

## Total Quality Management vs. Six Sigma

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**Abstract:** Quality assurance models are an essential factor for the successful completion of all activities. There is a growing global interest in identifying quality models, both in general and in education. The purpose of this paper is to analyze the characteristic elements of total quality management (TQM). TQM represents an integrated effort meant to improve the quality of each level of the organization. The historical evolution of the total quality management comprises four steps: quality inspections, quality control, quality assurance and, finally, the TQM process itself. Quality is obvious in human actions. The goal of the Six Sigma strategy is to increase an organization's profit by eliminating variability, reducing the number of defects and eliminating losses, which removes the consumer and harms the organization. The term Six Sigma is derived from the field of statistics, because  $\sigma$  represents the standard deviation. This model helps organizations improve the quality of their products and services to meet customer needs.

**Background:** Quality assurance models are effective tools at the level of institution management, in general, but also at the level of educational institutions, provided they are correctly implemented. The statistical control through inspections, the post-production effort of separating the functional and non-functional products, have led to a particular order of these steps. The selection should be carried out before beginning the development of the product. The development of control charts and the acceptance of survey methods in the period between 1924-1931 (Stewhart and Dodge-Romig) obviously helped, during the time, the inspection related prosperity of the field. During the Second World War, system production became a complex process and, thus, quality came to be analyzed by the means of inspections; the act was carried out much more efficiently when the workers' analysis was applied. Six Sigma referred to the possibility of manufacturing processes to produce a very high proportion according to specifications. In the field of quality management,  $\sigma$  represents the percentage of products without defects.

**Materials and Methods:** An analysis of representative models in terms of quality management is appropriate. The analysis of the models is based on several coordinates: identifying the characteristic elements, exploring the ways of capitalizing on the models at the level of the institution, highlighting the advantages and disadvantages. In the third step, that of quality assurance, there is a strategy analysis with the precise purpose of offering enough trust that a particular product or service satisfies the needs of the customers. The next step brought quality workbooks in which quality is achieved with average costs, and the development of the control process has the purpose of passing from the quality assurance era to that of total quality management. The level of the error-free production process in this method is determined by the number  $\sigma$ , which is the percentage of products without defects in percent at the exit of the process. A process with a quality of  $6\sigma$  at the output characterizes 99.99966% of cases without defects or at most 3.4 defects per 1 million operations.

**Results:** A successful model of quality in the organization's management emphasizes the relationships between internal employees, around which revolve the external influences of society, family, labor market requirements, the need for competence and lifelong learning. The model shows a set of practices which allows an organization to deliver quality products and services. The term total from the total quality management phrase highlights the fact that everybody from the organization should be involved in the efforts of continuous improvement in all of the departments. The term quality is used, in its usual meaning, while the term management refers to the system of leadership which involves planning, organizing, leading and quality assurance. The Six Sigma model has a profound impact on product quality, customer service performance and staff professional progress. It examines all processes to eliminate variations that could contribute to malfunctions or defects of the final product. The Six Sigma model is applicable to all general processes and involves all employees to lead to the necessary changes.

**Conclusion:** Successful achievement of quality management is conditioned by compliance with clear performance criteria. These criteria are determined by different reference models in the field, such as Total Quality Management and Six Sigma. Total Quality Management (TQM) constitutes a way of leading an organization centered on quality through the participation of all of its members. Through this model, constant improvement is sought, along with the gradual introduction of the new processes, so as to obtain a higher degree of excellence in organizations. The analysis of the representative models in the field of quality led to the elaboration of a new approach for conceptualizing the quality management in close connection with the novelty

aspects of the standards related to the online environment. An employee - centered culture is promoted, as the model will be adapted to the requirements and needs of the main beneficiaries, as well as in connection with the external environment. Continuous improvement has been one of the important factors of organization development, as total quality management supports the development of good actions and results within organizations.

