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QUALITY COSTS CONCEPT AND MEASUREMENT – DOES A REAFFIRMATION IN A NEW DIRECTION NEEDED?

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ABSTRACT

This study primarily aims at presenting a realistic picture of the utilitarian nature of quality costs in companies around the world. This has led to researching the quality costs applications levels, the percentage share of the total quality costs, the percentage share measuring the quality costs categories, as well as the measured percentage shares of the quality costs in the companies. The analytical research methodology relies on an integrated chronological, comparative, logical and systematic analysis of scientific literature, complemented by inductive and deductive methods. The research results confirm the need to raise the awareness for, determination, and commitment to a broader application of the quality costs concept through an understanding and integration of the new societal values of contemporary operations, whereby the understanding of the application of the quality costs concept will deepen and the quality costs concept itself will shift from the margins of a purely theoretical concept. We expect that the contemporary ambitious concepts such as *Sustainability, Industry 4.0, Quality 4.0, Business Process Reengineering, Circular economy – Remanufacturing, Innovation 5.0* will contribute to the development a higher level of quality maturity which, in turn, will make the application of quality costs more attractive. In particular, as this will reflect on the redesigning and redefining the quality costs' structure to include new modernized elements of quality costs, and the quality costs concept will be reaffirmed in a new direction and will become recursive.

Keywords: quality, quality costs, measurement, PAF model, Industry 4.0, sustainability.

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INTRODUCTION

Within the contemporary approach to quality, we must consider the quality costs as a separate group of costs for activities to improve the product quality. The quality costs by definition mean all the costs to prevent poor quality, as well as costs incurred as a result of poor quality (Omurgonulsen 2009, 547), or which could be explained as the difference between the actual and the ideal costs to achieve quality (Czajkowski 2017, 352).

However, the awareness of the existence and the identification of quality costs, in itself has no impact on the improvement of quality in the companies (Pires et al. 2013, 785), if the companies do not take advantage of the benefits resulting from the measurement of the quality costs (Yang 2008, 176). This means that the quality costs measurement process not only enables the identification of weaknesses in the operations of companies, but also creates opportunities to undertake appropriate preventive or corrective measures in the process of improving quality, thereby strengthening the quality control, and evaluating the effects of quality management (Trehan, Sachdeva, and Garg 2015, 70; Yang 2008, 190).

The inevitability of measuring quality costs became a requirement reflected in the literature in the 1950s, through the work of Joseph M. Juran (Giakatis, Enkawa, and Washitani 2001, 181), whose importance was specially emphasized in the philosophy of Total Quality Management and its practical implementation (Jaju, Mohanty, and Lakhe 2009, 1076). Therefore, measuring quality costs is a feature of any company working to improve the total quality (Tye, Halim, and Ramayah 2011, 1303), expressing the quality using the language of money in order to draw the attention of top management and motivate managers to commit to an in-depth understanding and substantive implementation of the quality costs measurement system (Starcević, I. Mijoč, and J. Mijoč 2015, 247), as well as the attention of the other employees to raising the level of intradepartmental cooperation within the companies (Trehan, Sachdeva, and Garg 2015, 81).

However, not every company measures quality costs in practice (Gupta and Campbell 1995, 47) and most companies deliberately avoid and ignore it, or apply it inappropriately without a systematized approach to measuring and monitoring quality costs (Yang 2008, 176). The difficulties

in understanding and identifying quality costs, the excessive number of quality costs elements, double or multiple tracking, the inability to measure parts of quality costs make many companies to doubt and resist the application of quality costs (Pursglove and Dale 1995, 569-570). In addition, people have noticed an inclination of the company employees to hide the costs of quality because they knew that the quality costs "speak" about the inefficiencies of the processes, activities, and systems in the company (Trehan, Sachdeva, and Garg 2015, 79-80).

