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Six sigma strategy for world class quality – A case study

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ABSTRACT

Six Sigma methodology provides the techniques and tool to improve the capability and reduces the defects in any process. It concentrates on measuring product / service quality, reducing variation, driving improvements and saving the cost. The original application was to eliminate assembly line defects, but since then it has expanded into almost every corporate operation. Six Sigma is described as a philosophy, methodology and breakthrough strategy to solve the problems. There are many organizational examples (mainly USA and UK based) of large scale improvements in defects and process measures attributed to this approach. Six Sigma methodology improves any existing business process by constantly reviewing and returning the process. To achieve this, Six Sigma uses a methodology known as DMAIC (Define opportunity, Measure performance, Analyze opportunity, Improve performance, Control performance). Six Sigma strives for perfection. It allows for only 3.4 defects per million opportunities for each product or service transaction for world class quality. Six Sigma relies heavily on statistical techniques to reduce defects and measure quality. The aim of this paper is to explore the possibilities of the implementation of Six Sigma strategy to the book publishing industries in India, which is not very old and not as advanced as in developed nations.

Key words : Ashwagandha, Chakka, Shrikhand, Chemical quality

In developing countries like India, economy is based on agriculture which accounts for 60 to 80% of their GNP (Gross National Product) and their industries are in various stages of developments. Consequently, most producers are not aware of the benefits of the quality systems and their effects on profitability and long term growth. These substandard materials, when introduced into the manufacturing system adversely affect the quality of end product. Developed nations like USA, UK, Japan and Germany are working to attain 99.99997% defect free or even zero defect production by using TQM techniques. Six Sigma strategy is one of the technique which could be effectively implemented in any industry so as to get world class quality. Six Sigma quality strategy provides an overall framework for customer oriented, structured, systematic, productive and quantitative companywide approach for continuous improvement of manufacturing, services, engineering, suppliers and other business processes (Jam, 1998).

The quest to achieve Six Sigma had its birth at Motorola in 1979. Art Sundry's proclamation sparked a new era within Motorola. Bill Smith, an engineer at Motorola's communication sector presented paper (1985) concluded that if a product was found defective and corrected during the production process, other defects were bound to be missed and found later by the customer

during early use of the product. This means that the effort to achieve the quality really depends on detecting and fixing defects? Or could quality be achieved by preventing defects in the first place through manufacturing controls and product design?

Six Sigma would allow a business leader to be proactive, rather than reactive. Motorola was operating at nearly Six Sigma in many of its manufacturing operations and within four years, Six Sigma had saved the Company \$ 2.2 Billion. Six Sigma delivered more than \$300 million to General Electric's operating income and financial benefits of Six Sigma more than doubled to over \$600 million. Larry Bossidy, CEO of Allied Signal Inc. (1994), the cumulative impact of Six Sigma has been savings in excess of \$2 billion in direct cost. Daniel P. Burnham, CEO of Raytheon (1998), has made Six Sigma a cornerstone of company's strategic plan. GE'S, William Woodburn (1994) has increased the operations return on investment fourfold and cut the operation's in half by Employing the Six Sigma breakthrough strategy. Polaroid Corporation's Joseph.J. Kasabula believes, with Six Sigma, companies focus on the processes that affects the quality and profit margin on a project by project basis and Six Sigma helping Polaroid to add 6% to its bottom line each year. After the successful implementation of Six Sigma breakthrough strategy, Asea Brown Boveri (ABB) to its power

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transformer facility, has reduced measurement equipment error by 83%, piece count error from 8.3 to 1.3% and no load loss to within 2% and also improved material handling, resulting in an annual estimated cost savings of \$ 775000 for a single process within a single plant (Harry Mikel, 1998). In India, Wipro (1998-99) recorded saving of Rs.4.40 Crore during its first year of implementing Six Sigma. Godrej-GE brought down the defects to 1000 per million parts between Four and Five Sigma, which was previously at the rate of 3,00,000 for every million parts (Mankar, 2002).

