

# IMPLEMENTING QUALITY MANAGEMENT IN A SOFTWARE ENGINEERING ORGANIZATION

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**Abstract:** Research regarding the different measures to implement and maintain an efficient quality management system in a software engineering organization has received significant importance on the market, because based on these criteria the products and services delivered could highly impact the reputation and corporate identity of the producer. Many people believe that quality is a key factor in determining how well an organization performs. The purpose of this study is to highlight the value of quality management inside an organization and how can it be achieved. The quality management system, in general, was analyzed based on the most recent methodologies used in the software engineering branch. A sustainable quality management system is a cutting-edge strategy that places a strong emphasis on long-term planning and continual development in order to improve an organization's overall performance and keep a competitive advantage in the industry. In order to maintain sustainability, this article discusses what a quality system in a software engineering organization is and why is so highly encouraged to have one.

**Keywords:** quality, management, software, engineering, project

## 1 INTRODUCTION

The active planning and ongoing assurance of quality needs throughout the project in a productive, economical, and goal-oriented manner constitute the quality management of the project, which is a key component of the software systems engineering framework. The three essential components of the quality strategy—the product, the process, and the people—should always serve as the foundation

for quality management. Through a structured and organized procedure, proactive project quality management integrates actions for process evaluation (quality assurance) and delivery inspection (quality control). Nonconformities are typically easier to avoid or spot early than they are to find and fix.

In general, the two main components of quality management are as follows:

1. The Plan-Do-Check-Act (PDCA) cycle, which is commonly referred to as a quality

management plan, is one method of continuous improvement.

2. Regular (often required) or ad hoc quality checks.

The Figure 1 shows the PDCA cycle (Plan - Do - Check - Act), that was developed by Deming and Shewhart and is a component of ISO 9001. It deals with quality planning, management, assurance, and improvement.

