Identification and Management of Quality Costs in Companies

Joselyn Garcia-Ortega and Gabriela Chica-Contreras
LIDI, Accountant and Auditory School,
Universidad del Azuay, Cuenca, Ecuador
jgarcia@es.uazuay.edu.ec; magaby@uazuay.edu.ec

Juan Manuel Maldonado-Matute and Maria Jose Gonzalez Calle
UDA Business Observatory, Bussiness Adninistration School
Universidad del Azuay, Cuenca, Ecuador
jmaldonado@uazuay.edu.ec; mgonzalez@uazuay.edu.ec

Catalina Astudillo-Rodriguez and Paul Crespo-Martinez
LIDI, Computer Science Engineering School,
Universidad del Azuay, Cuenca, Ecuador
cvastudillo@uazuay.edu.ec; ecrespo@uazuay.edu.edu

Ana Vasquez-Aguilera
LIDI, Engineering of Production School
Universidad del Azuay, Cuenca, Ecuador
anavasquez@uazuay.edu.ec

Abstract

Companies implement quality management systems to be more competitive and achieve organizational objectives efficiently; Quality is essential for any type of company and is present in all processes that are designed with the purpose of guiding the company towards a culture of continuous improvement. Because traditional cost accounting does not perform in-depth quality cost analysis, this research develops a methodology that allows companies to identify, quantify, and manage quality costs from an accounting perspective. The methodology used has a cross-sectional approach and analyzes companies as generic entities without focusing on a specific activity or sector, as results a process map is proposed to identify where the main quality costs are located, considering the main activities that can be develop within a company, then a chart of accounts is presented that allows recording the different costs related to quality, and finally indexes are proposed for their management. The method and results are consistent with traditional accounting and operations management. It can be combined with business management tools such as ERP systems. This method can be of special interest to small and medium-sized companies due to the complexity and cost of having ERPs commercial systems that perform this type of analysis.

Keywords

Administration management, Quality management, Quality accounting and Cost accounting.

1. Introduction

Organizations seek to be competitive, because markets are changing and dynamic over time, this change requires the development of higher quality products and services at the lowest possible cost, in this way organizations can secure new customers and maintain already existing ones, offering a range of products and services that seek to satisfy customer expectations. Meeting these expectations is of vital importance for organizations, since it allows them to maintain and increase their profits, preserve or improve the image of the company, and allows a better understanding of the reality of their processes and operations. On the other hand, poor quality is reflected internally in organizations, both in product and service defects and in financial statements; The mismanagement of the processes that add value

can occur in as early stages as in activities related to external suppliers and supply activities, going through internal processes, to distribution activities that allow products and services to reach end users.

Quality within companies must be understood as a fundamental element to achieve the success of business work, which goes hand in hand with continuous improvement. Quality assurance not only depends on the monitoring and follow-up of transformation processes, but can also be achieved through an adequate knowledge of quality costs, this through a mechanism that allows to identify, quantify and subsequently manage these costs, without being this proposal contrary to commonly accepted standards in International Accounting Standards (IAS) (International Accounting Standards Board, 2016).

Just as quality is a critical dimension of competitiveness, costs are for profitability; It is very common for managers when considering improvements in quality systems to ask themselves, what is the cost of quality management? and what are the benefits of quality improvement? (Kehoe, 1996)

1.1 Objectives

This research aims to propose a methodology to identify, quantify and manage quality costs in organizations, the methodology covers the main processes that allow the materialization of a product from an accounting perspective consistent with international accounting standards.

2. Literature Review

The economic, social and industrial progress of a country depends primarily on its high levels of productivity and quality, as well as on the constant growth of these components, which leads to planning and following an adequate strategy to achieve them. At present, various ways of managing quality have emerged, which is why quality management systems constitute a necessary instrument that allows to achieve a competitive advantage in the market. Quality is designing, producing and delivering a product of total satisfaction, as well as doing things right from the first time (Díaz and González, 2018).

The International Organization for Standardization (2015) points out that quality is the fulfillment of the requirements of a set of inherent characteristics. Leyva and Moreno (2013) state that quality should not be seen as an indeterminate and incalculable concept, rather it should be perceived as an ally of the company in the search for good business performance and continuous improvement of its processes, which allow discovering opportunities that lead to improvement and credibility of management's work in order to meet customer expectations.