**Key Word:** Quality assurance; Quality management; Models; Management; Performance.

## I. INTRODUCTION

TQM is a management concept which has initially evolved from the Japanese management processes and stems from the industrial experience. TQM is a management philosophy and practice meant to valorize the human and material resources, basic resources of every organization, which lead, when most efficiently used, to the achievement of the organizational objectives. According to Ojo (2006), this is a quality-centered management style: customer-oriented, fact-based, team-directed; all of these factors target the achievement of organizational objectives. Six Sigma is a recently developed method, introduced by Bill Smith, one of Motorola's top experts, on January 15, 1987 (Tavakoli&Azizi, 2018). The term Six Sigma is derived from the field of statistics, because  $\sigma$  represents the standard deviation. First, it referred to the possibility of manufacturing processes to produce a very high proportion according to specifications. In the field of quality management,  $\sigma$  represents the percentage of products without defects. Six Sigma is a quality management program for improving process performance, by reducing variations, for continuous and innovative improvement (Dehviri, 2014).

## II. MATERIAL AND METHODS

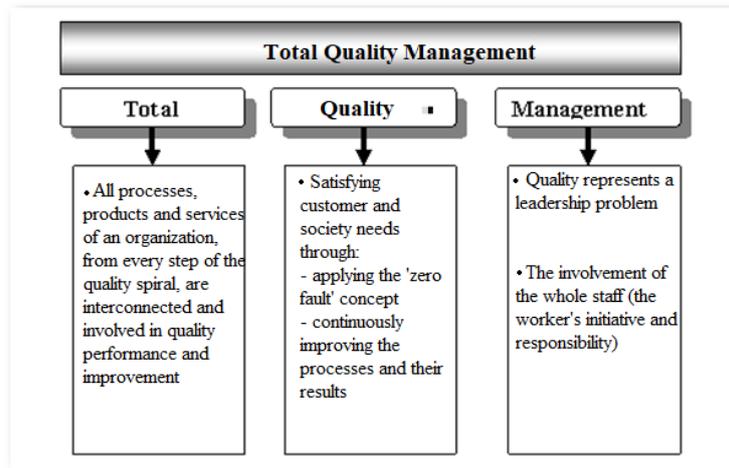
TQM, by the means of multifunctional teams trained to use basic statistical instruments so as to collect and analyze data, professional staff and workers from every department, has highlighted the potential efficiency in solving the problems approached. There are different approaches concerning TQM, but most of them lead to some common points. They guide organizations to concentrate on satisfying the needs of the customers, to develop and put to use the whole potential of all of the employees, to engage all of the efforts in order to find better ways of managing business using reliable data and information targeting financial outcomes.

The programme presented by Deming (cited in Pop, 2009) comprises the following 14 aspects determining the framework of quality improvement:

- Assure the continuous improvement of product and service quality, on a planned basis, in order for the business to resist.
- Adopt a new philosophy, while giving up the “acceptable quality level”.
- Drop the whole control of products and processes, by introducing statistical control methods meant to establish the accordance with the specified requirements.
- Ask the provider for proof concerning the statistical quality evidence.
- Discover the problems. The management has to deal with the continuous improvement of all of the processes from every step of every process of the product trajectory, from the design to the assurance of service usage.
- Provide, for all of the employees, the instruments necessary for the appropriate performance of activities.
- Eliminate fear, encourage communication, so that every employee can openly express his/her viewpoint.
- Eliminate the barriers between the departments of the enterprise. Form groups containing persons from different departments so as to identify problems and prevent them in future processes.
- Eliminate posters and slogans connoting forced labor. Before seeking a productivity increase, make sure the measures do not go against quality, which has to be continuously improved.
- Review the standard working hours, so as to prevent them from becoming an obstacle in the way of productivity or quality.
- Eliminate all of the obstacles impeaching people to be proud of their work.
- Establish a rigorous staff training programme in accordance with the development of procedures, methods and techniques used in all of the company departments.