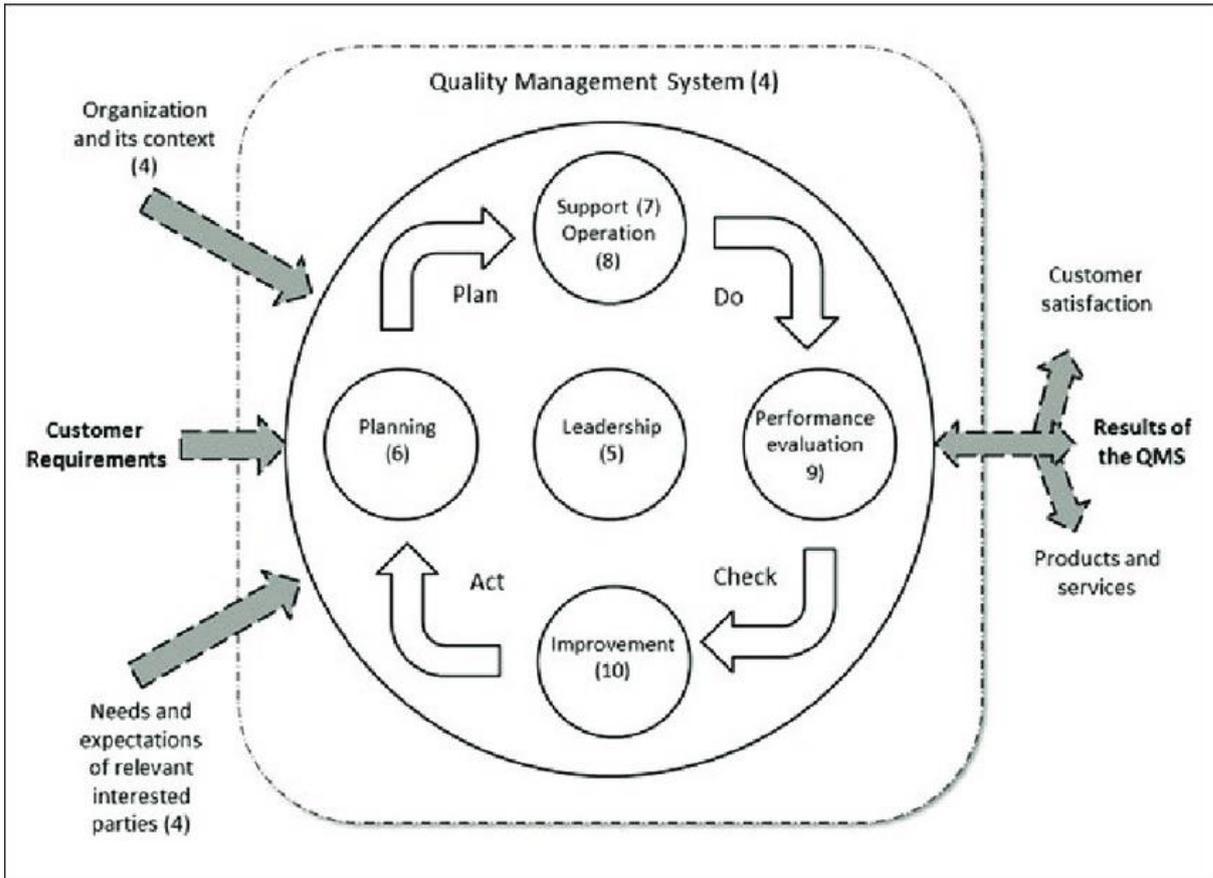


Figure 1. The PDCA cycle in the quality management plan (Buthmann, 2010)

The quality management plan (QMP), which must be created during the project planning and clarification phase and maintained throughout the project life cycle, is applicable to all associated activities in the PDCA cycle.

The cost of failure and the cost of prevention must be balanced in the quality management strategy, as indicated in the Table 1:

Table 1. The processes of the Quality Management Plan

TOPIC	DESCRIPTION
Prevention	<ul style="list-style-type: none"> <li>• Planning</li> <li>• Training</li> <li>• Inspection</li> <li>• Testing</li> </ul>
Failure	<ul style="list-style-type: none"> <li>• Waste</li> <li>• Rework</li> <li>• Liability for damages</li> </ul>

The total cost of quality (TCQ) should be optimized by the quality management strategy by taking into account cost-saving and effort-simplifying initiatives. The following key categories are used to accomplish this, as shown in Figure 2 and Figure 3:

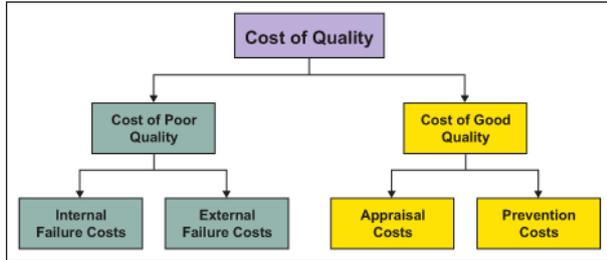


Figure 2. The total cost of quality (Javed & Alenezi, 2023)

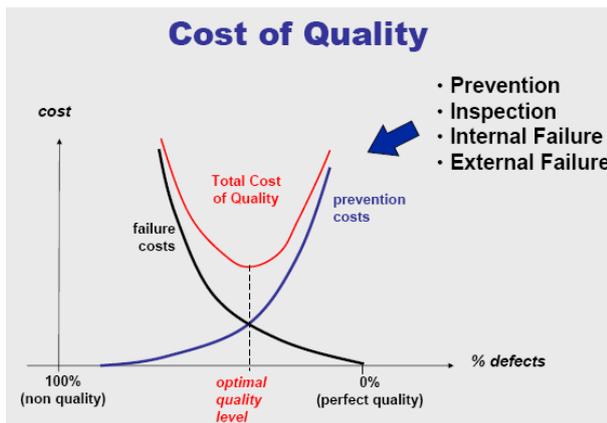


Figure 3. Graph depicting the total cost of quality (Kafetzopoulos, Gotzamani & Gkana, 2015)

The topics in Table 2 that need to be adequately maintained are listed for guidance's sake:

Table 2. Quality management expenses by procedures

TOPIC	DESCRIPTION	EXAMPLE
Costs of prevention	These actions are taken to prevent inferior quality.	<ul style="list-style-type: none"> <li>Evaluation of processes</li> <li>Committed teams for quality improvement</li> <li>Regular training</li> <li>Analysis of usage</li> <li>Gathering of requirements</li> </ul>
Appraisal costs	These are associated with the discovery of quality problems.	<ul style="list-style-type: none"> <li>Inspection</li> <li>Testing</li> <li>Audit</li> </ul>
Internal failure costs	They are linked to flaws that were discovered prior to offering the goods or service to the client.	<ul style="list-style-type: none"> <li>Regression testing</li> <li>Time and resource waste</li> <li>Bug fixes</li> <li>Rework</li> </ul>
External failure costs	These are linked to issues with the product or service that are discovered after the customer has purchased it.	<ul style="list-style-type: none"> <li>Overloading the technical support department</li> <li>Investigating customer complaints</li> <li>Product recalls and refunds</li> <li>Loss of customer's confidence</li> <li>Warranty costs</li> <li>The price of taking on culpability for harm</li> </ul>