The objective of quality costs is to analyze business processes from a technical-accounting perspective (engineering and accounting), these have a focus on continuous improvement since they allow taking corrective actions and eliminating activities that do not generate value to the service or product and that on the contrary have an impact on the economy of the company. In the same way, the adoption of a management system oriented to quality and cost reduction helps to give the product or service an added value, since it focuses totally on the client (external and internal) with the objective of satisfy their needs and expectations (González-Reyes and Moreno-Pino, 2016). Ramos et al. (2014) state that quality costs are the financial image that makes possible the identification and management of activities corresponding to management processes, such as planning, control and improvement; This shows the transversal nature of these activities, which can range from the strategic level to the operational level of the organization. Thus, planning is related to prevention costs, control is associated with evaluation costs, and improvement is managed based on preventive and corrective measures, resulting in lower failure costs.

For his part, Valenzuela (2016) defines quality costs as those expenditures for activities developed to deliver customer satisfaction through the product or service, these costs are generated before the product or service is delivered to the customer. On the other hand, this author indicates that poor quality costs are those expenditures for activities carried out as a result of not having done things well and in turn trying to satisfy the customer. Quality costs are classified into prevention costs and evaluation costs, and poor-quality costs are classified into internal failure costs and external failure costs. In the same vein, quality costs have an incidence from the moment a company's quality systems are designed, implemented, operated and maintained, these business costs are also linked to continuous improvement processes, and to the costs of products, services and systems that did not give positive results or were rejected by the

market. From the perspective of García et. al (2002) these costs are categorized into quality prevention costs, quality evaluation costs, internal costs of poor quality and external costs of poor quality.

Oña et al. (1998), Torres and Callegari (2016), Arango (2009) and the previously cited authors agree on the way to categorize quality costs, coinciding in the following categories: prevention costs, evaluation costs, costs for internal failures and costs for external failures; although it is convenient to classify these categories into two large groups such as: costs to ensure quality and costs of non-quality, or as Kehoe (1996) calls it, costs of conformities and costs of non-conformities. Mukherjee (2019) and Arango (2009) coincide in defining these categories as detailed below:

- Prevention costs: they are all the expenses that are generated to do things well from the first time the work is carried out, these expenses are within the fixed costs, variable costs and indirect costs.
- Evaluation costs: these are all the expenses that originate in the production and audit of the process to measure the conformity with the pre-established criteria and procedures.
- Costs of internal failures: these costs occur when the activities were not done well from the first time, so costs are generated due to errors made by the company and that are detected before the product or service is delivered to the customer.
- Costs of external failures: are all those errors incurred by the producer and occur when the product or service has already been delivered to the customer, that is, unacceptable products or services are supplied.

Quality costs can be considered as a criterion for evaluating quality management, but only if valid comparisons can be made between different sets of cost data. The comparability of data sets depends on the definitions of the cost categories and the elements used to compile them (Dale, 1991).

Gao and Zhang (2016) mention in their research the importance of hidden costs of quality, since usually more attention is paid to explicit costs and hidden costs are omitted, which represent the highest percentage of the total cost of quality. Similarly, Sansalvador and Brotons (2014) establish that quality costs are one of the most important aspects in the development of a quality management system, the authors conclude, like Gao and Zhang (2016), that one of the main problems of estimating quality costs in companies is the existence of hidden quality costs whose quantification becomes uncertain, hence the importance of a correct mapping of each of the activities that can generate quality costs within of an organization.

3. Methods

The research is interdisciplinary, since it is based on traditional accounting, production administration, quality management and cost accounting, it seeks to make a proposal that allows to identify, classify and determine indexes for quality cost management considering three quality perspectives. First, the specific quality of the product, which occurs exclusively in the production process, where the product is expressly transformed; second, the quality of the production process, which has to do with supply, production and distribution activities, the processes related to this perspective are presented from the moment the goods or services are designed, until their sale and delivery materialize; The processes related to obtaining supplies, maintenance and control of the plant, as well as those related to after-sales are also considered; Finally, the quality of the organization as a whole is considered, it is visualized in all the processes that are designed to guide the company and its activity, management, manufacturing and complement other processes.

