

TOTAL QUALITY MANAGEMENT: A STUDY ON SIX SIGMA TOOLS AND PRACTICES

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ABSTRACT

Six Sigma methodologies have been found as a best potent Quality Improvement Technique. To attain almost zero defects process, it practices both Statistical and Non Statistical Quality tools. The aim of this paper is to get a strong understanding of the 6σ practices, philosophies and concepts. This paper seeks to deliver the most recent qualitative findings to achieve a successful implementation. We discuss the six sigma implementation strategies and the similarities and differences between them. The paper also discusses on various 6σ training and certification levels. Finally the paper concludes with the application of 6σ Methodology in various fields such as finance, marketing, operation and also its role in achieving sustainability.

Keywords: Quality tools, Quality Control, Six Sigma, Sustainability and Total Quality Management.

TOTAL QUALITY MANAGEMENT(TQM):

It is defined as "a management philosophy and company practices that aim to harness the human and material resources of an organization in the most effective way to achieve the objectives of the organization"(BS 7850-1, 1992)

Joseph Juran, and Edwards Deming, Armand Feigenbaum were the main contributors to Total Quality management Concept (How to Built Quality, 1989). Due to their success, many adopted their ideas. In Japan, these concepts were accepted readily and they introduced annual prize, Deming Prize, for the excellence in manufacturing (Total Quality Management). The Six Sigma concept was based on Statistical Process Control (Anand, Ward, & V. Tatikondac, 2010). In Motorola it is introduced to decrease defects or errors by reducing the variation in the processes (Kumar & Gupta, 1993).

The approach in Six Sigma and TQM is different (Six Sigma vs Quality management). TQM is a continuous team approach, in which all the employees of the company participate for the overall improvement (Total Quality Management).

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“The common TQM practices are the following:

1. Customer-focused
2. Total employee involvement
3. Process-centered
4. Integrated system
5. Strategic and systematic approach
6. Continual improvement
7. Fact-based decision making
8. Communications

1. Customer-focused:

The customer ultimately determines the level of quality. No matter what an organization does to foster quality improvement—training employees, integrating quality into the design process, upgrading computers or software, or buying new measuring tools—the customer determines whether the efforts were worthwhile.

2. Total employee involvement:

All employees participate in working toward common goals. Total employee commitment can only be obtained after fear has been driven from the workplace, when empowerment has occurred, and management has provided the proper environment. High-performance work systems integrate continuous improvement efforts with normal business operations. Self-managed work teams are one form of empowerment.

3. Process-centered:

A fundamental part of TQM is a focus on process thinking. A process is a series of steps that take inputs from suppliers (internal or external) and transforms them into outputs that are delivered to customers (again, either internal or external). The steps required to carry out the process are defined, and performance measures are continuously monitored in order to detect unexpected variation.

4. Integrated system:

Although an organization may consist of many different functional specialties often organized into vertically structured departments, it is the horizontal processes interconnecting these functions that are the focus of TQM. Micro-processes add up to larger processes, and all processes aggregate into the business processes required for defining and implementing strategy. Everyone must understand the vision, mission, and guiding principles as well as the quality policies, objectives, and critical processes of the organization. Business performance must be monitored and communicated continuously. An integrated business system may be modeled after the Baldrige National Quality Program criteria and/or incorporate the ISO 9000 standards. Every organization has a unique work culture, and it is virtually impossible to achieve excellence in its products and services unless a good quality culture has been fostered. Thus, an integrated system connects business improvement elements in an attempt

to continually improve and exceed the expectations of customers, employees, and other stakeholders.

5. Strategic and systematic approach:

A critical part of the management of quality is the strategic and systematic approach to achieving an organization's vision, mission, and goals. This process, called strategic planning or strategic management, includes the formulation of a strategic plan that integrates quality as a core component.

6. Continual improvement:

A major thrust of TQM is continual process improvement. Continual improvement drives an organization to be both analytical and creative in finding ways to become more competitive and more effective at meeting stakeholder expectations.

7. Fact-based decision making:

In order to know how well an organization is performing, data on performance measures are necessary. TQM requires that an organization continually collect and analyze data in order to improve decision making accuracy, achieve consensus, and allow prediction based on past history.

8. Communications:

During times of organizational change, as well as part of day-to-day operation, effective communications plays a large part in maintaining morale and in motivating employees at all levels. Communications involve strategies, method, and timeliness.

These elements are considered so essential to TQM that many organizations define them, in some format, as a set of core values and principles on which the organization is to operate" (Westcott, 2013).

