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A SHORT OVERVIEW ON SIX SIGMA

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Abstract: *To face consumer's expectations companies are implementing new kind of strategies or management concepts that should lead to better quality products with the lowest possible manufacturing cost. Six Sigma is adopted, generally by organizations who reached a certain maturity regarding quality and quality management in order to enhance their performances. Six Sigma management methods include TQM, a stronger customer focus, additional data analysis tools, financial results and project management. From the statistical point of view, applying Six Sigma assume having a success rate of 99.9997% where sigma is a term used to represent the variation about the process average.*

Key words: *Six Sigma, Total Quality Management, differences.*

1. Introduction

Nowadays consumer's expectations are in a continuous growing. They require perfect products and they are defining perfection by several characteristics, such us: price, quality, performance, appearance, package etc. To face consumer's expectations companies are implementing new kind of strategies or management concepts that should lead to better quality products with the lowest possible manufacturing cost. Such methods that are today very popular among specialists are Just-In-Time and pull production, Lean Manufacturing or 'Lean Thinking', 5S, Kanban, Total Productive Maintenance, Total Quality Management, Six Sigma [1] etc.

The present paper intends to illustrate and clarify the main principles that Six Sigma involves and to emphasize the connection and differences between Six Sigma and Total Quality Management. Other authors have also tried to express the fact that although the tools and techniques in Six Sigma are strikingly similar to prior approaches to quality management, it provides an organizational structure not previously seen [12].

2. Discussion on Six Sigma and TQM

The Six Sigma method is a project-driven management approach to improve the organization's products, services, and processes by continually reducing defects in the organization. It is a business strategy that focuses on improving customer requirements understanding, business systems, productivity, and financial performance [9].

The specifics of the Six Sigma method were first formulated by Bill Smith at Motorola in 1986 after the moment when Motorola established a goal of 99.99966%

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free of defects products, equaled to the statistical six sigma, for all of its manufacturing operations [6]. Six Sigma was inspired from quality improvement methods (quality control, TQM - Total Quality Management, zero defects) and based on the work of several pioneers in the field such as: Shewhart, Deming, Juran, Ishikawa, Taguchi and others.

Six Sigma uses a structured method patterned after Deming's PDCA (Plan-Do-Check-Act) cycle, which can be either the DMAIC (define, measure, analyze, improve, control) method used for the improvement of an existent process, or the DMADV (define, measure, analyze, design, verify) method used to create new processes for new products [10], [15].

Six Sigma metrics are used to set improvement goals [13]. Using objective data should reduce corporate use of political agendas to drive solutions. Using explicit, challenging goals in Six Sigma projects can increase the magnitude of improvements, reduce performance variability of the projects, and increase employees' improvement efforts and commitment to quality. Moreover, Six Sigma integrates business-level performance, process measures, and project metrics into a systematic review process so that managers can manage the organization quantitatively and translate the business strategy into tactical tasks [13].

An overview of Six Sigma tools and processes is shown in Figure 1.

