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A REVIEW: MODELS COSTING QUALITY AND ITS IMPACT ON THE PLANNING AND CONTROL PROCESSES IN MANUFACTURING INDUSTRIES

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ABSTRACT

In today's world, industrial organizations must pay attention to policies and procedures that balance cost and quality in production processes. Therefore, it must adopt a framework that enables it to accumulate the CoQ. The purpose of this work is to understand CoQ analysis's philosophy, its impact on the planning, control processes in industrial companies, the mechanism of reporting in the financial report, its importance in reducing costs, and enhancing competitive advantages. Also, this work intended to complement the existing literature by reviewing and critically appraising several CoQ models together with details of their application. The study results show that conformity costs are subject to Control. Planning processes are the costs of conformity as for the expenses of non-conformity, cannot be avoided. In general, every philosophy and approach views quality from its perspective. Still, everyone agrees that the product must meet the customer's needs, requirements, and desires.

Keywords: Total Quality Cost, Quality Costs Models, Control, Planning Processes

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1. INTRODUCTION

Despite CoQ models' diversity, the most widely applied model in practice is the traditional PAF for the CoQ model, introduced by Feigenbaum (1956). The original model of Feigenbaum still provides a frame of reference for CoQ and quality improvement. However, it is not very adequate for current manufacturing processes. Of course, the company's operations characterized by rapid change based on changes in the environment, work to adapt to these changes for survival and continuity, so the companies have re-evaluated ideas, develop performance, search for ways to limit, reduce the types of waste and loss in all operations through inputs or outputs. According to its needs, each company can edit its CoQ model because it may not be necessary for

another company. These differences among companies are resulting in the various CoQ structures. Therefore, there is not one basis that can be used in comparing the results of different companies.

It was concluded that the institutions that applied the quality programs could achieve cost savings from the production process. Still, these results were generalized to companies operating in the industrial sector only. Meaning can be said that quality cost programs have achieved success in an application in industrial sectors. Many classifications deal with quality cost models. Still, all of the traditional PAF classifications were introduced by Feigenbaum (1956). Quality costs are classified into prevention costs, appraisal costs, and failure costs (internal, external).

The prevention costs are represented by the impenetrable dam through which the defective products will be eliminated or reduced. In other words, it is the costs incurred in doing things correctly at first glance Crosby (, 1976). Generally, these costs include planning, design, training, pre-production calibration, identification of quality problems, etc. In comparison, evaluation costs include reviewing, inspecting, and testing processes related to quality, laboratory testing, and external inspections.

Regarding failure costs, the costs will disappear if there are no non-conforming products, including internal failure due to insufficient production and external failure. The product does not meet the desires and expectations of customers. On the other hand, many companies want to provide high-quality products that meet customers' wishes and needs. Suppose the company fails to provide satisfactory outcomes. In that case, it may incur additional costs represented by the prices of defective products and recycling costs, thus reflecting negatively on the final product's costs. Note that there are hidden costs of quality that can be avoided if greater attention is given to product care to reach the customer to achieve satisfaction, thus increasing the customer's confidence in the company's products, which leads to achieving competitive advantage.

The factors that can be avoided, thus add value to the final product are called the hidden CoQ, which are the costs borne by the customer as a result of the purchase of the product, the cost of customer dissatisfaction with the product, the price of loss of goodwill, in addition to the costs of internal and external failure, which are considered CoQ control. Thus, additional costs can be avoided by focusing on controlled cost elements and adding value to the product.

Through this study, CoQ's impact on industrial companies' planning and control processes was studied through the main paragraphs. Emphasis on the research methodology, the theoretical framework statement, and previous studies, the last section was devoted to discussion and conclusions.

2. RESEARCH METHODOLOGY

This article aims to study, understand the philosophy, analyze total CoQ, impact the planning, control processes in industrial companies, the report's mechanisms in the

financial statements, and their importance in reducing costs. As well as in enhancing competitive advantages. The emphasis was placed on the descriptive-analytical approach through management accounting and cost accounting literature to achieve the research objective. In comparison, the study strategy was developed by reviewing three papers, which serves as a beacon that guides this field's interest. The three schools of quality, for each to Juran, Deming, and Crosby, detailed studies of CoQ models in industrial companies, were conducted.

