https://doi.org/10.55843/ivisum2272109v

INTEGRATION OF JURAN'S TRILOGY, DEMING'S QUALITY CYCLE AND DMAIC METHODOLOGY IN THE DEVELOPMENT OF MANAGEMENT WITH QUALITY COST METHODOLOGY

Cvetanka Velkoska, page 109-123

ABSTRACT

This paper presents systematized approach to introducing and implementing a management system with quality costs, with a development of a management methodology using quality costs which, in a structured and systematic manner includes all relevant procedures (algorithms), with a view fully expressing the benefits and usefulness of the quality costs. The methodological approach includes the algorithm for introducing and implementing the management system with quality costs, the algorithm for the selection of a relevant quality costs approach and model, the quality costs identification and categorization algorithm, the quality costs measuring algorithm, as well as the quality costs management algorithm and the algorithm for management with quality costs. The scientific contribution of this paper involves the integration of the three known methodologies used in quality management: Juran's trilogy, Deming's quality cycle – PDCA, and the DMAIC methodology, in the development of the methodology for quality management with quality costs, aimed at improving the effectiveness of the management system with quality costs and the sustainability of the company.

Keywords: quality costs, Juran's trilogy, PDCA, DMAIC.

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Date of received: 30.06.2022

Date of acceptance: 15.08.2022

Declaration of interest: The authors reported no conflict of interest related to this article.

INTRODUCTION

Today, one of the most fundamental consensuses reached between the theoreticians and the practitioners in the area of quality costs, revolves around the need to exert continuous pressure to improve the level of quality until a perfect quality level, i.e., 100% compliance with the quality requirements. This approach suggests that perfection can be achieved by a bigger focus on and investments in the prevention costs, rather than the costs for repairing of failures. Quality can no longer be sustained and guaranteed by increased product inspection and control, because modern quality management relies on quality control and inspection, which entails prevention of potential and implementation of an effective monitoring system that offers new possibilities to guarantee quality (Nel and Pretorius 2016). Modern developments, such as smart technologies, high automatization and computerization levels contribute to reducing the previously accepted material failures, product failures, and human resource failures, which, in turn results in opportunities to aspire to a higher level of quality with least possible quality costs which converge to a value of zero.

Considering that modern management science is fully dedicated to management with total quality (Mantri and Jaju 2016), then this justifies the need to apply the quality costs concept which will help find out the system, process, and product weaknesses, as well as learn new things about improving the work of the companies (Mahmood and Kureshi 2015). Unlike the traditional approach, where the quality concept focuses on descriptive and diagnostic analytics), the modern approach uses predictive and prescriptive analytics) and answers the questions: what will happen, what is the best thing to do, and how to achieve it (Jegannathan, Aishwaraya, and Nandakumar 2016).

When making optimal decisions in the company management process using the quality costs concept, one should not only know the quality costs model categories and elements (Sailaja, Basak, and Viswanadhan 2015), but also how to identify, record, store and analyze the quality costs quickly and economically for proper, predictable, and enhanced analytics (Selim 2021).

The quality costs concept still waves in the scientific and professional communities with its controversy, its nature, the different aspects, and approaches to the understanding of this concept, as well as

the critical overview and the discussions about the importance and the usefulness of applying this concept (Cebeci 2013). One of the main scientific gaps relates to the method of implementing quality costs, having in mind the obvious subjectivity, invasiveness, and the hard work in identifying the quality costs category elements. The various aspects of defining the concept of quality depending on the circumstances and the context wherein it is used, the quality costs monitoring systems, which are neither traditional accounting systems, not a classical cost calculating methodology are the reason for and the threat of subjectivity when identifying quality costs (Nel and Pretorius 2016). No broad consensus has yet been reached regarding the definition of the quality costs structure. The analyzed scientific literature and the recorded industrial practices still have not completely answered the question how to determine all of the elements in the categories of the quality costs, having in mind that the determination of all of the quality costs elements represents one of the most important prerequisites for an effective and an efficient quality costs management system (Snieska, Daunoriene, and Zekeviciene 2013). The improper and untimely identification and measurement of the quality costs elements, the different level of maturity of the management system with quality costs, the different existing approaches to quality costs, the different quality costs models, the difficulties and the impossibility to identify the quality costs elements, related to consequences of poor quality for the user and society, further complicate the implementation of quality costs and introduce dilemmas in the determination of the correlation between the level of quality and the costs of quality (Schiffauerova and Thomson 2006). It is necessary to generate a comprehensive, structured, and systemic framework arising from the identification of the scientific gaps and dilemmas, which represents a basis in the development of the methodology for management with quality costs.