Quality costs measurements should rely on a structured approach and a systematic measurement of the quality costs, that ensures the timeliness, accuracy, reliability and cost effectiveness of the data and quality costs related information (Velkoska, Tomov, and Kuzinovski 2018, 65-66). This marginalizes the accuracy and objectivity of the assessment of the quality costs category elements (particularly opportunity costs) which has always been questioned (Cheah, Md. Shahbudin, and Md. Taib 2011, 414-415). On the other hand, the lack of sufficient resources, the way the quality costs are identified and tracked, which differ from the existing forms of accounting systems, can limit the proper and consistent implementation of quality costs measurement systems (Williams, van der Wiele, and Dale 1999, 447).

This, as well as all known difficulties and benefits of implementing quality costs benefits motivated the authors of this paper to present the utilitarian nature of the quality costs in the companies that use them. The research in this paper primarily aims at systematizing and analyzing the findings from the available existing research studies in order to answer the following research questions:

1) What is the scale of cost of quality in companies, as a percentage of sales, production costs and the sales contract?
2) What is the percentage of companies implementing the quality costs?
3) What is the percentage of companies that measure or track, or report of quality costs categories?
4) What is the percentage of measured values of quality cost categories in the companies?

The findings in this research should present the current state of affairs about the extent to which companies apply quality costs, which quality costs categories do the usually measure, as well as the quality costs measured values.

RESEARCH METHODOLOGY

This research employs a methodology that integrates a chronologic, comparative, logic, and systematic analysis of the scientific literature, complemented with inductive and deductive methods that should provide answers to the research questions and, at the same time it should lead to new knowledge, assumptions, as well as considerations for future research.

ANALYTIC RESEARCH

Unlike the development of the scientific thought about quality costs, its verification in the area of empiric results from actual quality costs implementation, represents a feature of a modern age (Daunoriene and Staniskiene 2016, 121). Out of all generic models, the most frequently applies quality costs models (Velkoska, Kuzinovski, and Tomov 2018, 162) in the existing studies include PAF (Prevention-Appraisal-Failure) model and the Crosby Dichotomous Categorization Model: costs of conformance or non-conformance with the requirements.

During the period from 975 to 2014, 42 research studies were published. These studies showed that the quality costs values usually range from 16.91% to 26.9% of the company revenues, and the lowest quality cost value ranges from 2.81% to 3.85% of the company revenues (Mahmood and Kureshi 2015, 13-14).

For the purposes of the research, the authors of this paper systematized and analyzed the already published studies about the value of quality costs. The analysis showed that the percentage share of the quality costs ranges between 4%-38% of the sales value (Banasik and Beruvides 2012, 10; Chopra and Garg 2012, 503; Cheah, Md. Shahbudin, and Md. Taib 2011, 413; Giakatis, Enkawa, and Washitani 2001, 181; Glogovac and Filipovic 2018, 1524; Kirlioglu and Cevik 2013, 94; Mantri and Jaju 2016, 498; Omachonu, Suthummanon, and Einspruch 2004, 279; Starcević, I. Mijoč, and J. Mijoč 2015, 232; Sower, Quarles, and Broussard 2007, 122; Sansalvador and Brotons 2013, 380; Yang 2008, 175-176; Williams, van der Wiele, and Dale 1999, 445), between 7%-40% of the value of production costs (Banasik and Beruvides 2012, 11; Giakatis, Enkawa, and Washitani 2001, 181; Jafari and Rodchua 2014, 223; Omar and Murgan 2014, 397; Starcević, I. Mijoč, and J. Mijoč 2015, 232; Yang 2008, 175;

Williams, van der Wiele, and Dale 1999, 445), and between 18%-33% of the value of the sales contracts (Jafari and Rodchua 2014, 223).

The large span of the interval of the quality costs percentage share, reflects the different company sizes, the business type, the existence of quality programs, the quality system the company maturity, the culture of continuous quality improvement in the companies, (Glogovac and Filipovic 2018, 1303), as well as the improper and untimely identification and measurement of the quality costs (Schiffauerova and Thomson 2006, 664).