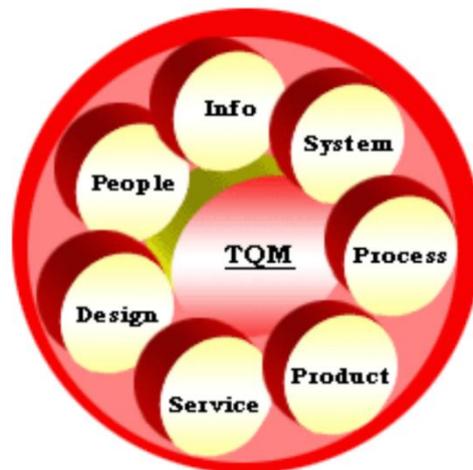
TQM is a permanently evolving concept, which changes with new concepts and new models of development. According to Strickland and Wither, TQM is both a philosophy and a set of governing principles which provide the fundament of continuous organization improvement. The meaning of each of the TQM words is:

- Total – Every person from the organization is involved (including the customer and the provider);
- Quality – The customers' requirements are faithfully addressed;
- Management - The managers are fully committed.



**Figure 1.** Total Quality Management

The model shows a set of practices which allows an organization to deliver quality products and services. The term total from the total quality management phrase highlights the fact that everybody from the organization should be involved in the efforts of continuous improvement in all of the departments. The term quality is used, in its usual meaning, while the term management refers to the system of leadership which involves planning, organizing, leading and quality assurance.



**Figure 2.** Total quality management (TQM)

The basic instrument of total quality management is the PDCA (plan-do-check-act, see Figure 3) cycle, (a.k.a. the Deming Wheel), a method of organizing management activities oriented towards the continuous improvement of quality management. This quality improvement method was devised by W. E. Deming (1993).

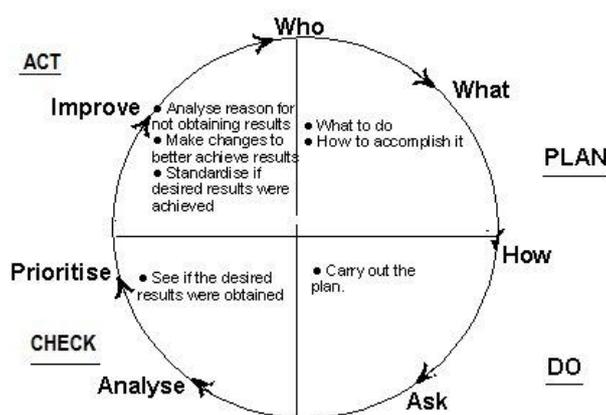


Figure 3. The Deming Wheel (PDCA Cycle) for Continuous Process Improvement

**Plan** signifies the planning of the objectives and processes required to obtain the results according to the customer needs and organization policies. **Do** refers to process execution and implementation. **Check** deals with the actions of control, monitoring and measurement of processes, according to the policies, objectives, requirements, as well as result announcing. **Act** involves action seeking procedures meant to improve process performance. The **PDCA** method involves a methodical approach to problem solving and solution implementing.

**The Six Sigma strategy** can be perceived and understood in three different ways. Metrically, the Six Sigma level is assured when 3.4 defects are obtained per million opportunities. From a philosophical perspective, Six Sigma involves reducing the variation of the organization's processes, focusing on the consumer and making decisions based on data and facts. Methodologically, Six Sigma is based on the use of two methods, **DMAIC and DMADV**, which use different tools and techniques of quality management for their management. **The DMAIC process** is an improvement system for processes that do not conform to the performance specifications required by the customer or managers. This process includes the following operations (Figure 4.): Defining the manufacturing processes in accordance with the customer's requests and establishing the strategy; measuring the main aspects of the current process and collecting the main data; data analysis and identification of causes and determination of relationships, to ensure that all factors have been taken into account; improving and optimizing the processes based on the analyzed data; control, to ensure that any deviation from the main purpose is corrected before they turn into defects.

