level through training classes'' before unleashing the employees into the world of six sigma. There is usually a hierarchy of expertise, which is identified by the ``belt system''. The belt system ensures that everyone in the organization is speaking the same language. This makes the setting up and execution of six sigma projects much easier throughout the organization. The curriculum in the belt system varies from organization to organization and consultant to consultant; however it needs to be provided by identifying the key roles of the people directly involved in applying six sigma. For example, the training for becoming a black belt within Motorola is a minimum of one year. In order to be accredited to black belt, candidates must complete an application form to demonstrate how they have met the requirements in both training and practice of six sigma. In GE, the length of training is approximately 16-20 weeks. Qualification as a black belt is very important when employees are being considered for promotion. In general, it appears that GE has a more structured approach to training than does Motorola. Moreover, the length of training in GE is comparatively much shorter and therefore results in a greater number of accredited black belts. However, the black belt training in Motorola seems to be more flexible and potentially should result in a greater depth and breadth of expertise.

2.4. 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 the various deadlines or milestones during the course of the project. Most of the projects on six sigma fail due to poor project management skills, setting and keeping ground rules, determining the meeting's roles and responsibilities.

2.5. Project prioritization and selection, reviews and tracking

There have to be proper criteria for the selection and prioritization of projects. Poorly selected and defined projects lead to delayed results and also a great deal of frustration provides three generic categories of projection selection criteria. These are:

(1) Business benefits criteria
- ❑ impact on meeting external customer requirement;
- ❑ financial impact;
- ❑ Impact on core competencies.

(2) Feasibility criteria
- ❑ resources required;
- ❑ complexity;

(3) Organizational impact criteria
- ❑ cross-functional benefits;

Learning benefits, i.e. new knowledge gained about the business, customers and processes.

Project reviews must be conducted on a regularly scheduled basis to drive the projects to a successful completion and closure. Review process would enable the black belts and green belts to follow the six sigma methodology correctly. Six sigma champions should use the project review process to understand what the black belts and green belts see as barriers to the progress of their projects. It is good practice to have a project tracking system to track all projects which are submitted for consideration, accepted for implementation, in progress and completed.

2.6. Understanding the Six Sigma methodology, tools and techniques

A healthy portion of the six sigma training involves learning the principles behind the six sigma methodology, i.e. DMAIC methodology. During the training, employees teach three groups of tools and techniques, which are divided into process improvement tools and techniques, leadership tools and team tools. For many six sigma projects, generally simple statistical tools or quality tools are more than enough to tackle the problem at hand. However, for greater break through improvements in business processes, certain advanced statistical tools and techniques (such as design of experiments, statistical process control, regression analysis, analysis of variance, etc.) are needed. In addition, there has to be a clear set of metrics that are used to measure process performance against customer requirements. Examples of metrics include defect rate, cost of poor quality, throughput yield, rolled throughput yield, etc. Accurate data are also required for analyzing potential root causes and support the team's decisions.

2.7. Linking Six Sigma to business strategy

Six Sigma cannot be treated as yet another stand-alone activity. It requires adherence to a whole philosophy rather than just the usage of a few tools and techniques of quality improvement. It needs to be clear how six sigma projects and other activities link to customers, core processes and competitiveness. Since the goal of every organization is to make profits, six sigma projects make business processes profitable while attacking variability which leads to high scrap rate, high rework rate, low productivity, etc. In every single project, the link between the project objectives and the business strategy should be identified.

2.8. Linking Six Sigma to the customer

A key element of the success of six sigma program is its ability to link to the customers. Projects should begin with the determination of customer requirements. However before customer needs can be met successfully, there has to be a good understanding of the organization and its linkage to various business activities. The process of linking Six Sigma to the customer can therefore be divided into two main steps:

(1) Identifying the core processes, defining the key outputs of these processes and defining the key customers that they serve.
(2) Identifying and defining the customer needs and requirements.

An important issue here is the selection of critical-to-quality characteristics (CTQs). These CTQs must be identified quantitatively in the starting phase of the six sigma methodology. Quality function deployment is a powerful technique to understand the needs and expectations of customers and translate them into design or engineering requirements. In service industry, the customer requirements are often ambiguous, subjective and poorly defined.

2.9. Linking Six Sigma to human resources

Human resources-based actions need to be put into effect to promote desired behavior and results. Some studies show that 61 per cent of the top performing companies link their rewards to their business strategies, while lower performing companies create minimal linkage. Across all GE businesses no one will be promoted without the full Six Sigma training and a completed project. This in itself is an impressive behavior driver. Moreover, Jack Welch of GE requires the black belt managing the project to prove that the problems are fixed permanently.

2.10. Linking Six Sigma to suppliers

Many organizations that implement six sigma find it beneficial to extend the application of six sigma principles to management of their supply chain. The concept that ``everybody plays'' created special challenges for General Electric Appliances (GEA). You cannot be a six sigma company without your suppliers participating in the culture change. The key element of successful integration of suppliers into six sigma is obtaining support up front from the highest levels of management in the supplier firm. Under Six Sigma philosophies, one way to reduce variability is to have few suppliers with high Sigma performance capability levels.