3. THEORETICAL FRAMEWORK AND PREVIOUS STUDIES QUALITY COSTS CONCEPT (COQ)

The concept was first used by Juran (1951) in the early 1950s, where he called for the need to estimate the CoQ. Feigenbaum (1956) subsequently defined the quality cost approach, known as the traditional PAF approach, in the literary milieu. Initial explanations for quality costs were identified by Juran (1962), stating that increased spending on prevention and appraisal costs reduced failure costs (internal and external). Crosby (1976) introduces the conformance costs and non-conformance costs approach, in which this approach is an arrangement of the concepts introduced by Juran (1951) and Feigenbaum (1956). Although several authors have addressed the interpretation of the CoQ, this concept is still not widely uniform. Defined by Juran (1951), costs would not occur if there were no inferior products. According to Crosby (1976), the cost incurred in doing things correctly is from the first stage. The quality cost categories are determined acceptably by Feigenbaum (1956) and Crosby (1976). In Comparison, Crosby (1979) defines CoQ as the conformance price and non-conformance price.

The low-quality costs include "those costs associated with avoiding poor quality" and "those incurred as a result of poor quality" Evans and Lindsay. (2011). CoQ would represent the difference between the actual cost of a product or service and the reduced cost if there were no possibility of substandard service, product failure, or manufacturing defects. "Financial Measures For The Strategic Implementation Of Quality Management" (2012), Feigenbaum (1956).

CoQ's precise definition in the accounting literature is due to Juran, who followed the same interest (Crosby, Feigenbaum, and Deming). It was the agreement of most authors in the measurement, classification of CoQ to propose five basic models as shown in the Table 1 .

They are considered as investments made to keep appraisal and failure costs to a minimum, that is, to reduce the other two quality cost categories ultimately. Chopra and Garg (2011), Tsai (1998), Al-Dujaili (2013), Elmaki (2017), Jafari and Love (2013)& Lari and Asllani (2013) et al.

Table 1 GenericCosts Of Quality Models

Generic model	Cost /activity
P-A-F models	Prevention+ appraisal+ failure
Crosby's model	Prevention+ appraisal+ failure+ opportunity Conformance + non-conformance
Opportunity or intangible cost models	Conformance + non-conformance + opportunity Tangible + intangibles
Process cost models	PAF (failure cost includes opportunity cost) Conformance + non-conformance
ABC models	Value-added + non-value-added

4. MODEL PAF

According to Feigenbaum (1956), classified quality costs as the cost of prevention, appraisal, and failure, this classification is considered to be generally accepted among researchers and those interested in the prices of quality, as well as companies that adopt systems of continuous improvement through which the costs of quality are determined. In general, the quality costs can be divided down into four major components: prevention costs, appraisal costs, and failure costs (internal & external failure costs). Prevention costs are those costs associated with preventing defects from occurring.

Prevention costs: These costs are associated with the design, implementation, and maintenance of the TQM system. Prevention costs are planned and are incurred before actual operation Tsai (1998). While defined by Chopra and Garg (2011), these are the expenses that occurred to prevent the occurrence of defects and nonconformities and include the qualifying expenditure to keep unsatisfactory products from coming about in the first place. According to Al-Dujaili (2013), quality planning, designing, implementing, and managing the quality system, auditing the course, supplier surveys, and process improvements are associated with quality planning.

Appraisal costs: These costs are associated with the supplier's and customer's assessment of purchased supplies, processes, intermediates, goods, and services to assure conformance with Tsai's specified requirements Tsai (1998). Appraisal costs are associated with measuring the level of quality attained by the process Elmaki (2017). While indistinct by Chopra and Garg (2011)are the costs associated with measuring, assessing, or auditing goods, components, and purchased materials to assure conformance with quality standards and performance requirements. According to Al-Dujaili (2013), they are associated with measuring, evaluating, auditing products and raw materials to ensure conformance with quality standards and performance requirements in the factory. In other words, it is the detection of errors or defects by measuring conformity to the required level of quality: incoming and completed material inspection Jafari and Love (2013).

Failure Costs: Costs resulting from products or services not conforming to requirements or customer/user needs. Failure costs fall into internal and external

categories.