Research shows that it could be expected that companies that have greater quality requirements and work in the area of highly productive technologies and electronics, show a higher level of awareness about measuring quality costs and a much smaller share of quality costs, as opposed to companies from the service sector which show much higher values (Schiffauerova and Thomson 2006, 656-660; Williams, van der Wiele, and Dale 1999, 445).

Some of the researchers of quality consider that 2.5% - 5% of the sales value can be expected for the total value of quality costs in order to achieve an optimal level of quality (Jafari and Rodchua 2014, 223). Implementation of the quality program in many companies, have decreased the quality costs to 2% of sales (Trehan, Sachdeva, and Garg 2015, 72). Nevertheless, there are serious dilemmas about the "typical scale of the value of quality costs" (Glogovac and Filipovic 2018, 1525).

Table 1 provides findings derived from the analyzed research studies, related to the percentage shares of surveyed companies applying quality costs (Ayach, Anouar, and Bouzziri 2019, 100-105; Biadacz 2021, 1; Glogovac and Filipovic 2018, 1524; Gupta и Campbell 1995, 43; Omurgonulsen 2009, 547; Porter and Rayner 1992; Prickett and Rapley 2001, 215; Rabfeld et al. 2015, 1074; Sower, Quarles, and Broussard 2007, 122; Starcević, I. Mijoč, and J. Mijoč 2015, 242; Tye, Halim, and Ramayah 2011, 1303, 1307;

Williams, van der Wiele, and Dale 1999, 447; Yang 2008, 176).

The data analysis shows that the application of quality costs in approximately one third of the surveyed companies in the period from 1981 to 2009, suggests that the companies in the world did not broadly accept the quality costs concept. However, in the past decade this percentage has noticeably increased in particular in Germany, Malaysia, Croatia, and Serbia.

Table 2 shows an overview of published research studies that registered the percentage share of companies that measure quality costs by relevant categories. The data analysis suggests that the companies mostly measure the costs of internal and external failures, which reflects the domination of the retrospective aspect of quality costs. A positive surprise is the measurement supplier quality costs, environmental quality costs, and social quality costs, in a more recent research study which indicates that the sustainable operations elements are integrated in the quality costs concept.

Table 3 presents the suggested and measured values of the quality costs categories, as a percentage of the total quality costs. We can conclude that the PAF model structure features a high percentage share of the internal and external failure costs relative to the appraisal costs and prevention costs. This trend is changing in the last two decades, which register a growth of the percentage share of the appraisal costs and the prevention costs, which confirms the development of the preventive aspect of the quality costs.

Table 1. An overview of published research studies that registered percentage shares of surveyed companies applying quality costs

Surveyed companies (year of research study publication)	Findings of research - percentage shares of surveyed companies applying quality costs	
National Survey in manufacturing companies (1981)	33%	Collecting the quality costs.
Companies in United Kingdom (1985)	33%	Collecting the quality costs.
20 manufacturing companies in the North of England (1992)	35%	Made effort to monitor quality costs.
Companies in Western Michigan (1992)	38 %	Have established system for measuring of quality costs.
250 manufacturing companies in United Kingdom (1995)	78%	Understanding the quality costs.
	59%	Reporting the quality costs
Manufacturing companies in USA (1995)	33% (40%)	Calculating the quality costs (from two surveys).
An experimental study with marketing managers (1996)	50%	Calculating the quality costs.
Manufacturing companies (1996)	40%	Performing the quality costs analysis.
The surveys of quality costs conducted in various countries (1998)	33%	Collecting the quality costs.
Companies in USA (2000)	33%	Calculating the quality costs.
1000 Manufacturing companies in North-East United Kingdom (2001)	33%	Application of the quality costs.
Various companies (2003)	33%	Have established system for measuring of quality costs.
393 companies in USA (2007)	34%	Systematically tracking the quality costs.
107 manufacturing companies in India (2009)	79%	Determine and use the cost quality system.
30 food manufacturing companies in Turkey (2009)	23%	Measuring the quality costs.
63 manufacturing companies in Malaysia (2011)	82,5%	Application of the cost quality system.
215 manufacturing and service companies in Germany (2015)	66%	Systematically measuring the quality costs.
48 companies in Croatia (2015)	71,7%	Measuring the quality costs.
186 manufacturing and service-based companies in Serbia (2018)	58%	Determining the quality costs.
	72%	Analysis or usage of the quality costs.
234 various industrial companies in Marocco (2019)	35.5%	Implemented quality costs system.
400 companies from manufacturing, services and production sectors in Poland (2021)	9.75%	Application of the quality costing.
	39.25%	Undertaking some actions towards accounting the quality costs.