The proposed method involves three phases, in a first stage it is identified where the quality costs are generated and what they are through a generic process map, this map analyzes companies as generic entities without focusing on a specific activity or sector; Later a classification of the identified activities is made considering two categories, costs to ensure quality and non-quality costs. In the second stage, the quality costs are organized; Through a generic chart of accounts in accordance with International Accounting Standard 1 (IAS 1), it is proposed that companies present a breakdown of expenses, using a classification based on their nature or according to the function they fulfill within of the organization; The proposed chart of accounts is expected to be compatible with the company's existing accounting and can be coupled with it, without becoming a parallel accounting system. Finally, the last stage seeks to determine indexes so that companies can carry out quality cost management, these indices are expected to be complementary to the ratios that companies usually use for the analysis of their financial and operational performance. Additionally, the methodology and result of this investigation were tested in the ERP-UDA platform developed by the University of

Azuay, which aims to become a low-cost management tool for use in small and medium-sized companies, information and details about this tool are included in (Astudillo-Rodríguez et al. 2020).

4. Results and Discussion

The proposal seeks to manage the quality and costs of the activities linked to production in an integral way and from an accounting perspective, three stages are proposed for this purpose: identification and classification of quality costs, quantification of quality costs, and quality cost management.

Identification of quality costs

Using a generic process map, applicable to most business models (Figure 1), it is identified which are the processes and activities that can generate quality costs and in which macro-processes they are developed. Macro-processes are classified in three categories: i) strategic process, ii) operational process, and iii) support process. Strategic processes refer to those that are related with the planning, measuring, monitoring and controlling of the business activities, strategic processes do not directly add value to customers, but are necessary in order to ensure the organization operates effectively and efficiently. Operational process are end-to-end, cross-functional processes that directly deliver value to external clients, operational processes are often referred to as "primary" processes as they represent the essential activities an organization performs to achieve its goals, these processes are where the highest amount of quality costs are expected to be generated. Support processes are enabling processes designed to assist the value-delivering operational processes by providing the resources and infrastructure required by primary processes, those process add value to internal customers and do not directly deliver value to external customers. It must be taken into account that depending on the type of company and its activity, the processes within each macro-process may be more or less extensive. Even though the greatest amount of quality-related costs would be expected to be generated in operational processes, this should not be taken as a general rule as quality planning and maintenance occurs in strategic and support processes, respectively.