Internal failure costs: These costs occur when work results fail to reach designed quality standards and are detected before transfer to the customer occurs. According to Al-Dujaili (2013), these are associated with processes, equipment, products, and product materials that are defective or fail to meet quality standards or requirements. While defined by Chopra and Garg (2011), these are the costs that occur when products, components, and materially fail to meet quality requirements before the transfer of ownership. These are costs that would disappear if there were no defects in the product.

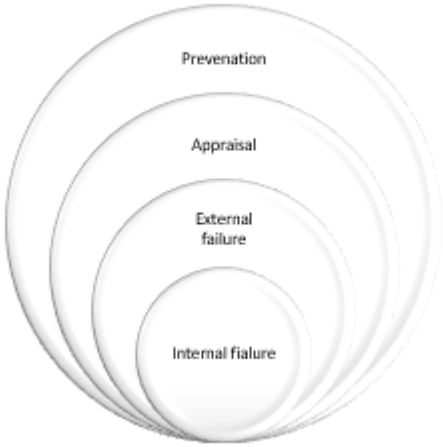

Figure 1 **A model for COQ Source: Adapted from authors**

External failure costs: External failure costs are the costs that occur when products or services fail to reach design quality standards but are not detected until after transfer to the customer. According to Al-Dujaili (2013) & Lari and Asllani (2013)et al., the external failure costs are generated by defective products, services, and processes during customer use. Chopra and Garg (2011) defined it as the costs that occur when the product does not perform satisfactorily after transferring ownership to the customer. These costs would also disappear if there were no defects in the product. According to Lari and Asllani (2013), Chopra and Garg (2011) , Al-Dujaili (2013) et al. They include warranties, complaints, replacements or recalls, repairs, insufficient packaging, handling, and customer returns.

5. CROSBY'S MODEL (1979)

This model does not differ much from the PAF scheme. (Crosby) believes that quality is "conformance to specifications" and, therefore, defines the CoQ as the set of conformance and cost of non-conformance. The cost of conformance is the cost involved in ensuring that things are done right the first time, including actual appraisal and

prevention costs. The non-conformance cost is the money wasted when work fails to conform to customer wishes—usually calculated by quantifying the cost of correcting, reworking, or scrapping, which corresponds to actual failure costs.

6. INTANGIBLE COSTS' MODELS

These models focus on the role of intangible cost within the total quality cost scheme. In general, intangible costs can only be estimated, such as profits not earned because of lost customers and reduction in revenue due to the non-conformance. This group of model's intangible or opportunity losses cost is incorporated into a typical P-A-F scheme N.M. Vaxevanidis et al. (2009).

7. THE PROCESS COST MODE

this is having been model developed by Ross (1977), and first used for quality costing by Marsh (1989), represents systems of quality costs that focus on process rather than products or services Schiffauerova and Thomson (2006). This model also represents enforcement for continuous improvement within the company. According to this model, the cost of quality means the sum of conformity costs with non-conformity costs for a specific production stage. According to the standards and a particular production set, the expenses according to the production phases represent the production stage's actual costs according to the standards and a specific production set. The costs of non-conformity of the production stage, consistent with the concept of failure, are costs resulting from deviations of actual expenses from the criteria set during a specific production stage. Nevertheless, this model is more important than the PAF model. The operations model has broader application. It facilitates collecting and analyzing quality costs for both direct and indirect functions Porter and Rayner (1992). This model differs from the Crosby model in the possibility of identifying the costs of conformity and non-conformity costs for each production stage separately. In contrast, the Crosby model determines this type of charge for the final product only. However, the process cost model is not in widespread use Goulden and Rawlins (1995).

The main difference between the three quality schools lies in the issue of measuring CoQ. Joran considers that industrial companies must measure CoQ regularly to be one of the management tools for control operations. Crosby is not much different from this concept. It is considered that measurement processes may help develop the administrative perception of quality, even if it is not for Control. In Comparison, Deming has an entirely different view of Crosby and Joran in measuring quality costs. Measuring CoQ is a failure to understand product quality problems.