Inspections or quality checks are sub-processes that must be carried out at specific project milestones to make sure the major deliverables produced are of sufficient quality to move on to the following phases. In Table 3 it is outlined the quality-oriented strategy.

	move it to the next stage; <ul style="list-style-type: none"> <li>• Executing quality control processes in every significant project event.</li> </ul>
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Table 3. The scope and objectives of quality inspections

SCOPE	OBJECTIVES
By assessing findings before moving on to the following phase of the project, the quality of the project's execution could be improved (In this way the risks and failure rate in the project can be reduced).	<ul style="list-style-type: none"> <li>• Focusing on what needs to be produced;</li> <li>• Deciding whether to approve or retouch deliverables;</li> <li>• Deciding whether to stop the project or</li> </ul>

## 2 THE QUALITY SPIRAL IN SOFTWARE SYSTEMS ENGINEERING ORGANIZATIONS' METHODOLOGIES

According to ISO 9000:2015, quality is a notion that refers to a product's overall attributes as they relate to meeting the needs that have been expressed. Quality thus offers for sustainable businesses an infinite lever of evolution leading to efficiency, effectiveness, and profit with wise resource management.

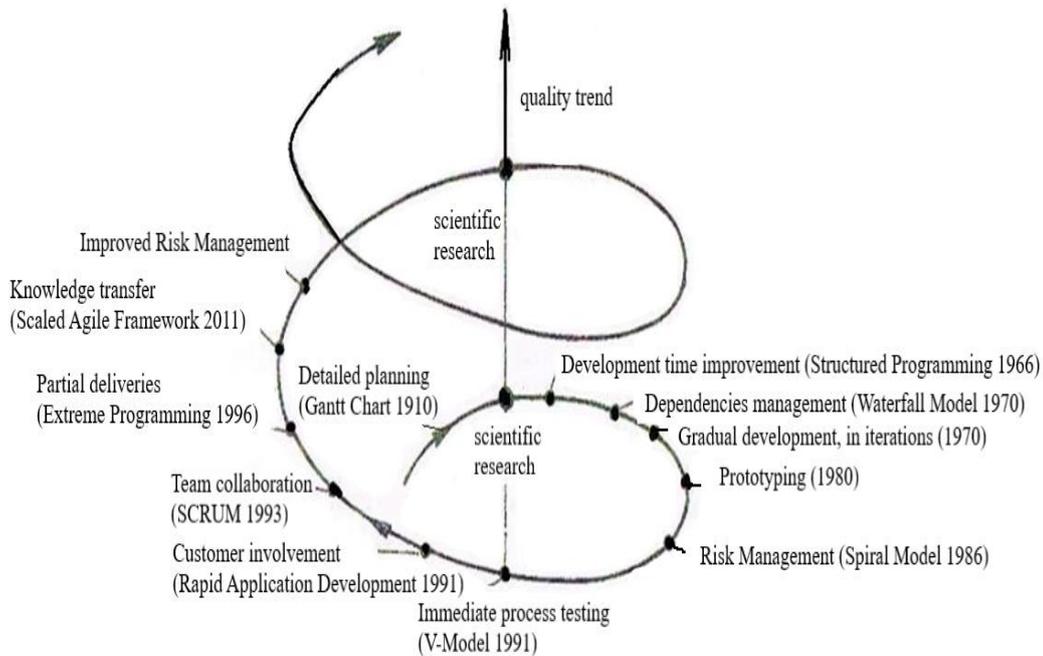


Figure 4. The quality spiral in methodologies used in software systems engineering organizations

The absence of clear-cut standards to govern the planning and management of projects at the start of project management as a discipline allowed for organizations to advance and focus on structuring needs and meeting them through specialized strategies embodied in the form of methods and methodologies. The quality spiral is a useful tool for analyzing metrics that objectively show an organization's growth, and in Figure 4, there are highlighted some of the most significant advancements made in the field of software systems engineering. The points on the quality spiral are laid out chronologically and

suggest moments of introspection and retrospection by organizations when they have discovered areas where improvements can be made or there are problems and have come up with solutions. The spiral has an infinite tendency because there are many ways that an area can evolve.