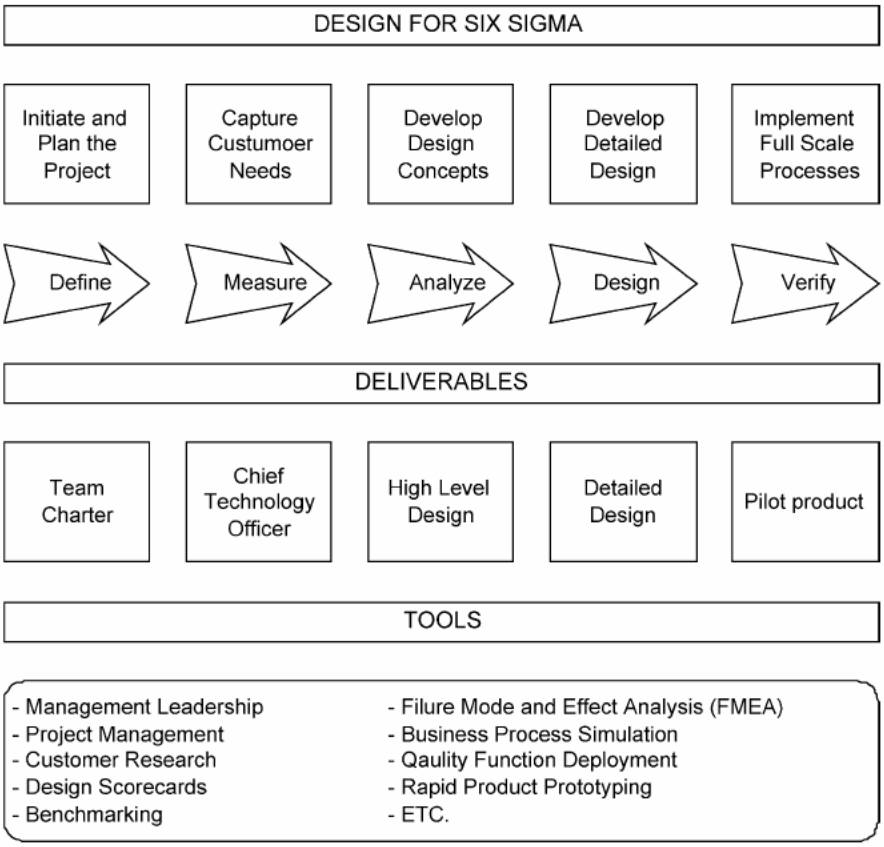

Fig. 1. *Schematic representation of Six Sigma* [9]

Six Sigma uses a group of improvement specialists, typically referred to as champions, master black belts, black belts, and green belts [8], [10], [13]. These specialists go through intensive trainings designed to improve their knowledge and skills in statistical methods, project management, process design, problem-solving techniques, leadership skill, and other managerial skills [13].

The six sigma method includes measured and reported financial results, uses additional, more advanced data analysis tools, focuses on customer concerns, and uses project management tools and methodology [9]. Six Sigma management methods can be summarized as follows:

Six Sigma = TQM + Stronger Customer Focus + Additional Data Analysis Tools + Financial Results + Project Management [3].

It is known that Six Sigma is adopted, generally by organizations who reached a certain maturity regarding quality and quality management in order to enhance their performances. Such organizations have been the subject of many papers [2], [7], [11], between them: 3M's Dental Division, Ford, Honeywell, American Express, General Electric [12].

The key ingredients for the effective introduction and implementation of Six Sigma in manufacturing and services organizations are [4]:

- Management commitment and involvement;
- Understanding of Six Sigma methodology, tools, and techniques;
- Linking Six Sigma to business strategy;
- Linking Six Sigma to customers;
- Project selection, reviews and tracking;
- Organizational infrastructure;
- Cultural change;
- Project management skills;
- Liking Six Sigma to suppliers;
- Training;
- Linking Six Sigma to human resources.

Other authors [12] suggest that Six Sigma should be viewed as an "organization change process and this might provide improved ways for implementation of the Six Sigma process and a more enlightened analysis of what needs to be changed. It might also improve management of the change management process itself".

From the statistical point of view, the term six sigma is defined as having less than 3.4 defects per million opportunities or a success rate of 99.9997% where *sigma* is a term used to represent the variation about the process average. If an organization is operating at three sigma level for quality control, this is interpreted as achieving a success rate of 93% or 66.800 defects per million opportunities. Therefore, the Six Sigma method is a very rigorous quality control concept where many organizations still performs at three sigma level [6].

The main differences between Six Sigma and TQM as shown by *Schroeder et al.* are [12]:

a) The focus on financial and business results as Six Sigma usually requires financial returns from most projects and from each full-time Six Sigma specialist. The financial focus is at the project level, in contrast to being on the organizational level in TQM.

b) The intense training of the full-time specialists and the full integration of statistical and nonstatistical tools are unique.

c) Use of specific metrics. Six Sigma requires a disciplined approach toward measurement and improvement that has not been evident in previous quality improvement efforts. Six Sigma metrics also help ensure a customer focus when engaging in process improvement efforts.

d) The use of a significant number of full-time improvement specialists in Six Sigma.

In the past, organizations were reluctant to make the investment in full-time specialists

and often assigned improvement tasks to already overworked staff on a part-time basis.

3. A Theoretical Implementation Model and Real Cases Benefits of Six Sigma

One of the reasons that cause a Six Sigma implementation program to fail is the lack of some theoretical models. Therefore, some authors tried to establish such models to guide the implementation programs. Figure 2 shows the Six Sigma implementation model recently proposed by *Satya S. Chakravorty*. The first four steps were: Strategic Analysis; Form High-Level Cross-Functional Team; Establish Improvement Tools; and Perform high-Level Process Mapping and Prioritization of Improvement Opportunities. These steps were considered strategic decisions, implying a top down approach, where management was primarily involved in decision making. Last two steps were: Detailed Plan and Form Low-Level Improvement Teams; and Implementation, Documentation, and Revision. These steps were considered tactical decisions implying bottom up approach where engineers or technicians were primarily involved in decision making [5].