DEVELOPING A METHODOLOGY FOR MANAGEMENT WITH QUALITY COSTS

The methodology for management with quality costs should serve as a tool to make informed management decisions, while helping plan and forecast, in all stages of product creation (design, manufacturing, use, and disposal of used products in the form of waste), in order to achieve minimal total costs of quality and the lowest possible sensitivity of the product to external influences, which would lead to a sustained quality levels and increased company profits. The development of the

methodology for management with quality costs (figure 1) begins with an Algorithm for Introducing and Implementing the System for Management with Quality Costs**,** also applicable and flexible from the point of view of the different maturity levels of the quality and the quality costs of companies, structured using the well-known trilogy of Joseph M. Juran (Quality Planning, Quality Control and Quality Improvement) (Godfrey and Kenett 2007) and Deming's quality cycle - PDCA (Plan Do, Check, Act), (Sokovic et al., 2009) presented on figure 2.

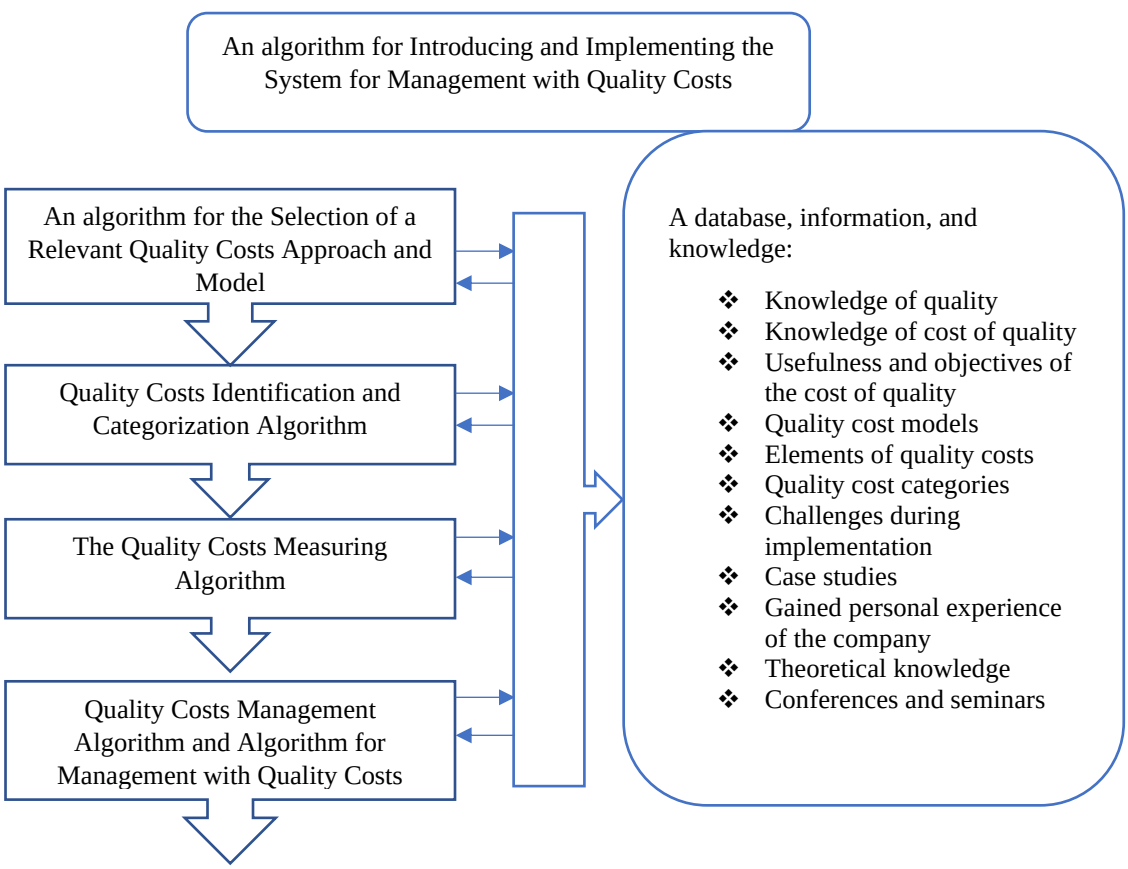
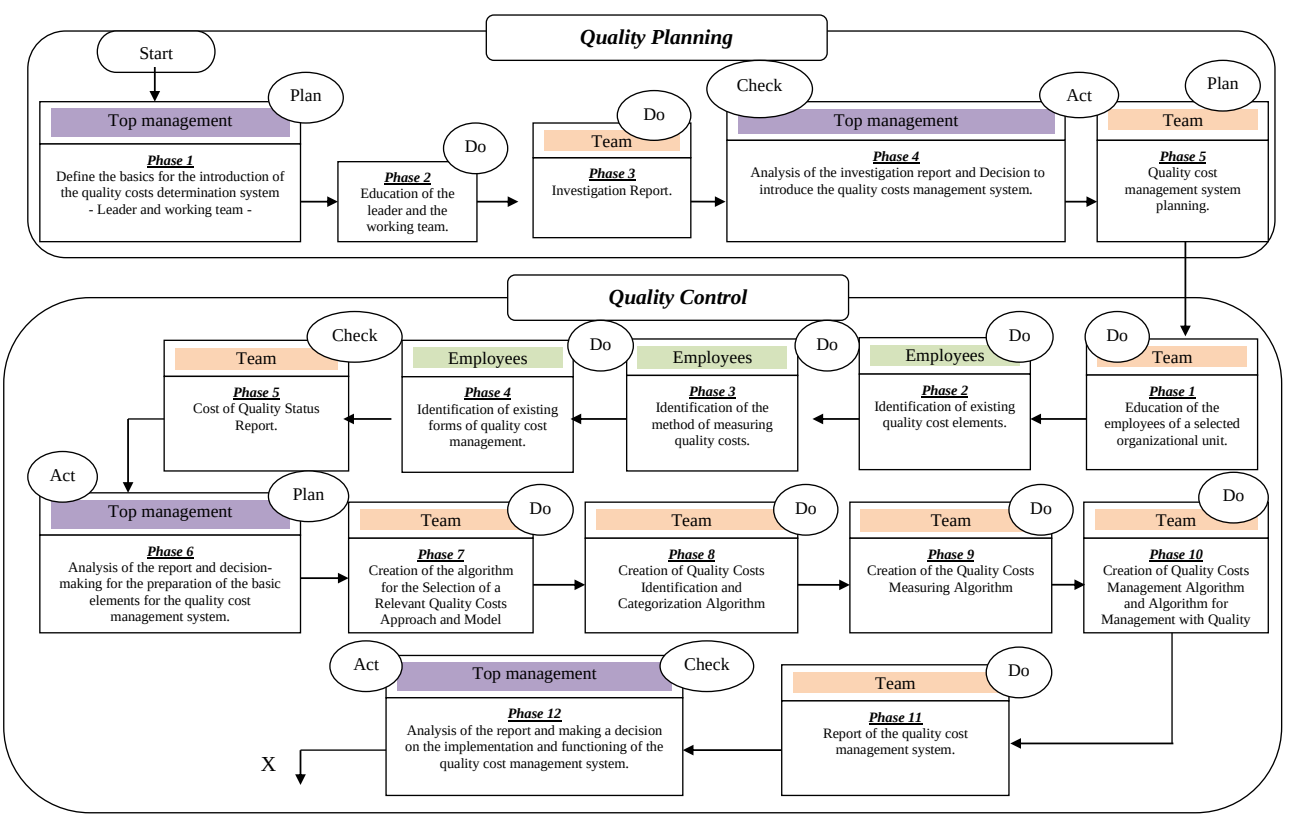


Figure 1. Development of the methodology for management with quality costs.

The new trends of the 21st century necessitate a shift towards a visionary approach to the understanding of quality costs and the management with quality costs, which should integrate the technical and technological aspects, the environmental aspect, and the innovation aspect into the existing knowledge of quality costs (Jaju, Mohanty, and Lakhe (2009). Table 1 presents the characteristics of the classical, the modern and the visionary approach to quality costs (Tomov and Velkoska 2021; Velkoska, Kuzinovski, and Tomov 2018). This requires a quality costs model based on the integration of the already proven approaches and models, as well as the complementarity (cumulation) of their benefits, in order to develop a robust quality costs model (Czajkowski 2017). The selected quality costs model is expected to develop into a formal framework for monitoring the behavior of the quality costs categories and elements and a tool for companies to track the investments in quality, as well as the returns on the investments in quality, i.e., to appraise the efficiency of the improvement measures.