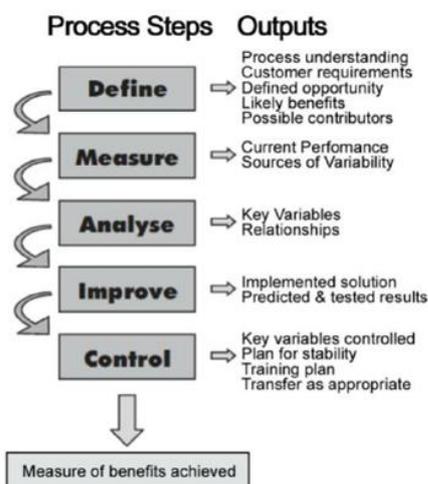
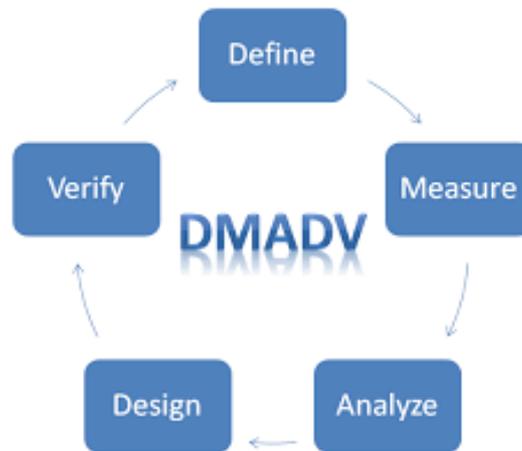


Figure 4. The Six Sigma DMAIC Process and Key Outputs

**The DMADV process** is an improved system for creating a new process or product that can reach the six sigma quality level (99% of opportunities are not mistakes). This process includes the following operations (Figure 5.): defining goals that are relevant to customer requirements and adopting a strategy; measurement to identify product capacity, production process capacity and risks; analysis of the project and design alternatives,

in order to determine a high level of project design and evaluation, as well as to select the best project; design and implementation of the production process and project verification.



**Figure 5.** Specific operations at the DMADV process level

*Similarities and Differences Between DMAIC & DMADV*

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D M A I C	THE SAME AS EACH OTHER		D M A D V
	Gathering existing system data, MSA, Process Capability,	Focus on VOC, Kano Model,	
	Inferential Statistics, Multi-Vari, Hypothesis Testing	Quality Function Deployment (QFD), Benchmarking, selecting final design	
	DOE, pilot solutions, confirm improvements	Preliminary Drawings, evaluated against FMEA or DOE	
	SS, Statistical Process Control, Updated process maps & SWI	Validating the design, process maps, SWI	

**Figure 6.** DMAIC VS. DMADV

The Six Sigma methodology may eliminate opportunities to improve the process, such as reducing unproductive activities, reducing waiting times, reducing inventory and transportation costs, optimizing jobs, and so on. The Six Sigma model has a profound impact on product quality, customer service performance and staff professional progress.

**III. RESULT**

**The PDCA method** involves a methodical approach to problem solving and solution implementing. Each step requires specific operations. Step 1, plan, involves the exact identification of the problem and its correlation with the information necessary to find solutions. This step requires the collection of useful data for the current situation assessment and for the development of the improvement plan. An analysis is needed to find out what can be improved, so as to determine the areas of change opportunities. Step 2, do, consists in the following key activities: generate possible solutions, choose the best solutions and implement the pilot project. Change needs to be planned and implemented afterwards. When possible, it is preferred to implement change on a lower scale first, in order to prevent and correct certain difficulties. Step 3, check, requires the assessment of the pilot project efficiency and the collection of information necessary for its improvement. The success of the generated solution and of the pilot project implementation determines the way of applying the whole initiative, although it may be necessary to repeat the steps related to development and checking and incorporate the needed modifications. Step 4, act, targets the total implementation of the solution. The PDCA cycle does not stop here, as the steps can be repeated, since the initiatives of improvement must be an unceasing process. The Deming

cycle can be successfully implemented when three basic elements are taken into account: the leadership agreement and the consideration of the Deming cycle implementation as a compulsory policy of change; the consideration of the concept as a circular plan, and the implementation of the concept in every department of the organization.