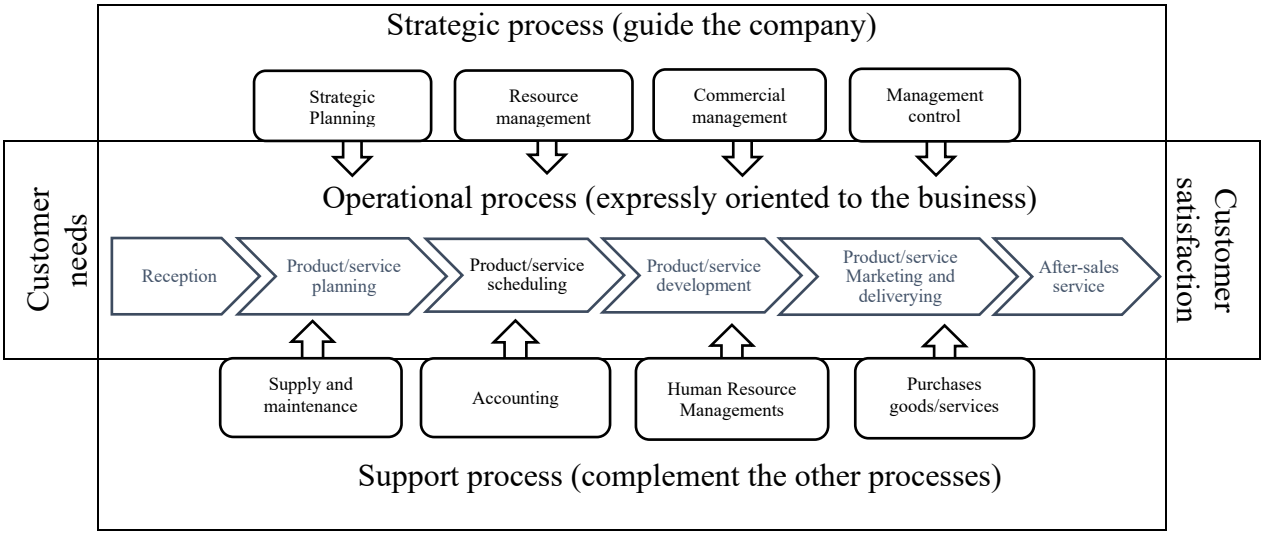

Figure 1. Generic process map

Classification of quality costs

The classification is carried out according to the type of cost that each activity generates and according to each of the categories related to the quality costs mentioned above, that is, it is identified if the costs generated result from costs to ensure quality – prevention activities (P) or evaluation activities (E) – or from non-quality costs – internal failures (IF) or due to external failures (EF) –. Table 1 and 2 list different activities related to each type of cost, the activities are not rigid and can be modified according to the type of company, economic activity, size and the sector to which it belongs.

Table 1. Activities distribution according to ensure quality costs

Prevention Costs		**Evaluation Costs**	
Activities		**Activities**	
P01. Quality planning	P02. Design review and development	E01. Internal and external audits	E02. Staff report evaluation
P03. Clients communication	P04. Product rating	E03. Conformity inspection	E04. Shipping inspection
P05. Technical manuals elaboration	P06. Quality assurance programs and plans	E05. Equipment calibration	E06. Setup inspections
P07. Process capacity studies and tests	P08. Supplier conformity assessment	E07. Finished designs review	E08. Materials testing and inspection
P09. Work standards elaboration	P10. Specification verification	E09. Test and inspection data review	E10. Working methods evaluation
P11. Process modeling and simulation	P12. Operational staff training	E11. Post-sale monitoring	E12. Process evaluation
P13. Requirements verification	P14. Quality general training	E13. Prototype inspection and testing	E14. Process controls
P15. Facilities inspection	P16. Preventive maintenance plans	E15. Specs fulfillment analysis and control	E16. Equipment usage tests
P17. Supplier research and classification	P18. Quality control plans development	E17. Suppliers audit and control	E18. Quality staff training
P19. Failure mode and effects analysis	P20. Continuous improvement plans	E19. Orders tests and control	
P21. Control system regulation	P22. Packaging tests		

Table 2. Activities distribution according to non-quality costs

Internal failure costs		**External failure costs**	
Activities		**Activities**	
IF01. Reinspection due to failures	IF02. Re-planning and re-programming	EF01. Failure verification	EF02. Repairing returned products
IF03. Corrective actions (for internal failures)	IF04. Re-process management	EF03. Fault repair center management	EF04. Guarantee management
IF05. Failure report elaboration	IF06. Classification activities	EF05. Corrective actions (for external failures)	EF06. Reactive actions (for external failures)
IF07. Reprocesses analysis	IF08. Corrective maintenance	EF07. Redesign (due to external failures)	EF08. Reinspection and retesting
IF09. Redesign (due to internal failures)	IF10. Non-quality costs	EF09. Product withdrawal	EF10. Returns analysis
IF11. Delays due to external modifications	IF12. Handling of defective products	EF11. Modification delays	EF12. Post-sale problems management
IF13. Process modifications	IF14. Corrective actions (for internal failures)	EF13. Wrong stock registration	EF14. Failure report elaboration
IF15. Use of temporary tools	IF16. Abandoned programs	EF15. Product service due to failures	EF16. Maintenance staff training
IF17. Waste/scrap analysis and control	IF18. Adjustment delays	EF17. Customer service due failures	EF18. Guarantees analysis
IF19. Idle hours	IF. 20 Repair of defective products	EF19. Rejected and returned products management	

In a second classification, it is proposed to order the activities already established in Table 1 and 2 based on the generic process map to recognize if the activity generates a cost or an expense, in addition to identifying in which processes these activities are found (Table 3). It is considered that, due to the transversal nature of the approach applied, certain processes that help to manage quality are directly involved. It is observed in Table 3 that the processes belonging to

operation macro-process are those with the highest concentration of quality costs, in relation to the strategic processes and the support processes.