When addressing the creation of software in software systems engineering, the term most frequently refers to a computer program created to make it easier to visualize certain knowledge and to make modifications to it.

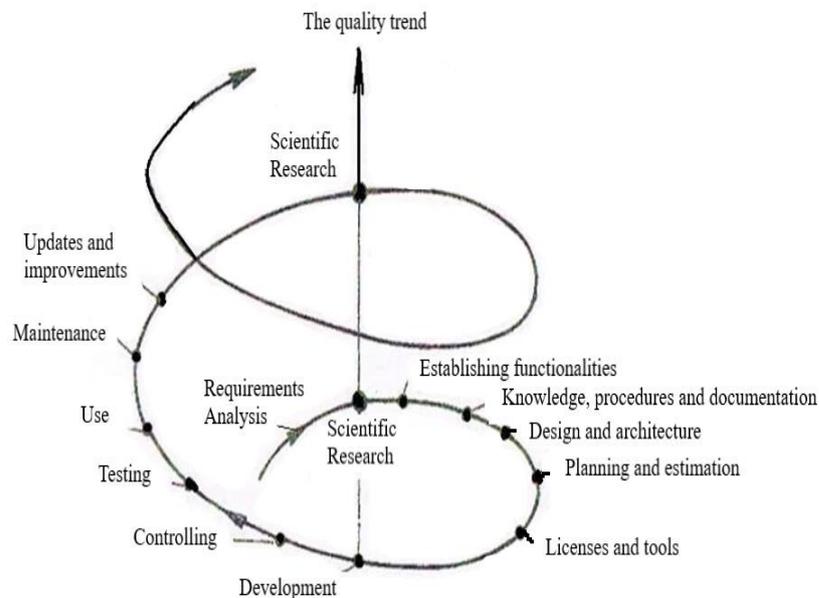


Figure 5. The quality spiral in software production

The sum of steps an organization takes to best satisfy the project's requirements constitutes the quality process in general. The phases that lead to the development of quality procedures in the creation of software are shown in Figure 5, and it is mentioned that companies should occasionally pause what they are doing to assess how well they are doing it and how it may be done better.

The computer program produced can be conceptualized differently depending on the

methodology employed, but the steps are essentially the same regardless of how the project is carried out. For instance, the testing of a software product is carried out at the conclusion of development using the Waterfall model, during each development process using the V-Model, and during each iteration using the Agile methodology.

The testing process in the quality spiral, however, relates to the enhancements, effectiveness, and efficiency of testing across

all approaches. In this situation, strategies to improve the quality of the testing process can be developed by adding more resources, creating templates with various standard scenarios, automating testing using computer programs, creating production-independent test environments, or simply by breaking the testing process into as many operations as possible, each of which is then examined separately.

### 3 CONCLUSION

This study aimed to highlight the impact of an efficient quality management to the sustainable development of a software engineering organization. As the list of customer requirements by each project is growing day by day, each individual needs to adapt quickly and these factors can make a huge difference in the quality of a product or service delivered. Leadership, personnel management, process approach, customer focus, and continuous improvement are the principles that are used most frequently. (Taraza, Anastasiadou, Masouras & Papademetriou, 2023; Teli, Majali & Bhushi, 2010)

One part of this article focused on showing that even in the history, willing to progress, organizations have come up with multiple models and methodologies in order to increase the quality of their activities and products. However, there is still a lot of room for improvement, most probably in the risk management area.

On a deeper insight, this research contributes to the current state of the art by presenting that also in the production processes of a software product, quality management enhances the areas where better results could be achieved. In addition, an efficient and effective quality management can discard the jeopardize on the reputation of the organization, leading to a higher performance and an increased customer

engagement. To summarize, the idea of quality management has developed from a theoretical and conceptual foundation that is supported by models that can help organizations in the software engineering industry generate excellence in a structured and integrated way. (Zizakov, Vuckovic, Vulcanovic, Dakic & Delic, 2023)

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