SIX SIGMA:

Motorola introduced the 6σ concept in the late 1980s. Since then many firms are implementing it. The Six Sigma can be used as a Metric, Methodology and Management System (Ansari, Lockwood, Thies, Modarress, & Nino). During manufacturing, as a metric, the errors or defects rate is equal or less than 3.4 defects per one million (Ansari, Lockwood, Thies, Modarress, & Nino). The 6σ methodology can be used to confirm that improvement efforts developed are aligned with the company's strategies (Ansari, Lockwood, Thies, Modarress, & Nino). The 6σ as a Methodology, concentrating and managing on the requirement and expectations of customers', results in the improvement in business of the company (Rudisill & Clary, 2004) (Brewer & Eighme, 2005).

"To put it simply, Six Sigma uses statistical methods to achieve an almost defect-free process. If the distance between the mean of a process and the closest specification limit (a boundary set by the customer) is six standard deviation units, then the process is considered a *six sigma process*. The manufacturing sector was the first to integrate six sigma practices into its daily activities, as it involves many highly complex processes that can be easily measured. However, as project managers and Six Sigma leaders became aware of the program's success in

cutting costs in manufacturing, companies began to implement the concept in other areas of business such as information management (IM) and finance”(Galloway, 2009).

The 6 σ is data-rich, process-oriented environments; hence it can be used in many service sectors like Finance, Information Management without making much change in those departments (Pestorius, 2007). “Not until recently has Six Sigma pushed its way into the transactional process arena: sales and Marketing”(Galloway, 2009). The reasons for this delay are:

- (1) Easy to implement in other areas
- (2) Strong backgrounds of professionals in other areas
- (3) Purchasing has been good for the last many years
- (4) As marketing is considered as an art, it could not be combined with six sigma as it is considered as a scientific concept (Pestorius, 2007).

In 6 σ concept, the activities carried out in those departments, such as marketing & sales are needed to be considered as one whole process than a simple result (Webb, 2006). “The 6 σ takes away the “gut feeling” approach that is too often used in managerial decision making and replaces it with business decisions based on cold, hard data. In other words, Six Sigma is a process used to improve a process”(Galloway, 2009).

In India, among the companies, 6 σ is first adopted by Wipro (Sharma, Pandla, & Gupta). The industry average of project completion on schedule is 55% where as in Wipro; it is 91% (Sharma, Pandla, & Gupta).

The Five Six Sigma Phases (DMAIC):

“The Six Sigma methodology is conceptually rooted in the principals of a five phase project. Each phase has a specific purpose and specific tools & techniques which aid in achieving the phase objectives. When properly followed, these 5 project phases will almost always lead the Six Sigma professional to significant conclusions. The five phases are the following:

1. Define Phase
2. Measure Phase
3. Analyze Phase
4. Improve Phase
5. Control Phase

1. Define Phase:

Goals:

The goal of Define is to establish the projects foundation. This is arguably the most important aspect of any Six Sigma project. All successful projects start with a current state challenge or problem that can be articulated in a quantifiable manner. Additionally, it is not enough to determine the goal. Once problems and goals are identified and quantified the rest of

the define phase will be about valuation, team, scope, project planning, time line, stakeholders, VOC/ VOB etc.

Tools:

- Project Charter
 - Problem Statement
 - Business Case
 - Objective
 - High level time line
 - Project Scope
 - Project Team
- Stakeholder Assessment
- Pareto Charts
- SIPOC
- VOC/VOB & CTQ's
- High Level Process Map

2. Measure Phase:

Goals:

The goal of the Measure phase is to gather baseline information about your process or product. Following objectives can be achieved throughout the measure phase:

- Gather All possible x's and y's
- Analyze your measurement system & Data Collection Requirements
- Validate Assumptions
- Validate Improvement Goals
- Determine COPQ
- Refine Process Understanding
- Determine Process Capability
- Process Stability

Tools:

- Any Appropriate Tool from Previous Phase
- Process Maps, Value Stream Mapping
- Failure Modes & Effects Analysis (FMEA)
- Cause & Effect Diagram
- XY Matrix

- Basic Control Charts
- Six Sigma Statistics
 - Basic Statistics
 - Descriptive Statistics
 - Normal Distributions
 - Graphical Analysis
- Measurement Systems Analysis
 - Variable Gage R&R
 - Attribute Gage R&R
 - Gage Linearity & Accuracy
 - Gage Stability
- Process Capability & Sigma
- Data collection plan

3. Analyze Phase:

Goals:

The Analyze phase is all about establishing verified drivers. In the Six Sigma methodology, Analyze uses statistics and higher order analytics to discover the fact-based relationship between the process performance and the x's (root cause). Ultimately, you must establish a hypothesis for your improvement solutions.