The way to recognize whether the activity generates a cost or an expense is through International Accounting Standard 2 - Inventories (IAS 2), which refers to these aspects from paragraph 10 "cost of inventories" to paragraph 19 "cost of inventories for a service provider ", placing special interest in paragraphs 15 and 16, where it is explained about other costs that are included and excluded from the cost of inventories.

Table 2. Activities identification related to quality

Macro processes	Threads	Quality-related activities
Strategic processes	Strategic planning	P01 – P07 – P16 – P20 – E01 – IF10 – EF10 – EF18
	Resource management	E16 – IF15 – EF03 – EF04
	Commercial management	P03 – E11
	Management control	P02 – P04 – P13 – E07
Operational processes	Reception	P08 – E17 – E19 – IF12
	Product / service planning	P05 – P06 – P18 – P19 – E02 – E09 – E15 – IF07 – IF09 – IF14 – IF17 – EF06 – EF07
	Product / service programming	P10 – P11 – P12 – P21 – E06 – E08 – E10 – E13 – IF02 – IF13 – IF16 – IF18 – EF08 – EF11
	Product / service development	P22 – E03 – E12 – E14 – IF01 – IF03 – IF04 – IF05 – IF06 – IF11 – IF19 – EF02 – EF05
	Marketing and delivery of product / service	E04 – EF13
	After-sales service	EF01 – EF09 – EF12 – EF14 – EF15 – EF17 – EF19
Support processes	Supplying and maintenance	P15 – E05 – IF08 – IF20
	Human resources management	P09 – P14 – E18 – EF16
	Product / service purchases	P17

Table 3 adapts easily to traditional accounting; it is necessary to clearly define the activities that generate costs or expenses according to IAS 2 and in accordance with the company's cost accounting. However, it must be considered that costs and expenses are considered investment or reinvestment according to the form of action on the activity, that is, the investment are the costs of prevention and evaluation, and the reinvestment are the costs of internal and external failures.

Proposed chart of accounts for quality costs

A structure of accounting accounts is proposed that can be added in a generic chart of accounts such as the one in Table 4, so that, through these, quality costs can be ordered and subsequently recorded within a company, these accounts are raised based on the identification and classification of quality costs that was carried out in previous stages.

Table 3. Chart of accounts

Code	Account	Group
5.1	Cost of sales and production	Group
5.1.1	Materials used or products sold	Subgroup
5.1.1.1	Internal failure costs [a]	Account
5.1.1.2	External failure costs [a]	Account
5.1.2	Direct labor	Subgroup
5.1.2.1	Internal failure costs [a]	Account
5.1.2.2	External failure costs [a]	Account
5.1.3	Indirect labor	Subgroup
5.1.3.1	Evaluation costs [a]	Account
5.1.3.2	Internal failure costs [a]	Account
5.1.3.3	External failure costs [a]	Account

5.1.4	Other indirect manufacturing costs	Subgroup
5.1.4.1	Prevention costs [a, b]	Account
5.1.4.2	Evaluation costs [a, b]	Account
5.1.4.3	Internal failure costs	Account
5.1.4.4	External failure costs [a, b]	Account
5.2	Expenses	Group
5.2.1	Selling expenses	Subgroup
5.2.1.1	Prevention costs [c]	Account
5.2.1.2	Evaluation costs [c]	Account
5.2.1.3	Internal failure costs [a]	Account
5.2.1.4	External failure costs [a, c]	Account
5.2.2	Administrative expenses	Subgroup
5.2.2.1	Prevention costs [b, c]	Account
5.2.2.2	Evaluation costs [b, c]	Account
5.2.2.3	Internal failure costs [b, c]	Account
5.2.2.4	External failure costs [b, c]	Account
5.2.3	Financial expenses	Subgroup
5.2.3.1	Internal failure costs [a]	Account
5.2.3.2	External failure costs [a]	Account

For the adjustment of the chart of accounts, two main groups are distinguished (first level) with their respective subgroups (second level), the first group consists of four subgroups, and the second group consists of three subgroups. Each subgroup consists of accounts (third level) and subaccounts (fourth level) classified according the subindexes (a: operational process, b: support process, c: strategic process), and each subaccount consists of auxiliaries – activities – (fifth level), which are placed according to Table 3, that is, according to the categorization of quality costs and by the three types of macro-processes. The groups and subgroups originate from the generic chart of accounts, while the accounts are related to the categorizations of quality costs; the subaccounts are related to the macro processes, likewise, the auxiliaries will be assigned by the company itself, depending on the activities or sub-processes in the organization. The sub-index of each account indicates which subaccounts belong to this group; For example, account 5.1.4.1 Prevention costs have as subaccounts those related to a: operational process and b: support process, and each one of these subaccounts has its respective auxiliaries.