Table 2. An overview of published research studies that registered the percentage share of companies that measure quality costs by relevant categories

Surveyed companies and country/ reference	Findings of research - the percentage share of companies that measure quality costs by relevant categories	
330 manufacturing organizations in the North East of United Kingdom (Prickett and Rapley 2001, 216)	93%	Internal failure costs
	88%	External failure costs
	73%	Appraisal costs
	60%	Prevention costs
52 manufacturing companies in Malaysia (Tye, Halim, and Ramayah 2011, 1307)	44.2%	All four categories of the PAF model
	19.2%	The three categories of the PAF model
	30.8%	The two categories of the PAF model
	5.8%	One category of the PAF model
136 small and medium-sized manufacturing organizations in Slovakia (Šatanová et al. 2015, 1152**)**	67%	External failure costs
	39%	Internal failure costs
	30%	Prevention costs
	26%	Appraisal costs
140 manufacturing and service companies in Germany (Rabfeld et al. 2015,1077)	63.4%	External failure costs
	61.3%	Internal failure costs
	18.3%	Prevention costs
	11.3%	Cost of conformance
	3.5%	Cost of non-conformance
	4.2%	Opportunity costs
134 manufacturing and service-based companies in Serbia (Glogovac and Filipovic 2018, 1533)	46.3%	Total quality costs in all processes
	55.9%	Total quality costs in production processes
83 various industrial companies in Marocco (Ayach, Anouar, and Bouzziri 2019, 107)	49.4%	Total quality costs at all processes
	26.5%	Total quality costs in production and some other processes
	24.1%	Control total quality costs in production processes
	34.5%	Cost of non-conformance
	16.8	Stock management costs
	14.8	Over-consumption costs
	10.4	Supplier non-quality costs
	7.6%	Environmental non-quality costs
	8%	Social non-quality costs
39 companies from manufacturing, services and production sectors in Poland (Biadacz 2021, 22)	30%	Costs of prevention activities
	41.75%	Costs of quality assessment
	31%	Costs of internal deficiencies
	36.5%	Costs of external complaints
	18.75%	Costs of external quality assurance

Table 3. An overview of published research studies that registered the suggested and measured values of the quality costs categories