3. Real Benefits of Six Sigma

Six Sigma accentuates financial returns to the balance sheet of an organization. It has been so successful in many organizations where performance is significantly improved beyond that which can be obtained through other means. The following are the key benefits gained by Motorola, Allied Signal (Honeywell now) and GE from the implementation of six sigma(Jiju Antony and Ricardo Banuelas, 2002).

Motorola (1987-1994)

- Reduced in-process defect levels by a factor of 200.
- Reduced manufacturing costs by $1.4 billion.
- Increased stockholders share value four-fold.

Allied Signal (1992-1996)

- Reduced new product introduction time by 16 per cent.

Reduced manufacturing costs by more than $1 billion.

General Electric (1995-1998)

- Companywide savings of over $1 billion.

Service, transactional processes of six sigma

- Reduced medication and laboratory errors and thereby improved patient safety.
- Reduced profit margin significantly in a community hospital and the estimated saving is more than $1million per year
- Significant savings in process timeliness, improvements in cash management and increased customer loyalty and satisfaction.

4. Six Sigma Problem Solving Approach

There are five fundamental steps or phases involved to achieve the Six Sigma quality in a process are shown in figure 4.1. These phases are Define, Measure, Analyze, Innovate and Improve and Control (DMAIC). Each phase is designed to ensure (1) that companies apply the Six Sigma strategy in a methodical and disciplined way; (2) that Six Sigma projects are correctly defined and executed; and (3) that the results of these projects are incorporated into running the day to- day business.

Fig 4.1 Phases of six sigma

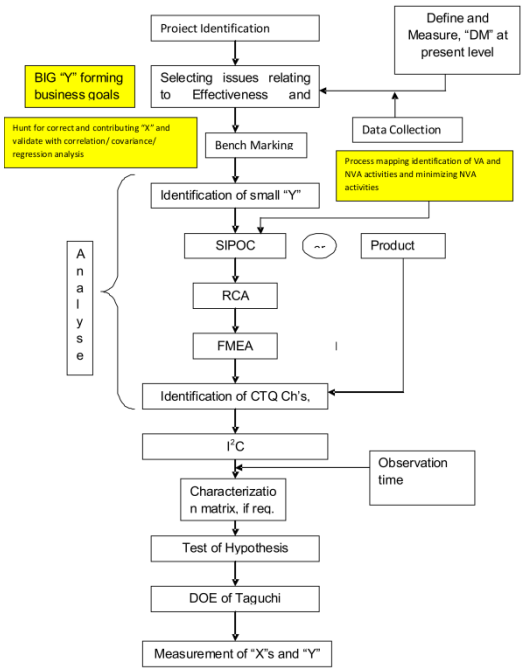
The define phase includes the identification of projects and the detailed problem statement with estimation of benefits. The measure phase includes a review of types of measurement system and their key features. Companies must understand the nature and properties of data collection and reporting. In the analyze phase, the six sigma strategy offers specific methods and tools to isolate key pieces of information that are critical to explaining the number of defective products. In the analyze phase, practical business problems are turned into statistical problems. This phase is to find change of which X's affect Y and in what manner and to find which X's are critical to move the Y in desired condition and to be maintained at what level. In the innovate and improve phase, the six sigma process guides

(1) How to select the solution
(2) How to pilot the solutions
(3) How to assess the risks
(4) How to implement the solutions.

Finally in the control phase, the Six Sigma ensures that the same problem doesn't re-occur by continually monitoring and implementing the control measures enabling to withhold the gains achieved.

5. Chronology of six sigma process

A typical flow to the six sigma project is as follows



6. Statistical Significance of Six Sigma

In statistics, sigma denotes the standard deviation of a set of data. It provides a measure of variability, which indicates how all data points in a statistical distribution vary from the mean (average) value. The normal distribution represents many data sets in business. When data follow a normal distribution, 99.73 per cent of the data points lie within ± three sigma from the mean (Figure 2.2). Now consider that a company uses a single-stage (one-step) process with a natural variation from the mean to manufacture a product where the mean value is the ideal specification of the product. Consider that design specification allows for a ± four sigma variation about this ideal mean value. About 99.9937 per cent of the products fall within a ± four sigma range about this mean. That leaves 0.0063 per cent outside the range. This translates to a total of 63 parts per million (defects) which will fall outside the defined range, both above and below the specification limits.