It is worth mentioning that the method proposed here is not specific to an industry, since the way in which value is generated and the way in which it seeks to ensure quality is similar regardless of the type of industry and organization. This can be supported by international regulations such as ISO 9001 where a specific quality management methodology is not specified for any type of industry. In addition, quality costs are generated regardless of the company's strategy, be it differentiation, cost leadership or innovation, the difference is that, depending on the type of strategy or organization, some costs will have more impact than others.

Hence the idea that a chart of accounts to manage and monitor quality costs should be generic and applicable to as many companies as possible. The point of this is that traditional accounting focuses primarily on production costs without properly classifying them from a quality point of view. In other words, for most companies the quality costs become part of the production costs without taking into account that depending on where they are generated, they can have a significant impact on the finances of the company.

Quality cost management

With the information collected in the previous stage, monetary values are obtained with which quality costs can be managed through indices based on the analysis that is wanted to be carried out. The indices allow direct comparisons with total quality costs, as well as making comparisons with total sales, production costs, and others according to the needs of the company. Once the indices have been defined, quality costs can be evaluated more efficiently and easily. Below are some of the proposed indexes.

Index based on total quality costs: The result corresponds to consequences of the past, and its objective is to control, direct and improve total quality costs.

$$\text{PCR} = \frac{\text{prevention costs}}{\text{total quality costs}} \times 100 \quad (1) \qquad \text{ECR} = \frac{\text{evaluation costs}}{\text{total quality costs}} \times 100 \quad (2)$$

$$\text{IFCR} = \frac{\text{internal failures costos}}{\text{total quality costs}} \times 100 \quad (3) \qquad \text{EFCR} = \frac{\text{external failures costs}}{\text{total quality costs}} \times 100 \quad (4)$$

Each of these ratios, (1), (2), (3) and (4), proportionally represents the different categories of quality costs with respect to total quality costs. Non-quality costs (internal and external failures) must be reduced, aiming for their value to reach zero, so that total quality costs also decrease. In the same way, as quality costs (prevention and evaluation) are controlled and directed, total quality costs will tend to decrease.

Index based on total sales and costs of sale and production: This index reflects the impact of quality costs on companies' operations, that is, how much quality costs and how much it represents on profits.

$$\text{TQSR} = \frac{\text{total quality costs}}{\text{total sales}} \times 100 \quad (5)$$

This index (5) represents the ratio of total quality costs to total sales. Decreasing total quality costs and maintaining or increasing total sales makes it possible to achieve better profitability and improve this index. The smaller this ratio, the better the quality costs and sales management.

$$\text{TQPS} = \frac{\text{total quality costs}}{\text{production and sales costs}} \times 100 \quad (6)$$

Expression (6) represents the total quality costs proportionally to the costs of sale and production. A company can be productive and competitive in the market when it decreases its total quality costs, as this happens, the costs of sale and production will also decrease gradually. Likewise, for a better detail and knowledge of the reinvestment in products or services that are generated by not complying with the requirements or specifications of the product, indexes are proposed regarding the groups of failures in the chart of accounts, these will help to visualize the costs that are generated by not doing things properly. When it comes to reinvestment, it refers to the costs of non-quality, that is, the costs of internal and external failures.

$$\text{IFPS} = \frac{\text{inernal failures costs}}{\text{production and sales costs}} \times 100 \quad (7) \qquad \text{EFPS} = \frac{\text{external failures costs}}{\text{production and sales costs}} \times 100 \quad (8)$$

$$\text{IFE} = \frac{\text{inernal failures costs}}{\text{expenses}} \times 100 \quad (9) \qquad \text{EFE} = \frac{\text{external failures costs}}{\text{expenses}} \times 100 \quad (10)$$

These indexes (7), (8), (9) y (10) proportionally represent the classification of non-quality costs with respect to the main groups of accounts and expenses of the chart of accounts.