Reference	*The suggested and measured values of the quality costs categories expressed as percentage of total quality costs*			
	PC	AC	IFC	EFC
Proposal for optimal proportion				
(Su, Shi, and Lai 2009, 1398)	0.5-5 %	10-50 %	25-40 %	20-40 %
	5-10 %	20-25 %	65-70 %	
Published quality costs data for manufacturing companies in the booklet the Urwick Group				
(Plunkett and Dale 1988, 1722)	2-5 %	10%	85-87%	
Expected percentage of the quality costs				
(Williams, van der Wiele, and Dale 1999, 449)	5%		95%	
The data draw from the national Council for Quality and Reliability - UK				
(Williams, van der Wiele, and Dale 1999, 449)	5 %	30 %	65 %	
Studies conducted in manufacturing company				
(Giakatis, Enkawa, and Washitani 2001, 181)	3.3%	40.3 %	56.4%	
	6%	14%	80%	
Quantitative data taken from quality-costing literature				
(Williams, van der Wiele, and Dale 1999, 450)	5%	28%	67%	
Study conducted in manufacturing industry				
(Williams, van der Wiele, and Dale 1999, 451)	22%	30%	48%	
Study conducted in automotive industry in Shanghai				
(Su, Shi, and Lai 2009, 1403)	4.8 %	26.5 %	44.4 %	24.3 %
Study in a manufacturer of coatings for industrial applications				
(Pursglove and Dale 1995, 572)	18%		68 %	14%
Study conducted in manufacturing industry in USA, for the first year of quality program and the latest year of quality program				
(Ittner 1999, 119)	18.4% (23.9%)	27.3% (28.7%)	38.9% (34.8%)	16.2% (13.3%)
Summary of reported quality costs in studies published in the period of 1972-1995				
(Burgess 1996, 12)	3.3%-20%	8%-45.3%	46%-79%	

	PC	*AC*	*IFC*	*EFC*
Study conducted in manufacturing industry in Malaysia				
(Cheah, Md. Shahbudin, and Md. Taib 2011, 413)	16.8 %	17.5 %	65.7 %	
Study conducted in water utilities in Texas				
(Banasik and Beruvides 2012, 7,10)	15.5 % 27.3% 22%	29% 31% 28.8%	55.5% 41.7% 49.1%	
Study conducted in manufacturing industry in Turkey				
(Kirlioglu and Cevik 2013, 95)	14.1 %	39.8 %	35.2 %	10.9 %
Study conducted in woodworking company in Slovakia				
(Sedliacikova et al. 2015, 79)	27.38 %	22.67 %	41.34 %	8.61 %
Study conducted in small and medium-sized manufacturing organizations in Slovakia				
(Šatanová et al. 2015, 1152)	24%	41%	16%	19%
Study conducted in Indian manufacturing organizations				
(Mantri and Jaju 2016, 503)	11.55 %	39.96 %	45.07 %	3.43 %
Study conducted in manufacturing organization				
(Holota et al. 2016, 124)	14%		86%	
Study conducted in manufacturing company in South-East Asia				
(Omar and Murgan 2014, 412)	13.5 % Production invisible quality costs 49.5% Visible quality costs 36.9 % Opportunity costs			

Note: PC – Prevention costs, AC – Appraisal costs, IFC – Internal failure costs, EFC – External failure costs.

CONCLUSION AND RECOMMENDATIONS

Irrespective of the many dilemmas and polemics related mostly to the structuring and determination of the quality costs elements in the quality costs definition models, the existence of quality costs is justified. The data shown in the analytic research, sufficiently corroborate that quality costs represent a serious economic category that most closely and inexorably reflects the state of quality and should not be neglected since they represent a huge opportunity to provide financial savings to the company by improving quality, which in turn increases profits.

The research presented in this paper confirms the need to raise the awareness, the determination, and the commitment to a broader

application of quality costs. This can be provided by integrating the new societal values in contemporary operations which will not only shift the quality costs from the margins of a purely theoretical concept, but will also contribute to deepening and modernizing the theoretical findings.

Considering that modern management science is fully committed to the management of the overall quality in order to generate sustainable benefits for companies, there is an inevitable synergy of the quality costs with methodologies such as Six Sigma, Total Quality Management, Lean Production etc., the standardized quality management systems, environmental protection, health, and safety at work and other standards, as well as the social responsibility standard.

Future research should involve continuous study of the contribution of the contemporary ambitious concepts such as *Sustainability, Industry 4.0, Quality 4.0, Business Process Reengineering, Circular economy – Remanufacturing, Innovation 5.0,* to the development of a higher level of quality maturity in the companies, which will make the application of quality costs more attractive. This will help redesign and redefine the quality costs structure with new and modern quality costs elements and the quality costs concept will be reaffirmed in a new direction and become recursive.

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