The Six Sigma methodology was initially applied in production and is currently used in all business sectors, including financial services, marketing, sales, logistics, medicine, education, human resources and public services. Educationally, the Six Sigma model has been applied in higher education to determine the root causes that lead to delays in approving the curriculum for new courses. With the help of this model, a US university established the main causes, which are the lack of standards, waste of time and complexity of the process. The solution was established at the level of the improvement phase, which consisted in the exact definition of the purpose, the fluidization and clarification of the approval processes of the new courses, by eliminating the duplication of approvals and the introduction of visual management. Therefore, the time for defining and approving a new course has been shortened by 78%. The Six Sigma model allows schools, universities and other educational institutions to improve the level of knowledge and skills, as well as the satisfaction of pupils and students in improving process performance, both in the educational and administrative spheres.

#### **IV. DISCUSSION**

The importance granted to quality is highlighted by the global existence of several quality awards, such as the Malcolm Baldrige National Quality Award (MBNQA) in the USA (1988), the European Quality Award (EQA) in Europe (1984), the Deming Prize in Japan (1996) and the Canadian Award for Excellence. Peleska and Zahlten (2008) emphasized the TQM traps: quality costs, threats concerning other management models, inaccurate quality indicator measurement, as well as the incompatibility between the TQM measures and the cultural background. TQM, by the means of multifunctional teams trained to use basic statistical instruments so as to collect and analyze data, professional staff and workers from every department, has highlighted the potential efficiency in solving the problems approached. There are different approaches concerning TQM, but most of them lead to some common points. They guide organizations to concentrate on satisfying the needs of the customers, to develop and put to use the whole potential of all of the employees, to engage all of the efforts in order to find better ways of managing business using reliable data and information targeting financial outcomes. A. V. Faigenbaum is acknowledged in the U.S.A. for the increase of quality awareness. The 'total quality management' phrase stems from his book, 'Total Quality Control' (1961, cited in Basu, 2004). According to Faigenbaum, the impact of the total quality control on the organization involves the application of technical activities meant to implement a customer-oriented quality as a primary responsibility of general management and of the main marketing operations, engineering, production, industrial relations, finance and services, as well as of the quality control function itself. Thus, quality becomes a strategic instrument in business. Armand Feirenbaum (1961) defines total quality management as "an organization system which allows the coordination of the efforts of quality development, maintenance and improvement made by different groups from the company, so as to assure that the customer-oriented studies, commerce, production and service are the least expensive, allowing, at the same time, the achievement of total customer satisfaction". The total quality approach is purely structural and economic and enables the factors required for its application. Considering all this, it is necessary to define the concept of total quality management, as quality itself is a part of the domain. According to Christian Potié (2001), total quality management comprises "the ensemble of priorities and characteristics of internal and external quality, seeking all of the competitive advantages".

The total quality management is seen as an additional competitive advantage for the enterprise by seeking customer satisfaction. This is even more appropriate as almost all companies apply, or at least pretend to apply total quality management. Thus, the customer satisfaction is not a discriminant factor, as long as it offers a competitive advantage. The quality assurance of a product is undertaken gradually, in well-established steps, in accordance with the advancements achieved in the process of its production. The quality of a system is created starting with the period of production and manifests during the period of usage. In software engineering, there is a reliance between the quality of the software development process, the project quality and the product. Joseph M. Juran, PhD, significantly contributed, in the 1920s, to the development of the methods of statistical quality control. He was mostly an engineer in the corporate industry, but was particularly concerned with the topic of quality, thus publishing the "Quality Control Handbook" (cited in Condrea, 2006). The author was the first to highlight the achievement of quality through communication (Basu, 2004). Through his approach, he offered an annual plan of quality improvement and cost reduction, as well as a form of continuous education in quality achievement. During the 1950s, Japanese companies started to notice the benefits of organization quality acknowledgment and, thus, resorted to W. Edwards Deming; he gave the Japanese companies a vigorous start in the quality movement. The researcher's methods included a process of statistical control and a step of technical problem solving, all concentrated within 14 input points necessary to obtain the stimulus needed to change the