The management of quality costs is carried out through reports, tables and graphs that are obtained from the quantification, measurement and recording of quality costs. The proposed classification facilitates the analysis and improves the conduct and impact of these costs, and at the same time allows to evaluate the fulfillment or non-fulfillment of the objectives of the company, as well as the satisfaction of the client with respect to the quality; In addition, with the information of the established indexes, it is possible to know the problems that affect quality and where they are located. Knowing these problems helps to take preventive and corrective measures to obtain continuous improvement.

The proposed methodology tries to cover the company as a whole and focuses on the total quality of a product by defining macro processes and each of the activities that intervene in each of them. The research uses a method focused mainly on the product, but if it is desired to apply the method to all the activities of the company encompassing total quality management, it is recommended to take as a starting point standards such as the ISO 9001: 2015 standard that helps to identify the activities that generate value and impact quality throughout the organization.

On the other hand, when the accounting is recorded and the costs are charged to the product or service, to calculate the cost of sale, the different cost items remain at zero, so the balances in the "T" accounts cannot be displayed. This makes a cost sheet essential to obtain the pertinent information. Consequently, a financial report directed to quality costs could be added, which consists of income, sales costs, operating expenses and non-operating expenses, including a breakdown of these according to quality costs. For certain accounts already existing in a generic chart of accounts, it has been necessary to change their location so that they refer to quality costs occupying the same action, but a different item of cost or expense.

The advantage of the method proposed here is continuity and that it also operates together with traditional accounting, providing information at the relevant periodicity; The disadvantage is that the method when applied can be complex for small companies, because they do not have specialized areas or departments to delegate activities and fully carry out the activities associated with the method.

5. Conclusion

Quality from the business point of view refers to a basic factor demanded by customers and fundamental for the competitiveness of companies, which is why quality is increasingly important as time goes by. In the same way, the importance of competitiveness lies in having knowledge of how to manage the organization's resources, increase productivity and recognize market requirements on time, which is why to obtain quality it is necessary to manage it, since it is efficient to produce goods or services, generating greater satisfaction at a lower cost.

The methodological proposal of this research work tends to be systematic and continuous, since it is complemented with traditional and cost accounting, providing convenience and time savings. In addition, this methodology can be implemented in management systems, such as ERP systems, considering that common accounting and production management systems do not have a tool that allows managing quality costs as part of their main functions, it is In other words, common systems often do not provide a means to identify, classify, quantify and help manage these costs. Since the method was evaluated in a general way, it is necessary that those who apply it have knowledge in production management and accounting; o that interdisciplinary teams are formed for greater effectiveness in the use of the method; Applying the methodology requires knowing and understanding material requirements planning (MRP) and the structure of processes, as well as the accounting structure of the organization.

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On the other hand, when applying the method, organizations may face difficulties in determining which activities are related to quality, and consequently, in which cost classification to locate it, since internally each company is different and they carry out their operations according to your business needs and goals. The method has the facility of being able to be implemented in any type of company, because it adapts to the activities and the chart of accounts of any organization, that is, the method is coupled to the accounting, administrative and management structure of the Business. In addition, the process that must be followed to implement this methodology is continuous, since, when establishing the process map, the cost-generating activities are determined and after this, these are classified relating them to the total quality of a product, in order to In this way, it is possible to identify in which macro process and sub-process the quality costs are found and, in turn, they can be managed in a specific way.

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Biographies

Joselyn García-Ortega is an external auditor at Auditores del Austro AustroAudi Cía. Ltda, Cuenca, Ecuador. She has a BA in Accounting and Auditing earned in Universidad del Azuay. She is linked as an intern to the project Development of ERP Software for SMEs of the University of Azuay. Her research interests include enterprise resource planning systems, auditing, finance, costing, cost management, quality, and administration.