The 63 defective parts produced per million products may not appear too large a number of defects (though it is not zero). But, in addition to the natural variation of a process, it has been found that the mean value itself is susceptible to a shift of up to ± one-and-a-half sigma. When this happens, the single-stage process discussed above, 99.379 per cent of the products fall within the ± four sigma ranges. This would leave 0.621 per cent or about 6,210 parts per million (defects) outside the specification limits. The yield (non-defective parts) is now reduced significantly (5). The above discussion is based on a single-stage production process. Real-world production is a multi-stage process and products consist of many components. Each stage of the overall process and each component of the product is subject to the levels of errors described above. The statistically independent yields for each stage or component are multiplied to get the overall yield. (3).Let us consider a 100-stage process, where each stage has a ± four sigma design specification range. The overall yield would be 53.64 per cent within the specification limits. That would leave 46.36 per cent outside the limits, or 463,600 defective parts per million products.

Most manufacturers use three sigma processes to meet four sigma specifications, resulting in a large number of defects. However, when specifications are set at ± six sigma, we get near zero defects result. This is true even when the process mean shifts and when multi-stage processing is involved. The overall yield at different sigma levels (specification limits), with multi-stage processes or multiple components is shown in Table 6.1.

If a design can accept a ± six sigma variation of the process, i.e. twice the normal process variation, then 99.99966 per cent of the products will be within specification limits or there will be no more than 3.4 defective parts per million made (see Table6.2). This is true of a single-stage process. Even when there are 100 stages in the product manufacturing process, the defect rate will only be 3,390 parts per million. Table 6.2 shows that for any defect level there is an associated sigma level. These values are for a single part or process step.

Motorola's worldwide benchmarking in 1986 found that the best-in-class companies had six sigma quality, while Motorola had only four sigma quality. Many firms operate at three sigma levels (zero per cent yield at three sigma for 1,000 stage process) and have almost no chance of producing defect-free products. To compare these sigma levels consider the following example. When we consider spelling errors, three sigma corresponds to 7.6 misspelled words per page in a book. But, four sigma corresponds to about one misspelled word per chapter in a book, while six sigma would mean one misspelled word in all the books contained in a small library. This logarithmic relationship between the numbers of sigma's and rate of errors implies higher sigma's lead to excellence in product quality

Table 6.1. Overall yield (distribution shifted ± 1.5 sigma)

Number of Stages/parts	± 3 sigma %	± 4 sigma %	± 5 sigma %	± 6 sigma %
1	93.32	99.379	99.9767	99.99966
10	50.08	93.96	99.768	99.9966
100	0.10	53.64	97.7	99.966
1000	0.0	0.20	79.24	99.661

Table 6.2. Defects per million and sigma levels

Number of defects per million opportunities	Associated sigma level
66,810	3.0
22,750	3.5
6,210	4.0
1,350	4.5
233	5.0
32	5.5
3.4	6.0

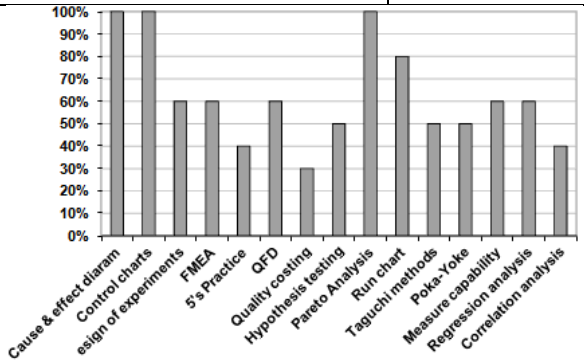


Fig 6.1 Tools and techniques used by the UK industry

Statistical/graphical tool purpose
(Kim Henderson and James R.Evans,2000)
One-sample t-test Compares mean to target
Two-sample t-test compares two means
ANOVA Compares two or more means
Box and whisker plot
To look for differences in the distribution of the data in a graphical fashion
Chi-square test
Compares the number of items in groups or categories
Dot plot
To visually represent all data points and enable graphical
Comparisons of two or more processes
Homogeneity of varianceor F-test
Compares two or more variables or F-test
Kruskal-Wallis test Compare two or more means with unknown distributions
Matrix plot
To screen for relationships between factors, and save time as compared to running individual scatter plots
Normal probability charts
Used to identify unstable and stable operations
One-way ANOVA
To examine statistical differences among different populations
PC-based statistics tool set
A statistical software package; provides many statistical tools for analyzing data; presents results in an easy to understand
Format; can be used to present data in several different graphical formats
Scatter plot

To evaluate the theory that two variables are related; the straight line and tightness of cluster indicate strength of relationship

7. Conclusion

Six sigma accentuates financial returns to the balance sheet of an organization. It has been so successful in many organizations' where performance is significantly improved beyond that which can be obtained through other means. Six Sigma highly focuses on zero defects in various fields for the satisfaction of the customer needs and also it satisfies the company's production at a higher range. It provides an economical change over industries and companies through which there would be a drastic evolution of entrepreneurship for the young generation. Six Sigma grows new every second along with innovations in technology oriented environment. Nevertheless it's a boon for the industries and manufacturing companies to reach their goal and compete with other countries for customer needs and satisfaction. It paves a way for future generation to think higher and have a zero defect theory in their respective fields

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