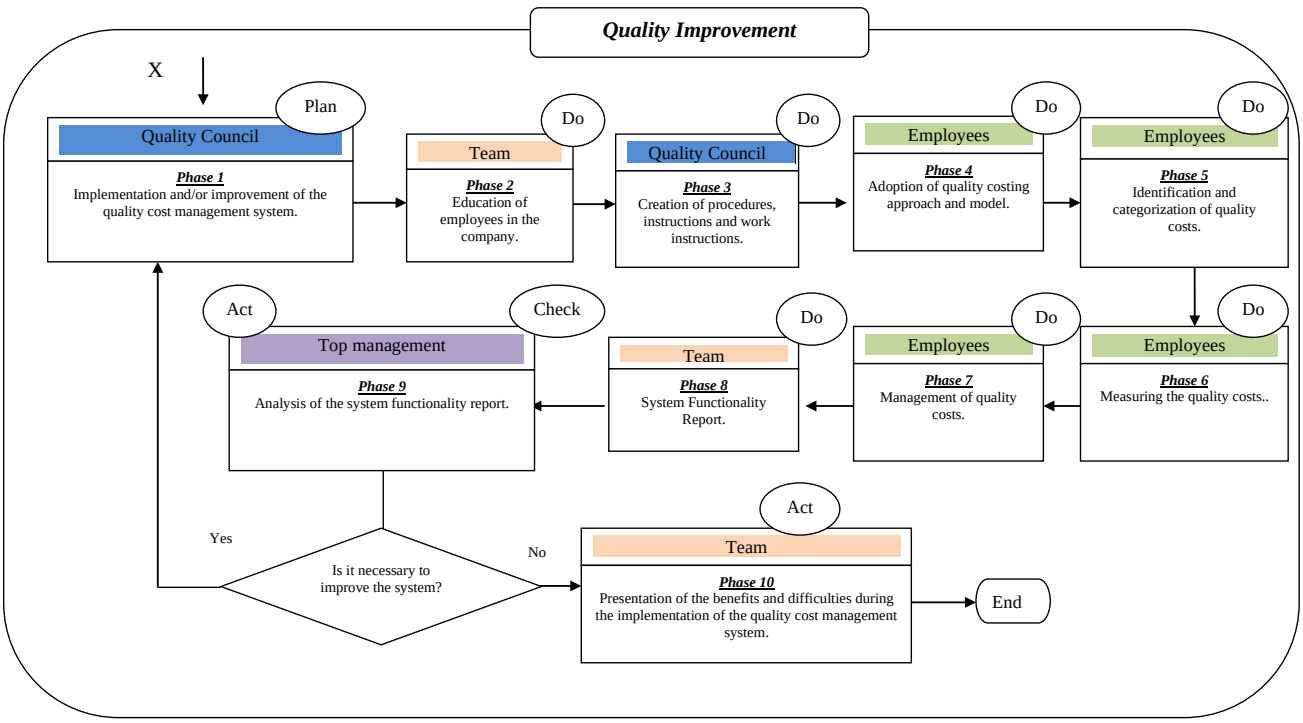
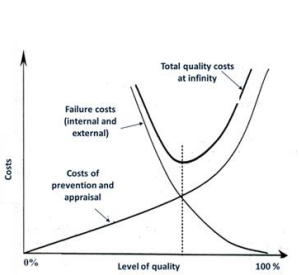
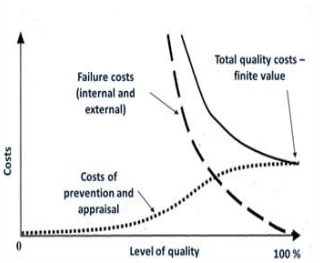
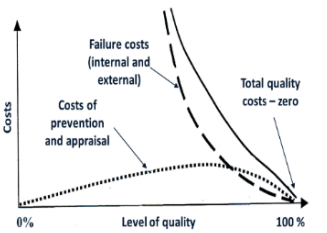


Figure 2. An Algorithm for Introducing and Implementing the Management System with Quality Costs.