The idiom, “An error is human” makes us to believe that an error is inevitable, thus we not only accept error, we anticipate it. The TQM techniques like Six Sigma when implemented in various industries could be handy in reducing cost, time, money and improving productivity and its quality to the world class level. As per our above discussion regarding various industries it is quite clear that, how Six Sigma strategy could be beneficial in almost in every aspect (Jam, 1998).

What is six sigma?:

The term Sigma is taken from Greek alphabet is the standard deviation used to designate the distribution or spread of any process. A Sigma quality level offers an indicator of how often defects are likely to occur in the process considered where Sigma levels and corresponding defect levels are as derived from standard probability curve for an organizational process. Process capability is defined as the probability of a product or service meeting customer requirements. The process capability index is defined as allowable process spread over actual process spread. Thus $C_p = (USL - LSL) / 6\sigma$ where USL and LSL are the Upper Specification Levels and Lower Specification Levels (Fig. 1 adapted from Pande *et al.*, 1999). A three Sigma process (normally distributed) gives a C_p of 1.0 with 66,807 defective parts per million (see list in Fig. 1). In contrast, a Six Sigma process will give a rate of only 3.4 ppm outside the limits. The higher the Sigma level, the less likely a

process is to create defective parts.

Note: Sigma 2 level- 308537 ppm; Sigma 3 level- 66807 ppm; Sigma 4 level- 6210 ppm; Sigma 5 level- 233 ppm; Sigma 6 level- 3.4 ppm; all in terms of defects, part per million, ppm. Thus, the term “Six Sigma” has been developed as an actual and aspirational quality measure for organization process (a ‘good’ organization usually being ‘four sigma’, for the majority of its main business processes (Chala Pathi, 2003), where the key measure is that of defects. Therefore, the main theme of the Six Sigma is that of focusing on measuring and reducing variability in processes and hence reducing the number of defects.

It is important to understand that Six Sigma is performance target that applies to a single critical to quality characteristics (CTQ), not to the total product. When an automobile is described as “Six Sigma”, this does not mean that only 3.4 automobiles out of a million will be defective but Six Sigma means that within a single automobile, the average opportunities for a defect of CTQ characteristics only 3.4 defects per million opportunities. So, rather than stating that, a product is Six Sigma, we say that the average opportunity for non-conformance within a product is Six Sigma. The basic objective of Six Sigma is not only to reduce the number of defects but also to increase the profit margins by reducing the cost of poor quality (COPQ). The cost of poor quality is composed of cost due to failure, appraisals and prevention. The COPQ is very high at lower Sigma level of quality.

Six Sigma has both management and technical components. On the management side it focuses on getting the right process metrics and goals, the right people to work on the projects and use of management systems to successfully complete the projects and sustain the gains over time. On the technical side the focus is on enhancing process performance (improving the average level of performance and reducing variation) using process data, statistical thinking and methods and a disciplined and focused process improvement methodology. Six Sigma places a clear focus on getting bottom line results. Identification of the business impact is part of the methodology. No Six Sigma project is approved unless the bottom line impact has been identified. Bottom line impact gets the attention of top management for, as Juran has pointed out, their language is money. In today’s competitive world, focusing on the customers, absolutely essential for the business growth and prosperity. If we are not able to satisfy all the stated and implied needs of the customers with respect to quality, price and delivery, we will not be able to sustain in the market. Thus Six Sigma strategy is very essential for continuous improvements in quality and cost goes down resulting in

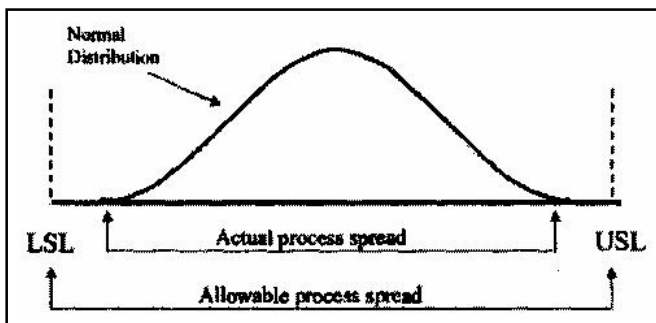


Fig. 1 : Statistical classification of Six Sigma

improved customer satisfaction (Mankar, 2002).