Analyzing this cost is a massive waste of time. Although there are differences in views on quality measurement, all these approaches have been agreed upon in terms of the quality objective. Quality aims to continually improve and measure customer

Table 2 **A Comparison Of The Viewpoints Of Crosby, Deming, And Juran**

Crosby 1979	Deming 1982	Juran 1951
There is no general acceptance in accounting literature about the importance of quality control and reporting on industrial companies' cost of quality. Still, each of the three quality schools of Deming, Crosby, and Joran has a distinctive and different style for each school.		
It is proposed to measure the CoQ, Though not for Control, But with the aim of administrative cognition of the concept of quality. The CoQ is the cost assigned to match the product with the customer requirements specification. The cost of quality is the sum of the costs of conformity with the expenses of non-conformity. The cost of conformity means paying attention to the product's productivity to the fullest from the first attempt, including prevention and appraisal fees. The non-conformity costs represent the waste resulting from the product's incompatibility with the customer's requirements and wishes. It usually includes the costs of reworking and evaluating the product and is originally the cost of failure. Hidden CoQ is costs that can only be estimated, such as unrealized profits, due to loss of customers and lower revenues due to mismatches.	Measuring CoQ is a failure to understand product quality problems. The analysis of this cost is a big waste of time where the product free of defects is right.	One of the most general or applied curriculum. It emphasizes the measurement of CoQ periodically as an administrative control tool. Quality is a suitable product for the customer's uses.
The three schools of quality agree in terms of management responsibility, where departments establish an organizational structure that focuses primarily on quality. These schools also agree on more than 85% of quality problems related to management policies in its operation and management. In comparison, all of these schools decided that quality lies in continuous improvement and customer reactions to its product after making improvements. In general, all these schools agree that the product must be commensurate with the customer's needs and desires.		

Deming (1982), Crosby (1979), Juran (1951).

feedback on its product after making improvements. It is clear from the table above that there are similarities and differences between these models. All models are consistent in quality goals, aiming to continuously improve and measure customer reactions to the company's product after making improvements. Deming and Taguchi agree with the basic orientation towards quality, by the essential factor to quality are technical. While Juran Considered the exposure is interim, Crosby the motivational Considered the critical factor in accessing quality. Deming's view of quality is that a perfect product is a right product. While Joran's Considered that quality is a product

Table 3 **Comparison Of Quality Approaches**

Quality	Juran's model	Deming's model	Crosby's model	Taguchi's model
The primary orientation towards quality	Interim	Technician	Motivational	Technician,
What is quality?	suitable for use	Non-defective system (Zero Defective System)	A system conforming to specifications	focus on customer requirements
Quality target	customer happiness; the continuous improvement	meet or exceeds what the customer needs; the continuous improvement	the constant improvement; zero defects	meet to customer's needs; the continuous improvement
Quality access methods	costing quality through planning, Control, and improvement	Statistical Methods	The frame consists of 14 points	Statistical Methods
Key elements of quality application	Completed large projects; quality board, quality team	The frame consists of 14 points	The frame consists of 14 steps, a quality maturity network	Statistically designed experiments; quality team
Element of Goodwill	Management is responsible for the quality	Course (planning, working, checking, Executing)	Zero defects	the introductory model of a product after development

Sources: 1. Marsh (1989), Deming (1982), Crosby (1979), Unal and Dean (1990).

suitable for customer uses, Crosby and Taguchi are no different from this concept. The Crosby model is known for its zero-defect model. Simultaneously, Juran considers that management is responsible for quality because it falls under its responsibilities. While the model of both Taguchi and Deming is closest to the applied method by giving space to experiment and correct mistakes as they occur.

In general, every philosophy and approach views quality from its perspective. Still, everyone agrees that the product must meet the customer's needs, requirements, and desires.

8. ABC MODEL

Despite the success of both the (ABC) model and the process model in identifying and measuring quality costs, the problem remains in the possibility of identifying and charging indirect quality costs, which distinguishes the cost-based quality system from the previous models. (ABC) was first introduced by Cooper and Kaplan (1988)Business School. ABC is defined as a system based on the collection of indirect costs of the company in cost pools to be distributed to the product by cost drivers

to achieve a more accurate price for the final product, leading to assist management in making sound decisions. This system contributes to improving the profitability of the company by reducing costs for non-value-added activities. Thereby reducing unexpected product losses. According to this system, prices are determined in two phases: the first phase through the allocation of indirect industrial costs on the costs pool. The second stage is to allocate the costs of activities on products based on the needs of products from these activities. This system also has a practical impact on the company's decisions and even on pricing decisions by calculating the product's cost more accurately. Usually more accurate to design a product or introduce a new product on the market. According to N.M. Vaxevanidis et al. (2009), The main shortcoming of traditional cost accounting is distributing overhead costs over products using volume-related allocation bases such as direct labor hours, direct labor costs, direct material costs, machine hours, etc. It will not seriously distort the product cost in the conventional manufacturing environment, where overheads are just a tiny portion of the product cost. In the modern manufacturing environment.