Table 1. Classical, modern and visionary approach to quality costs

Criterion	Classical approach to quality costs 	Modern approach to quality costs 	Visionary approach to quality costs 
Concept	Economics of quality	Zero defects	Ecology of quality
Standard for quality	Economic quality level	Perfect quality	Sustainable quality
Nature of approach	Static	Dynamic	Dynamic
Focus	Reduction of quality costs	Continuous improvement	Continuous refining of improvement
Matrix of thinking	Failure mindset (inspection)	Prevention mindset	Sustainability mindset
Behavior of total quality cost	Higher level of quality, higher costs	Higher level of quality, lower costs	The highest level of quality - zero costs
Maturity of quality	Low level of quality maturity	High level of quality maturity	Sustainable quality level
Investments in costs of prevention and appraisal	Unjustified	Justified	Mandatory
Behaviuor costs of prevention and appraisal to perfect level	Asymptotic to infinity	Exponential to finite cost	Convergence to zero cost
Time perception	Sustainable in the short term	Sustainable in the long term	Sustainable in the long term
Responsibility	Quality Control Department	Corporate Department	Social Accountability

After the analysis of the literature, an overview of generic quality costs models was prepared for the period 1996-2017, presented on figure 3. It is evident that there is no universal model. The PAF model and the process cost model are likely the most frequently generic quality costs models (Tomov and Velkoska 2022).