- Establish Transfer Function $Y=f(x)$
- Validated List of Critical X's & Impacts
- Beta Improvement Plan (e.g. Pilot Plan)

Tools:

- Any Appropriate Tool from Previous Phase
- Hypothesis Testing
- Simple Linear Regression
- Multiple Regression

4. Improve Phase:

Goals:

The goal of the Improve phase is to make the improvement. Improve is about designing, testing and implementing your solution.

- Statistically Proven Results from Active Study/Pilot

- Improvement/Implementation Plan
- Updated Stakeholder Assessment
- Revised Business Case with Investment ROI
- Risk Assessment/Updated FMEA
- New Process Capability & Sigma

Tools:

- Any Appropriate Tool from Previous Phase
- Design of Experiment (DOE)
- Implementation Plan
- Change Plan
- Communication Plan

5. Control Phase

Goals:

The last of the five core phases of the Six Sigma methodology is the Control phase. The goal of Control is establish automated and managed mechanisms to maintain and sustain your improvement. A successful control plan also establishes a reaction & mitigation plan along as well as an accountability structure

Tools:

- Control Plan
- Training Plans
- Poke-Yoke and/or Audit Plans
- Translation Plan - How can this be translated to others”(Parker, 2011)

Implementation and Impact of Six Sigma:

“The rapidly changing business environment of recent times has created an urgent need for an organized, structured way to foster innovation and creativity. The Six Sigma itself is not a radical concept, but rather the natural evolution of ideas that have been around since just after World War II. The need has always been there, of course, but accelerating growth and innovations in technology have increasingly made our competitors not the company next door, but the best company in the world, wherever it might be located”(Sage Consultants Limited).

“Six Sigma, with its emphasis on the training structure that creates a hierarchy of expertise within the organization (green belts, black belts, master black belts and so on) does exactly this –there has been little emphasis on the fact that for significant improvements to occur, it must be the specific job of some small group who can “take ownership” and push improvement activities through to a conclusion. Rigorous application of the Pareto Principle ensures that these activities satisfy the “So what?” test – they must concentrate on projects that will have

significant impact on organizational performance. The combination of the Six Sigma approach and the ideas of the Balanced Scorecard is a natural progression, the Six Sigma measurements giving a consistent way for organizations to think about and compare performance across quite disparate areas of organizational capability”(Sage Consultants Limited)

Strategies for Six Sigma Implementation:

“Since Six Sigma’s origin, many other organizations have defined their own Six Sigma process to improve organizational performance. The model or strategy used to deploy the 6 σ initiatives vary from organization to organization. In reality, there are as many strategies as there are companies implementing 6 σ . The concepts and tools also vary across organizations. It would be just as unreasonable to think a single deployment strategy would be effective across all organizations as it is to argue only one set of tools is needed regardless of process or product. While it is impossible to perfectly differentiate the many approaches to 6 σ training and improvement efforts, there seem to be three general categories of deployment strategies”(Sanders & Hild, 2000).

The 6 σ Organization Category is one among the three deployment strategies in which the individuals of diverse stages and diverse areas were trained in Six Sigma tools, techniques and concepts(Sanders & Hild, 2000). The 6 σ Engineering Organization is the second type where the engineering community is trained(Sanders & Hild, 2000). The Strategic selection is the third type in which strategically selected individuals are trained(Sanders & Hild, 2000).

Applications of Six Sigma:

Many companies, in service and manufacturing sectors, are using Six Sigma methodologies(Ansari, Lockwood, Thies, Modarress, & Nino). Through their experience the methodology is found very flexible to be applied in all functional areas of the business(Ansari, Lockwood, Thies, Modarress, & Nino).

1. Sales & Marketing:

In recent times, many companies apply 6 σ methodology to increase their sales and marketing activities(Ansari, Lockwood, Thies, Modarress, & Nino). The GE and Dow have been using the 6 σ methodology in their process of new product development and activities enhancing the customer support for improving the performance by reducing the cost(Maddox, 2004a). Many companies use this methodology to capture data related to market condition which eventually enable them to come up with the products and services that can fulfill the needs of the customer(Pestorius, 2007)(Rylander & Provost, 2006).(Pestorius, 2007)noted that it has the potential to improve the marketing and sales of the product and services of the company.(Rylander & Provost, 2006)suggests that the 6 σ Methodology will result in better customer support when it is used along with the online market research which eventually provide better customer satisfaction.