mentality of the organizations in need when offering high quality products and services. Deeming’s opinion on quality is strictly related to the field of management. In accordance with his theory, buyers are responsible with the understanding and assessment of the quality of all products and services, since they are the ones who should completely understand the quality requirements, while being also capable of communicating these requirements to the provider. Unlike Deming, Juran does not ask for major cultural changes in the organization; instead, he suggests to the American managers to improve quality within their familiar system. One of the advantages of the Six Sigma model is that it examines all processes to eliminate variations that could contribute to malfunctions or defects of the final product. The model is also effective because it is applicable to all general processes and involves all employees to lead to the necessary changes. Six Sigma is based on a strict method that constantly uses information and statistical data to measure and improve the organization's results. Quality management becomes effective with this model, as it focuses on identifying and preventing defects in the production phase, which leads to a high level of satisfaction, which exceeds the expectations of the parties involved. Six Sigma contributes to increasing the level of quality and optimizing the process, by eliminating defects and improving performance. Six Sigma focuses on understanding, quantifying, improving and controlling those variables or causes that influence customer expectations. Six Sigma implementation is a complex, intensive process that requires resources and qualified and dedicated staff. Large organizations that have adopted Six Sigma have shown that a certain organizational infrastructure is needed, in terms of staff roles and responsibilities. Along with the advantages, the model also has a number of disadvantages. The Six Sigma concept does not draw parallels between the quality and satisfaction of customers, on the one hand, and the duration and speed of processes, on the other hand. At the same time, the duration of the process is directly related to customer satisfaction in the provision of services and for production processes, frozen funds in the form of waiting stocks. The Six Sigma toolkit limits the potential for problem solving. The improvement of the process within the Six Sigma methodology is achieved, mainly, by reducing the variability of the processes by statistical methods and the redesign of the processes using the DFSS method (Design for Six Sigma).

There are differences between the Six Sigma model and other quality models, such as TQM, which are analyzed in **Table 1**.

**Table 1.** Comparative analysis of the characteristic elements of the Six Sigma and TQM models

<b>The Six Sigma Model</b>	<b>The TQM Model</b>
- the existence of a continuous effort to reduce the output deviations of the key processes of business success	- the organization's focus on understanding and responding to customer needs
- the commitment of the whole organization, in particular senior management, to the continuous improvement of quality	- the desire for continuous systematic improvement of all products, services and processes, as a result of the participation of all partners

## V. CONCLUSION

Total Quality Management (TQM) constitutes a way of leading an organization centered on quality through the participation of all of its members. Through this model, constant improvement is sought, along with the gradual introduction of the new processes, so as to obtain a higher degree of excellence in organizations. Continuous improvement has been one of the important factors of organization development, as total quality management supports the development of good actions and results within organizations. Successful achievement of quality management is conditioned by compliance with clear performance criteria. These criteria are determined by different reference models in the field, such as Total Quality Management, the Six Sigma model. The quality models were analyzed based on several criteria: identifying the characteristic elements, exploring the ways to capitalize on the models at the level of the institution, highlighting the advantages and disadvantages. The analysis of the representative models in the field of quality led to the elaboration of a new approach for conceptualizing the quality management in close connection with the novelty aspects of the standards related to the online environment. An employee - centered culture is promoted, as the model will be adapted to the requirements and needs of the main beneficiaries, as well as in connection with the external environment.

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