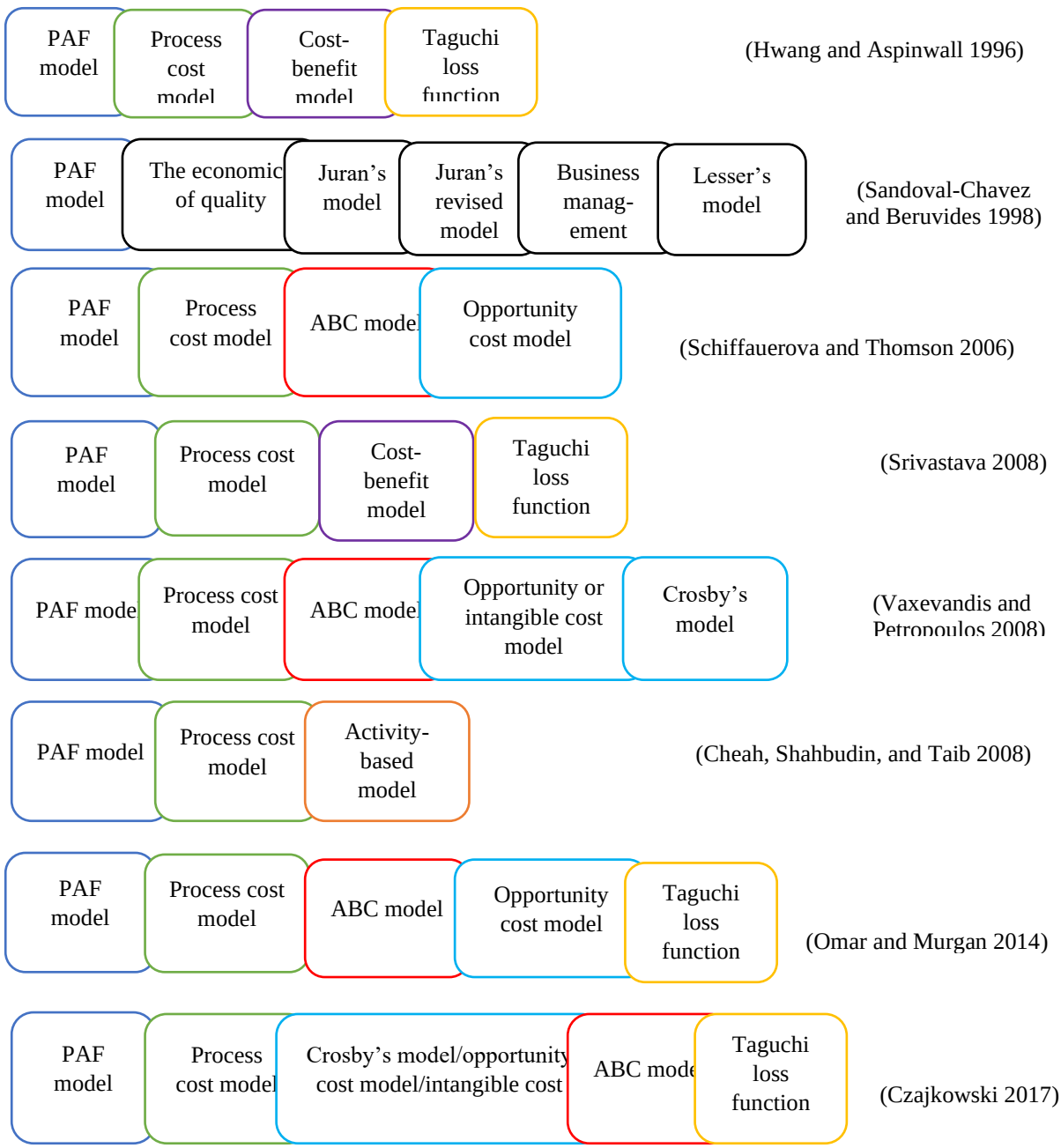


Figure 3. An overview of generic quality costs models for the period 1996-2017.

The proposed methodology in this paper contains the Algorithm for the Selection of a Relevant Quality Costs Approach and Model (figure 4.), where the decisions are made in accordance with the MCDM (Multiple-Criteria Decision Making) methodology (Tsai and Hsu 2010; Anderson-Cook 2017; Selimi, Milošević, and Saračević 2018).

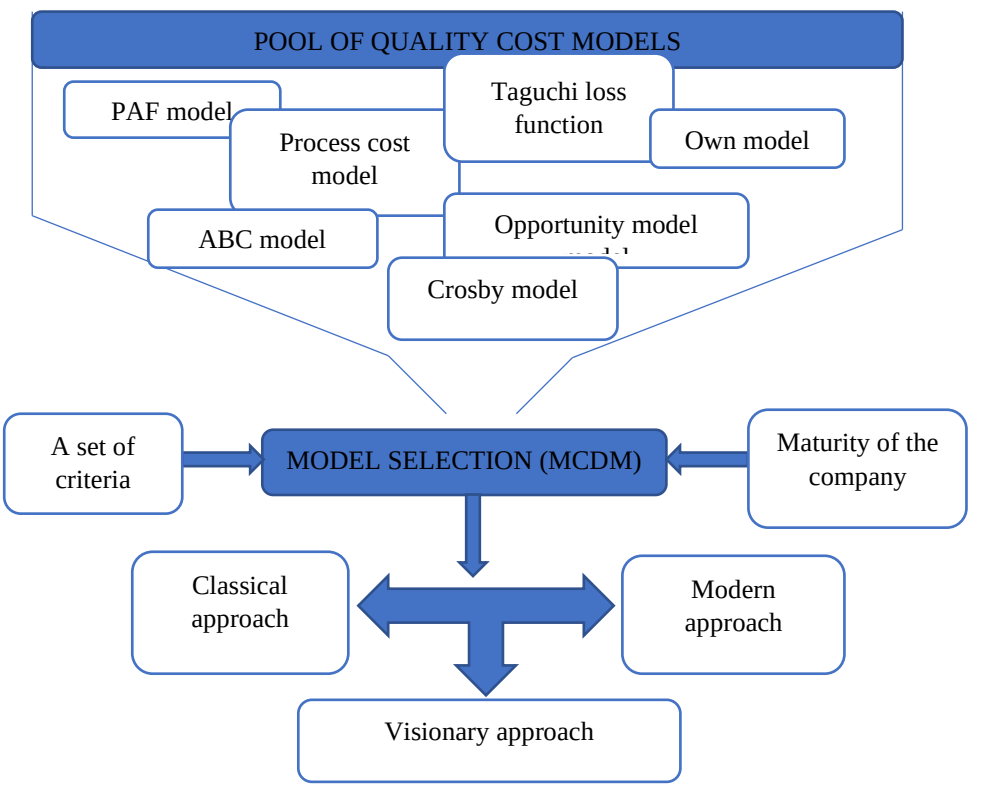


Figure 4. An Algorithm for the Selection of a Relevant Quality Costs Approach and Model

Next comes the Quality Costs Identification and Categorization Algorithm which should identify and describe the quality costs and approve the suitability and the adequacy of the quality costs data and information generating and updating process. The Quality Costs Measuring Algorithm is presented in the research study of Velkoska, Tomov, and Kuzinovski, 2018. The integration of the methodologies: DMAIC (Define, Measure, Analyze, Improve, Control) (Sokovic et al., 2009), augmented with phase D – Disseminate of knowledge, Deming's quality cycle, and the trilogy of Joseph M. Juran represents the basis for

the Quality Costs Management Algorithm (figure 5). Figure 6 presents the Algorithm for Management with Quality Costs through the prism of the DMAIC-D methodology, considered from the point of view of reducing the total quality costs and increasing company performance.