Six sigma methodology:

Poor quality costs amount to 20 to 30% of a company's revenues. Six Sigma improvement activities should be carried out in a project form. The prioritization and selection of project to be worked is vital to the success. Six Sigma is primarily a methodology for improving the capability of business processes by using statistical methods to identify and decrease or eliminate process variation. Its goal is defect reduction, elimination and improvement (Rodey McAdam and Brendan, 2004). The methodology which is used in applying the Six sigma are called "Breakthrough Strategy". Breakthrough strategy which consist of eight fundamental steps. These eight steps are as follows

- Recognize
- Define
- Measure
- Analyze
- Improve
- Control
- Standardize
- Integrate

The eight primary components of the Breakthrough strategy fall into one of the four categories.

The Recognize and Define phases fall under the category of Identification, where companies begin to understand the fundamental concepts of Six Sigma and get a sense of the Breakthrough Strategy as problem-solving methodology with a unique set of tools. In Define phase, Black Belts identify Six Sigma projects, based on product process benchmarking. Identification allows companies to recognize how their processes affect profitability and then define what the critical-to-business processes are.

The measure and analyze phases fall under the category of Characterization, where critical-to-quality characteristics in the process are measured and described. Following the measure and analyze phases that make up characterization, an action plan is created to close the gap between how things currently work and how the company would like them to work in order to meet the company's goals for a particular product or service.

In characterization, Six Sigma Black Belts select one or more of the products key characteristics and create a detailed description of every step in a process. The Black Belts then makes the necessary measurements, records the results on process control cards and the estimate what the short-term and long term process capability is? The improvement and control phases fall under Optimization, because these two phases maximize and maintain the

Table 1 : What are the values of a Six Sigma to an organization?

Issue	Classical focus	Six Sigma Focus
Analytical perspective	Point estimate	Variability
Management	Cost and time	Quality and time
Manufacturability	Trial and error	Robust design
Variable search	One-factor-at-a-time	Design of experiments
Problems	Fixing	Preventing
Problem solving	Expert based	System based
Analysis	Experience	Data
Focus	Product	Process
Behavior	Reactive	Proactive
Suppliers	Cost	Relative capability
Reasoning	Experience based	Statistical based
Outlook	Short-term	Long-term
Decision making	Intuition	Probability
Process adjustment	Tweaking	Statistical process-control charts
Approach	Systematic	Problematic
Design	Performance	Producibility
Aim	Company	Customer
Organization	Authority	Learning
Training	Luxury	Necessity
Chain-of-command	Hierarchy	Empowered teams
Direction	Seat of pants	Benchmarking
Goal setting	Realistic	Reach out and stretch
People	Cost	Asset
Control	Centralized	Localized
Improvement	Automation	Optimization

enhanced process capability. Optimization identifies what steps need to be taken to improve a process and reduce the major sources of variation. Using the various analysis, Black Belt determines which variables have the most leverage or exert the most influence. The final goal of the optimization in the Breakthrough Strategy is to use the knowledge gained to improve and control a process. This provides the organizations ultimately to improve profitability and customer satisfaction.

The Standardize and Integrate phases that makes up Institutionalization, address the integration of Six Sigma into the way the business is managed on a daily basis. As companies improve the performance of various processes, they should standardize the way those processes are run and managed. The integrate phase modifies the organization's managements processes by taking

advantage of the best practices identified through Six Sigma projects to support overall Six Sigma philosophy. Six Sigma applies to every level of organization. Almost every organization can be broken down into three basic levels. The highest level, the umbrella of a corporation, is the business level. The second level is operations level. The third level is the process level. While the Breakthrough Strategy applies to each level of company; at each level it achieves different, although complementary results (Mankar, 2002).