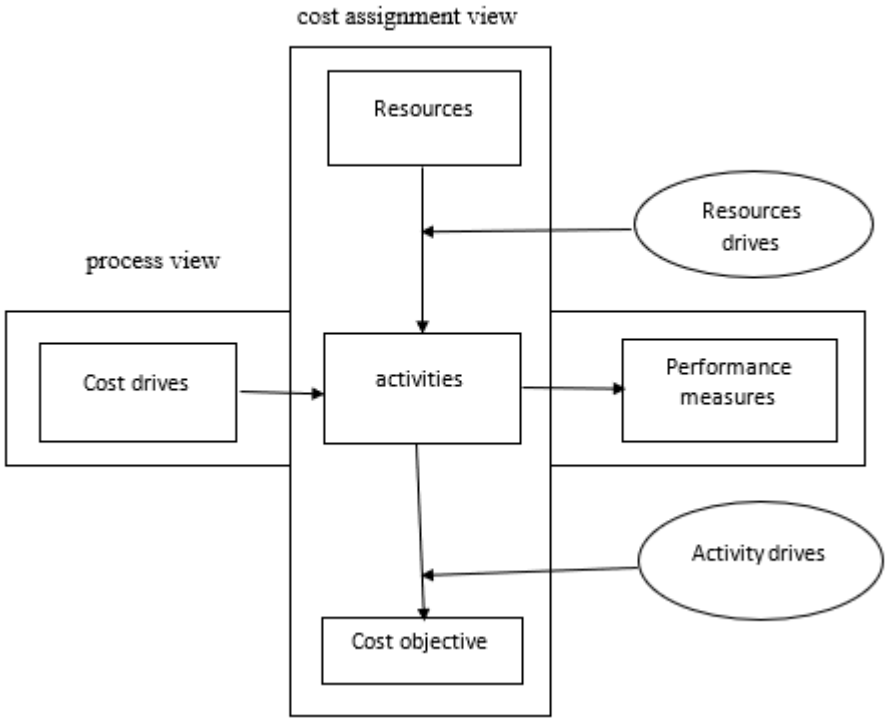

Figure 2 Two-DimensionalModel Of Abc

Sources: Vaxevanidis et al. (2009).

The CoQ models may be similar and vary in style, method of application, or purpose. Similarities and differences between CoQ approaches and the ABC system can be summarized in Table 4 . The ABC system combines the PAF model with the pro-

cess model. In terms of the overall thrust of measuring costs. ABC also has a distinct cost classification by classifying it into value-added and non-value-added activities. In contrast, the PAF scheme classifies the CoQ to prevention, appraisal, and internal and external failure costs. In contrast, the process model is closest to the Crosby viewpoint regarding classification to the conformance costs, non-conformance costs.

Table 4 Comparison Between Main Coq Approaches And Abc

aspect of comparison	Quality Costing		ABC Model
	PAF Model	Process Costing Model	
Orientation	activity-oriented	Process-oriented	Activity-oriented (cost assignment view) process-oriented (process-view)
Activity/costs categories	prevention, appraisal, internal failure, and external failure costs	Conformance costs and non-conformance costs	Value-added and non-value-added
Treatment of overhead	doesn't there an appropriate way to track the costs of quality based on its causes		Track activity costs to cost purposes through activity drives, in the second step of cost allocation using the ABC method
Tracing cost to their sources	No adequate method to trace quality cost for their sources		Tracing activity costs to cost objects by using activity drivers in the second stage of the ABC assignment view
Improvement objective	Activities related to quality costs	process-related activities	Activities/process
Tools of improvement	Quality circle, brainstorming, nominal group technique, cause and effect analysis, force-field analysis.		Process/activity value analysis, performance measurement, reference comparison, and cost-oriented analysis.