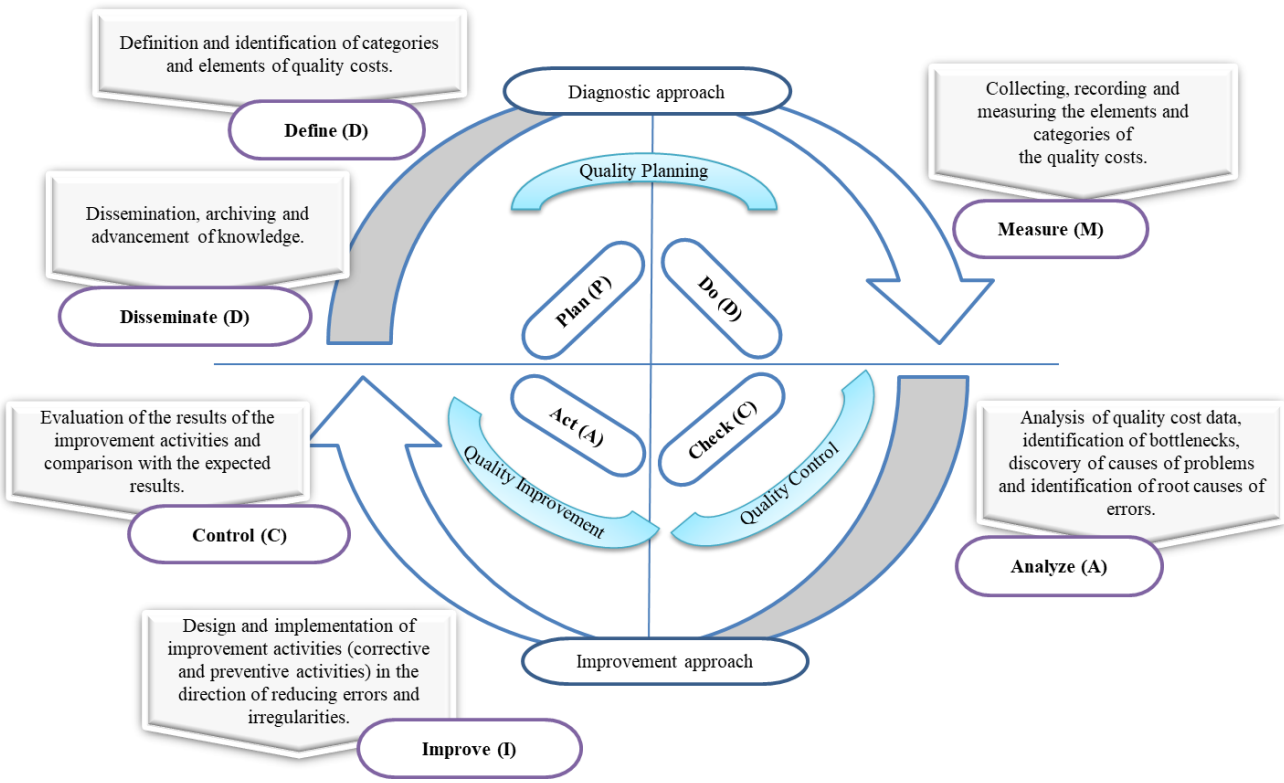


Figure 5. Quality Costs Management Algorithm

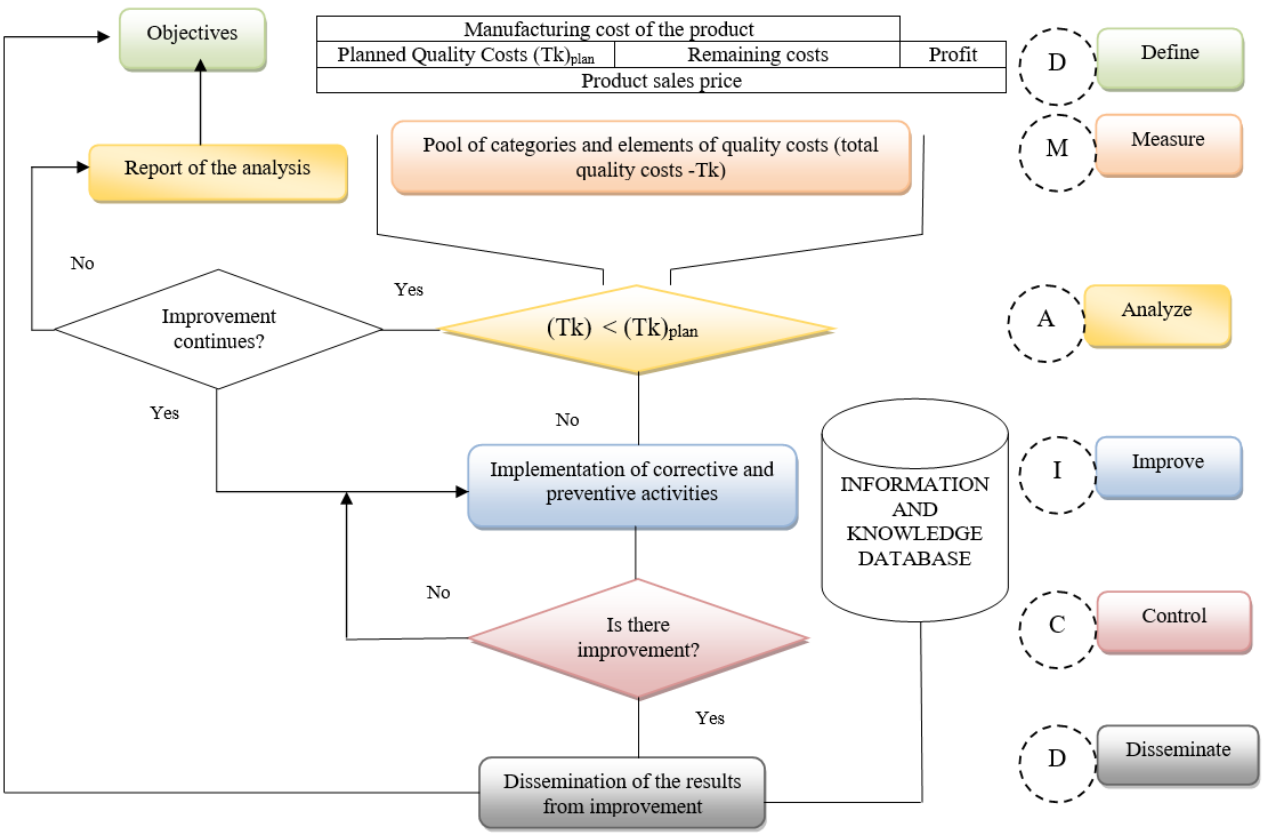


Figure 6. An Algorithm for Management with Quality Costs

CONCLUSION

The comprehensive research and literature sources, as well as the author's own understanding of quality and the costs of quality, confirm that the methodology for management with quality costs should include, in a systematic and structured manner, all relevant procedures (algorithms), with a view of fully expressing the benefits and the usefulness of quality costs. The introduction and implementation of a management system with quality costs is preceded by a methodological approach with structured and sequential phases that provide clarity in the understanding and systematizing the interconnected complex processes, locating the highest responsibility of senior management, making decisions based on informed facts, managing of risk, with a view of constantly improving the processes through teamwork and organizational learning. The decision to select a model and an approach to considering quality costs should be made based on the company goals and requirements. The identification and the

categorization of the quality costs depends on the proper description and understanding of the quality costs and their distinction from the other costs, their unique identification, and the knowledge of the possibilities for support from the company IT and accounting systems. The adequate, proper, and accepted quality costs measurement systems have the highest efficiency if the staged approach and the consequent systematization in appropriately designed algorithms facilitate the identification and the tracking of quality costs where such costs actually occur, and not where they are discovered. Management with quality costs through the prism of the constant improvement methodology DMAIC-D, represents one of the ways to increase the possibility of generating sustainable quality, by eliminating potential failures as early as possible. Decisions informed by management with quality costs, as well as by quality costs management increase the effectiveness of the management system with quality costs, influence company quality policy and the increase of competitiveness of the company. The market economy requires companies to know how to manage cost optimization with a view of skillful and rational resource utilization, which is possible if the decisions are informed by quality costs. This research presented in this paper provides practical framework for the sustainable development of the companies.

One limitation of this research is that the quality cost identification and categorization algorithm is not presented. It is a challenge for the future research to be conducted.

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