Six sigma players:

The success of Six Sigma project depends on the role played by the team members, who are:

- (a) Executive Leader (Involve in committing resources and sponsoring the project)
- (b) Master Black Belt (Training and coaching)
- (c) Black Belt (Lead improvement projects)
- (d) Green Belt (Support and run projects)
- (e) Champion (Involve in supporting the projects).

Master Black Belts (MBB's) provide training and support for both Black and Green Belts. Black Belts (BB) and Green Belts (GB) holders conduct the improvement projects. MBB and BB holders are full time improvement specialists having obtained four weeks training over a four-month period. GB holders are part time improvement specialist and retained their previous job duties. They receive two weeks training over a two-month period. Executive Leaders establish the strategic focus of a Six Sigma programme. Champions take their company's vision, missions, goals and metrics and translate them for individual projects. The Executives and Champions keep the programme moving in a planned direction. Executives attend a one- day executive training session. Champions receive one week of training (Dedhia, 2005).

Benefits:

A number of benefits are realized when the six sigma process is applied in a systematic way. A huge financial pay off is realized within a short period of time. Some of these benefits are:

Decreased work-in-progress:

Bottlenecks are removed and work flow smoothly in the line, thereby reducing in process inventory. Equipments and tools are utilized efficiently with decreased work-in-progress. There is no wait in line.

Improved capacity and output:

Due to decrease WIP, more can be produced and shipped. Improved customer satisfaction and Process flow:

On-time shipping and on-time delivery of goods will make customers happy.

Improved inventory turns:

With decrease in WIP and improved outputs, product will move faster out the door. There will be fewer inventories of raw material and finished product.

Increased productivity:

Productivity increased is realized when equipment and tools are running at capacity and wastage is reduced.

Reduced cycle time:

From the start to finish, a job can be done in the prescribed time. Waiting is removed from the operation.

Accelerate the rate of improvement:

The competitor who improves the fastest is likely to win the race. Six sigma helps to accelerate the improvements by borrowing the tools and ideas from many disciplines.

Attention to all business process:

Six sigma not only works in service quality but also pays more attention towards in all business processes. The six sigma has the potential to be more "Total" than total quality.

Executes strategic change:

Introducing new products, launching new ventures, entering new markets, acquiring new organizations- what were once occasional business activities are now daily events in many companies.

Organizational learning:

Giving employees access to knowledge and information systems encourages organizational learning. Personal developments and learning is also a key feature (Dedhia, 2005).

Application of six sigma - a case study:

Traditionally organizations compare current performance with past performance, not with what might have been or what is yet to be. Six Sigma tears down the structures that protect existing system. The Breakthrough Strategy give organization a road map to business situations not yet on the horizon or issues that are so unprecedented that there no time to learn by trial and error.

The Six Sigma Breakthrough Strategy broadens the definition of quality to include economic value and practical utility to both the company and the customer. The quality

of product comprises several engineering and manufacturing characteristics. So first define what is a characteristic?

- A dimension is a characteristic
- A chemical property is a characteristic
- A sensor property is a characteristic.

All these characteristics contribute towards the quality of the product.

Each of these characteristic is like a building block that goes into the construction of say, an arch, which may be considered to be quality as shown in the fig. 3

Now we consider the case of quality of book, as the problem.

Area of study:

Book and its Quality.

Objective:

The books publishing industries in India in technical education is not very old and not so advanced as in developed nations. The quality of published books is one of the measures of standard it is subscribing. The publishers do not know the factual status of quality that he is printing. However, he may be getting feedback from readers from time to time. It is therefore, worthwhile to take this project as a case study and reveal the status of quality of the book publisher by different publishers.

Six Sigma is a quality strategy which when implemented, discovers the quality level in terms of opportunity of defects per million units. The Six Sigma

quality level is 3 to 4 defects per millions of units.