2. Accounting & Finance:

In accounting, the application of 6 σ Methodology give rise to the decrease in cycle time, reduction in the errors during the processing of invoice, and the optimized cash flow(Brewer & Bagranoff, 2004). A Six Sigma Methodology is developed and applied by a healthcare insurance provider in their accounting department for the improvement of the accuracy in the account withdrawal process(Ansari, Lockwood, Thies, Modarress, & Nino). Before to its implementation, a number of reconciliation check points & manual workflow was involved in the error rectification of the billing process, which ended in sixty percentage of account of customers being charged less than the due amount whereas about forty percentage being overcharged. After its application, the rate of defect went down to almost zero and cycle times decreased to three days from fourteen days(Stober, 2006).

Six Sigma is used by many companies in the finance to reduce the cycle time variability, costs, error rates and to increase the employees' productivity ratio(Brewer & Bagranoff, 2004)(McInerney, 2006). It is also used in the financial reporting to lessen the cycle time(Brewer & Eighme, 2005). For reducing the variability in financial reporting, improving the value of shareholders, decreasing time for closing the books can be achieved by the application of 6 σ Methodology in finance(Gupta, 2004).A longitudinal study conducted by (Foster, 2007) in comparing the companies who used the Six Sigma methodology and those who not used Six Sigma Methodology. It reveals that there was significant effect on assets turn over, free cash flows of companies who used the Six Sigma methodology over those not used.

Very few actual case studies revealed the major effect of 6 σ on financial activities and even it can change the way the financial activities performs(Ansari, Lockwood, Thies, Modarress, & Nino).

3. Sustainable Development:

It is defined as "Development that meets the needs of the present generation, without compromising the ability of future generations to meet their own needs"(WCED, 1987). The optimum use of resources with minimal/zero waste leads to a sustainable business entity. The Six Sigma Methodology is a best suitable way to achieve sustainability, as it helps to achieve supreme quality level of product and services, through reduced errors/defects.

4. Diverse Areas:

The application range of 6 σ Methodology is wide. Though it is widely used in production/manufacturing sectors and service sectors, it can be used in consumption process to eliminate the waste and thereby increasing the efficiency of the consumption process(Womack & Jones, 2005). It can be used to improve the quality of hardwood flooring process(Williams, 2001).

Certifications:

"The Six Sigma Certification confirms a level of training, practice, and capability with respect to specific competencies. Each Six Sigma certification level are different, each requires training, and each participant, called a "Belt", is required to have a leadership-approved project prior to Six Sigma certification training"(Global Knowledge).

The levels of Training & Certification are: a) Yellow Belt, b) Green Belt, c) Black Belt, d) Master Black Belt and each with its own responsibilities.

a) Yellow Belt:

It is the lowest level of certification(Aveta Business Institute). The person who has received this level of certification will have a basic level knowledge and training in Six Sigma(Aveta Business Institute). They will not be a part of the management for team(Aveta Business Institute)

b) Green Belts:

Those who received Green Belts certification will lead the projects along with other additional duties and greater responsibilities in comparison with the yellow level certification(Aveta Business Institute). “Green Belts allocate up to 50% of their time on Six Sigma projects”(Global Knowledge).

c) Black belt:

They are the fully trained professionals and considered as leaders and change managers(Aveta Business Institute). Maintaining this level of certification is very difficult(Aveta Business Institute). These trained professionals are required to share knowledge and work closely with the lower levels to take the team to success level(Aveta Business Institute). “Black Belts normally dedicate up to 75% of their time to Six Sigma projects, and they assist Green Belts as needed”(Global Knowledge)

d) Master Black Belts:

“The master or master black belt is a person who is at the highest level of expertise on the subject”(Aveta Business Institute). “Six Sigma Master Black Belts represents the highest level of technical and organizational proficiency. They have received six weeks of training on the Six Sigma methodology, and they've learned the skills and tools required to teach Six Sigma philosophies and implement Six Sigma within an organization. Master Black Belts lead all levels of Six Sigma projects, and they help Black Belts apply methodology when necessary. Their jobs are completely devoted to Six Sigma. Black Belt certification is necessary for Master Black Belt certification eligibility”(Global Knowledge).

Conclusion:

The 6σ is a continuous process for the improvement of quality by detecting errors and eliminating them. It helps to reduce the cost of production by eliminating the waste due to error/defects. It is a modern approach that completely revolutionizes a business' organization and culture, through the use of statistical and non-statistical methods with the aim of delighting the customer. Once properly implemented, its results are tremendous. It can be used in not only in manufacturing sectors but also in service sector as well. It can be applied for marketing, finance, human resource, new product development, etc. which improves the business processes.

Bibliography

How to Built Quality. (1989). *Economist*.

(1992). BS 7850-1. In *Total quality management - Part 1 Guide to management principles*.