Adopting and correctly implementing Six Sigma can definitely bring the expected results, not only in the manufacturing sector but also in the financial sector. Typical six sigma projects in financial institutions include improving accuracy of allocation of cash to reduce bank charges, automatic payments, improving accuracy of reporting, reducing documentary credits defects, reducing check collection defects, and reducing variation in collector performance [9]. Table 1 summarizes some organizations projects, benefits, improvements, and savings

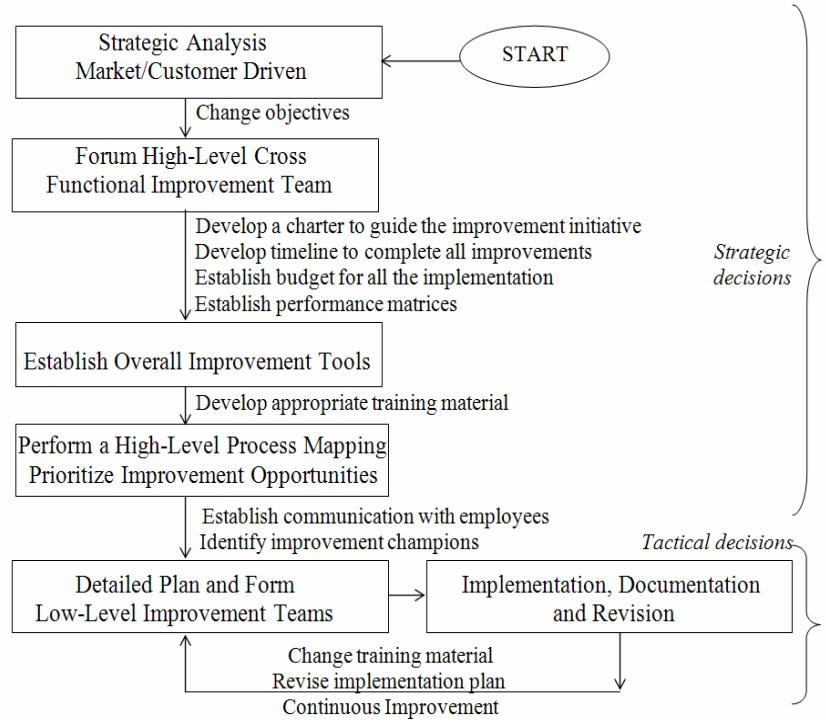

Fig. 2. *Six Sigma implementation models* [5]

Reported benefits and savings from Six Sigma in manufacturing sector [9] Table 1

Company/project	**Metric/measures**	**Benefit/savings**
Motorola (1992)	In-process defect levels	150 times reduction
Raytheon/aircraft integration systems	Depot maintenance inspection time	Reduced 88% as measured in days
GE/Railcar leasing business	Turnaround time at repair shops	62% reduction
Allied signal (Honeywell)/laminates plant in South Carolina	Capacity Cycle time Inventory On-time delivery	Up 50% Down 50% Down 50% Increased to near 100%
Allied signal (Honeywell)/ bendix IQ brake pads	Concept-to-shipment cycle time	Reduced from 18 months to 8 months
General electric	Financial	$2 billion in 1999
Motorola (1999)	Financial	$15 billion over 11 years
Dow chemical/rail delivery project	Financial	Savings of $2.45 million in capital expenditures
DuPont/Yerkes plant in New York (2000)	Financial	Savings of more than $25 million
Telefonica de espana (2001)	Financial	Savings and increases in revenue 30 million euro in the first 10 months
Texas instruments	Financial	$ 600 million
Johnson and Johnson	Financial	$ 500 million
Honeywell	Financial	$1.2 billion

by implementing the Six Sigma process as presented by *Young Hoon Kwak and Frank T. Anbari*.

An important factor that must be considered for a successful implementation of Six Sigma is the cultural aspect. In general, organizational culture represents the pattern of values, beliefs, and assumptions shared by members in an organization [14]. People facing cultural change and challenges due to the implementation of Six Sigma must firstly understand the change. This requires having a clear communication plan and channels, motivating individuals to overcome resistance, and educating senior managers, employees, and customers on the benefits of Six Sigma. Announcing the results of Six Sigma projects including successes, obstacles, and challenges will help future projects to avoid making similar mistakes and adopt only the very best practices [9], [14].

4. Conclusions

Even if at a first look Six Sigma can appear very similar to previous quality management approaches, organizations holding records in terms of quality adopted Six Sigma and admitted that it totally transformed their processes. Six Sigma is always applied after a previous total quality management approach.

The aim of this paper was to present the main principles of Six Sigma and to highlight that although there is a criticism that Six Sigma simply puts traditional quality management practices in a new package, the concept must be taken as a structured methodology for improving quality of products and processes. Also, it was shown that the main relation between TQM and Six Sigma is that Six Sigma implies TQM together with a stronger customer focus, an additional data analysis tools, financial results and project management methods.

The success of Six Sigma practices depend also on the organizational culture, therefore must be considered that cultural changes require time and commitment.

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