Gabriela Chica-Contreras is an Occasional Professor-Researcher at the School of Higher Accounting and the Faculty of Administration Sciences of the Universidad del Azuay, Cuenca, Ecuador. She has a Commercial Engineering, Accounting and Auditing Engineering, a Diploma in Tax Management and a master's degree in Business Administration. She is linked to multidisciplinary projects in conjunction with professors from the University of Azuay, titled projects: Development of ERP software for SMEs, Development of online product catalog for SMEs, Presence of the principles of tax law in taxes. Her research interests include enterprise resource planning systems, usability, web application, finance, costing, cost management. ORCID: https://orcid.org/0000-0002-7922-6509

Juan Manuel Maldonado-Matute is Production and Operations Engineering, Business Administration Engineering, a master's degree in Engineering specializing in Quality and Productivity systems, a master's degree in Applied Mathematics, master's degree in Corporative Social Responsibility and Doctoral candidate at Universidad Pablo de Olavide, Spain, in the Business Management and Administration program. Member of academic board of Business Administration School in the Faculty of Administration Sciences of the Universidad del Azuay, Cuenca, Ecuador. He is linked to multidisciplinary projects in conjunction with professors from the Universidad del Azuay and through the Business Observatory of the Universidad del Azuay, titled projects: Business Performance through the Measurement and Analysis of the primary and support activities of the value chain of the different sectors or industries of the city of Cuenca and development of ERP software for SMEs. He is an Associate Professor-Researcher at the Business Administration School and at the Production Engineering School. ORCID: https://orcid.org/0000-0003-2358-0055

María José González Calle is an Associate Professor-Researcher and Coordinator of the academic board of Business Administration School in the Faculty of Administration Sciences of the Universidad del Azuay, Cuenca, Ecuador. She is a Production and Operations Engineering, with a master's degree in Business Administration. She is linked to

multidisciplinary projects through the Business Observatory of the Universidad del Azuay, titled projects: Business Performance through the Measurement and Analysis of the primary and support activities of the value chain of the different sectors or industries of the city of Cuenca, School workshop in handling industrial machines for clothing and basic pattern II aimed at women belonging to the Fundación Avanzar. Delegated by the Universidad del Azuay to the HUB iTT South of Innovation. Member of the Academic Committee of the Master in Business Administration. ORCID: https://orcid.org/0000-0002-3222-1911

Catalina Astudillo-Rodríguez is an Associate Professor-Researcher at the School of Computer Science Engineering and the Faculty of Administration Sciences of the Universidad del Azuay, Cuenca, Ecuador. She is a Computer Engineer. Has a specialty in University Teaching and a master's degree in Multimedia Design, she is currently pursuing doctoral studies in Computer Science at Universidad Nacional de la Plata, La Plata, Argentina. She is linked to multidisciplinary research projects with professors from the University of Azuay, titled projects: development of ERP software for SMEs, Development of online product catalog for SMEs, Linguistic Documentation Project, Socio-linguistic Cartography, Augmentative Systems and Communication alternatives with FOSS technologies and Attentional Processes. Her research interests include programming, usability, user experience, and web applications. ORCID: https://orcid.org/0000-0001-8369-5300

Esteban Crespo-Martínez is Computer Engineer, a master's degree in Strategic IT Management, a master's degree in Business Administration, master's degree in Marketing Management and Doctoral candidate at Universidad Pablo de Olavide, Spain, in the Business Management and Administration program. Is an Associate Professor-Researcher at Universidad del Azuay, in Cuenca Ecuador. Is the creator of the ECU@Risk methodology for Information Risk Management. In addition, he is a member of the University Council and Cybersecurity coordinator of the same institution. Many International Certifications like Microsoft International Certificate in Information Security and Windows Operating Systems. Ethical Hacking Training Certificate issued by The Hacking Day, Scrum International Certificate, and International Certificate in CISCO Network Academy. In 2020, he was also invited professor by Metared and the University of Murcia to teach the Risk and Threat Management module in the First International CISO training course for universities. ORCID: https://orcid.org/0000-0002-3061-9045

Ana Vásquez-Aguilera is an Associate Professor-Researcher, and Director of Master of Manufacturing and Industrial Operations, member of the academic board of Production Engineering of Universidad del Azuay. She earned her Production and Operations Engineering from Universidad del Azuay, in Cuenca, Ecuador. Master´s degree in Advanced Manufacturing, Logistics and Supply Chain at Universidad Politécnica de Valencia, Spain. She has published journal and conference papers. ORCID: https://orcid.org/0000-0003-2204-5405