Anand, G., Ward, P. T., & V. Tatikondac, M. (2010). Role of explicit and tacit knowledge in six sigma projects: An empirical examination of differential project success. *Journal of Operations Management*, 28(4), 303-315.

Ansari, A., Lockwood, D., Thies, E., Modarress, B., & Nino, J. (n.d.). Application of Six-Sigma in finance: a case study. *Journal of Case Research in Business and Economics* .

Aveta Business Institute. (n.d.). *Learn About Six Sigma Belts (Yellow, Green, Black, Master)*. Retrieved 2014, from SIX SIGMA ONLINE: <https://www.sixsigmaonline.org/six-sigma-training-certification-information/learn-about-six-sigma-belts-yellow-green-black-master/>

Brewer, P., & Bagranoff, N. (2004). Near zero-defect accounting with Six Sigma. *The Journal of Corporate Accounting and Finance*, 15(2), 67-70.

Brewer, P., & Eighme, J. (2005). Using Six Sigma to improve the finance function. *Strategic Finance*, pp. 27-33.

Foster, S. (2007). Does Six Sigma Improve Performance? *The Quality Management Journal*, 14(4), 7-19.

Galloway, R. M. (2009). Six Sigma Implementation: An Empirical Analysis of Critical Success Factors and Performance Outcomes.

Global Knowledge. (n.d.). *Six Sigma Certifications*. Retrieved 2014, from http://www.globalknowledge.com/training/certification_listing.asp?pageid=12&certid=610

Gupta, P. (2004). Six Sigma in finance and accounting: Inside Six Sigma. *Quality Digest*.

iSixSigma. (n.d.). *Six Sigma Project Charter (With Template)*. Retrieved 11 29, 2017, from iSixSigma: <https://www.isixsigma.com/images/stories/migrated/downloads/charter.pdf>

Kumar, S., & Gupta, Y. P. (1993). Statistical Process Control at Motorola's Austin Assembly Plant.

Maddox, K. (2004a). Marketers embrace Six Sigma strategies. *B to B*, pp. 1-32.

McInerney, D. (2006). Slashing product development time in financial service. *iSixSigma Magazine*, pp. 1-3.

Parker, M. J. (2011). *Six Sigma Methodology*. (Lean Sigma Corporation) Retrieved 2014, from SIX SIGMA DIGEST: <http://www.sixsigmadigest.com/six-sigma-methodology.shtml>

- Pestorius, M. (2007). Apply Six Sigma to sales and marketing. *Quality Progress*, 40(1), pp. 19-25.
- Pestorius, M. (2007). Applying the Science of Six Sigma to the Art of Sales and Marketing. *Milwaukee: ASQ Quality Press*.
- Rudisill, F., & Clary, D. (2004). The management accountant's role in Six Sigma. *Strategic Finance*, pp. 35-39.
- Rylander, D., & Provost, T. (2006). Improving the odds: Combining Six Sigma and market research for better customer service. *SAM Advanced Management Journal*, 13-19.
- Sage Consultants Limited. (n.d.). *Six Sigma: Implementation and Impact*. Retrieved 2013, from The Strategic Quality Management Newsletter:
http://www.sqm.co.nz/material/SageNote_SixSigma_2.pdf
- Sanders, D., & Hild, C. (2000). A DISCUSSION OF STRATEGIES FOR SIX SIGMA IMPLEMENTATION. *Quality Engineering*, 12(3), 303-309.
- Sharma, D. M., Pandla, D. K., & Gupta, P. P. (n.d.). *A Case Study on Six Sigma at Wipro Technologies: Thrust on Quality*.
- Six Sigma vs Quality management*. (n.d.). Retrieved 2010, from <http://www.pmhut.com/six-sigma-vs-total-quality-management>
- Stober, M. (2006, July). Account withdrawal accuracy project example. *iSixSigma Magazine*.
- Total Quality Management*. (n.d.). Retrieved from www.en.wikipedia.org/wiki/total_quality_management
- WCED, W. C. (1987). *Our common future*. Oxford University Press.
- Webb, M. J. (2006). *Sales and Marketing the Six Sigma Way*. Chicago: Kaplan Publishing.
- Westcott, R. T. (Ed.). (2013). *The Certified Manager of Quality/Organizational Excellence Handbook* (4 ed.). ASQ Quality Press.
- Williams, T. N. (2001). *A Modified Six Sigma Approach to Improving the Quality of Hardwood Flooring*.
- Womack, J. P., & Jones, D. T. (2005). *Lean Solutions: How Companies and Customers Can Create Value and Wealth Together*. Free Press.