Reasons for selection of area:

Readers can't relish errors of types in that they purchase for reading. Such defects of type are irritating to the readers, resulting in disgusting attitude towards the publishers. This results in a great loss of market share of the books. Therefore, it is considered worthwhile to study and discover the quality status of publications.

Tata McGraw Hill publishing company Ltd., 7, West Patel Nagar, NewDelhi- 110008.

CTQ Name: - Typographic quality

CTQ Measure: - No. of typographical mistakes.

CTQ Specification: - Zero typographical mistakes.

Defect: - Any typographical mistakes.

Unit: - A word.

Opportunity: - Words per book.

Following data is found after study:

Total Defects = 05 typographical mistakes.

Units = (2250 words / page x 500 page /book) = 11.25.000

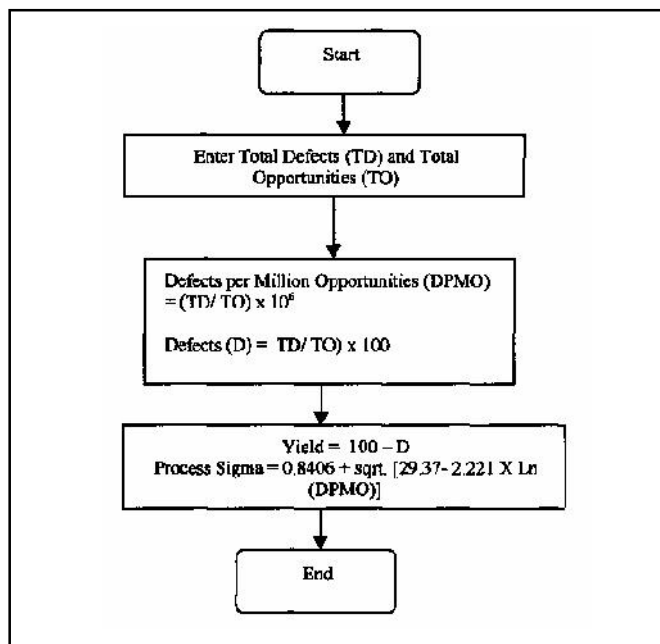


Fig. 2 : Flow chart for process sigma calculation

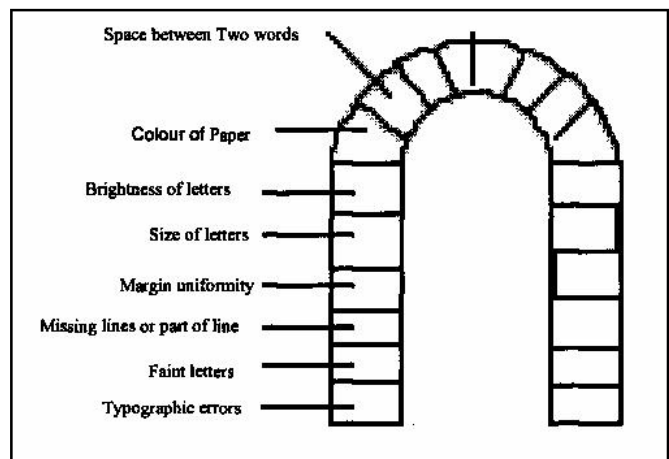


Fig. 3 : Arch of quality for book

Opportunities = One / word.

Total Opportunities = 11,25,000.

Now by using Process Sigma calculator, we get following result.

Therefore Process Sigma = 5.94 hence by considering different CTQ names like faint letters which are not legible, missing lines and margin size, process sigma can be calculated as 5.59, 4.54 and 3.69, respectively by using the same method used previously (Mankar, 2002).

Conclusion:

The book publishing company Tata McGraw Hill may have millions of readers or less depending upon the

popularity and importance of book published and authorship. A reader when buy a book, in general a novel, a fiction or a technical book, expects without any reservation zero mistakes of typographic nature, tolerably some mistakes of printing such as faint letters which are not legible, missing lines or part of line. The number of such mistakes, if falls within six sigma limit *i.e.* 3-4 parts per million may be considered as tolerable.

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