Continued on next page

Table 4 continued

Information outputs	Cost elements of the prevention, appraisal, and failure totals and their ratio compared to different bases, the total quality costs.	The costs of conformity and non-conformity costs of the production processes and their ratio compared to different bases, the cost of the comprehensive approach.	The costs of activities and processes of activities that add value and non-add value to actions and their ratios compared to various bases, more accurate prices of different fees objects (products, sections, and customers), activity-based Performance measures of costs, cost drives of activity.

Vaxevanidis et al. (2009).

The importance of the ABC system lies in the treatment of indirect costs. In contrast, these types of expenses remain in the absence of an accurate determination of the number of the costs distributed to the units produced.

9. CONTROLLING THE TOTAL COQ FOR MANUFACTURING ACCORDING TO PHILOSOPHY (PAF)

The growing pressure of developing markets leads managers to implement improved access analyses, planning and controlling, the innovation of organization structure and information systems Kilger et al. (2012). A condition for success is becoming maintaining, integrating information processing, business planning analyses, and managing Eschenbach and Siller (2011). according to Horváth (2008), the planning and control process is one of the tools that can secure, transform, and complete information about financial results.

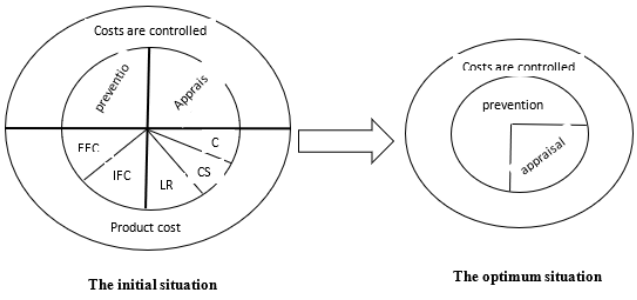

Figure 3 Controlled And Uncontrolled Coq

Source: Beecroft (2001).

Where, **[IFC=** internal failure costs**; EFC=** external failure costs; **CC=** costs the customer; **CS=** customer satisfaction**; LR=** loss of reputation**].**

That means it is planned and controlled. Control is also visible in quality management concerning managing quality costs Sasse (2001) & Wildemann (2000). however, necessary to interconnect the cost of quality monitoring with orientation on a customer, with the process orientation in the area of quality, where monitoring legal costs of quality indicators need to be supplemented by performance process indicators. In the end, controlling quality principles are closely related to principles of total quality Satanova and Sedliacikova (2015). There are avoidable costs and make them controlled. Note that there are hidden costs of quality, represented by the customer's fees, loss of reputation costs, and customer dissatisfaction. Ideally, after eliminating the hidden costs of quality, notice that all prices are controlled, prevention costs are much higher than appraisal costs and take a large part of its quality cost structure. Thus, the possibility of eliminating the costs of failure in all internal and external forms.

On the other hand, the basic philosophy of prevention, appraisal, and failure costs (PAF) is that failure costs are inversely proportional to prevention costs. That is, the higher the prevention costs, the more progressively lower the appraisal costs. As a result, companies can get rid of or reduce the cost of internal and external failure.

10. DISCUSSION AND CONCLUSION

Quality is not only a technical category. The system of management system is not focused on product quality orientation. Quality and costs are closely interlinked. For this reason, part of the quality management system should monitor the structure of CoQ Weinstein et al. (2009a) . The primary objective of using CoQ data for continuous improvement is to fight CoQ, reduce them to zero levels. Attention to CoQ reports is also a target for users of published internal and external accounting information. Therefore, the company's management can plan and control. Thus, it is possible to reduce these costs, pursue continuous improvement in the quality of products, and access competitive advantage. Focusing on prevention costs reduce appraisal costs, thus obtaining a lower price of failure, Where the expenses that are subject to the control and planning processes are the conformance costs as for the non-conformance costs, cannot be avoided even though most examples confirm that quality improvement, cost measurement processes significantly reduce a company's CoQ towards quality excellence. The literature presented and reviewed noted a significant role of the CoQ model in achieving costs and achieving a competitive advantage by reducing the non-conformance costs between product quality and customer requirements. Thus, gaining a competitive advantage over other companies. But in many enterprises, this does not work. ISO standards and the TQM approach are also devoted to processing measurement, including quality management's economic fundamentals Rosenfeld (2009). There is still difficulty in implementing the PAF scheme

for many industrial companies. This is due to the problem of applying, finding the proper practices, and their cost factors.

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