

## Quality management applied in a computer software entity

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**Summary:** From the description in NTC ISO 9001:2015, a study and implementation were made in a process of the quality system in software and computer services S.A. based in various diagnostic tools like DOFA, PESTAL y VESTER to know the status of such established on the standard. The required documentation was updated with the results obtained for the correct purpose of the entity. In addition, the process of Service Desk was evaluated in which the system was implemented and showed the importance of itself in terms of improvement in the response time since it went from 20% to 1% in the number of clients that are out if the controlled limit established, keeping in mind the times in the development of the activities. Thanks to the enforcement of the documentation, the company already complies with 100% keeping in mind the coverage of their areas obtaining a relationship between costs and benefits of 1,30 that contributes directly to the provision of the service. The sum of activities are evaluated by means of indicators to demonstrate the efficiency giving compliance to the requirements of the end user, which demonstrates that the development of these systems generate competitiveness against other companies in today's globalized world.

**Keywords:** Quality, Service Desk, ISO 9001:2015, quality management, indicators.

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### I. Introduction

Among the factors that add value to the services in companies, international standards are of great importance to be implemented within the different systems of the organization because these provide a standard guide for the processes executed within the different contexts in which it operates in order to improve the response times given to customer requirements.

Specifically, ISO 9001: 2015 [1] "Companies and organizations around the world, large or small, must have their entire quality system based on the standard, which was last updated in 2015. In this way, they verify their ability to provide products and services that meet the needs of its customers, as well as applicable legal and regulatory requirements, in order to increase customer satisfaction through process improvements and conformity assessment", with part of its importance in the development of the documentation of the processes as internal aspects for an organization, but not before relating the requirements of the clients, contractual agreements and different types of variables that directly affect the quality of the product or service provided.

In the case established in this article, opportunities for the implementation of the quality management system are evidenced, taking into account the development of the processes, which were not carried out in an orderly and correctly documented manner, which caused an increase in response times, it affects the promise of quality to customers, which is why the restructuring of the company's internal documentation (processes, procedures and formats) was suggested.

To this end, an initial diagnosis began to find the internal and external state of the company, using different engineering tools such as the DOFA matrix that [2] "is the process of exploring the internal and external environments of an organization and extracting convenient strategies based on their strengths, weaknesses, opportunities and threats" and the PESTAL matrix [3] that "is a framework or tool used to analyze and monitor macro-environmental factors that have an impact on an organization", in the same way, with This seeks to ensure both customer satisfaction and the guarantee on the effectiveness of the services, without neglecting the fact that the certification should be given regardless of the scope of the company's performance.

As time goes by, the information contained within the documents applicable to the quality management system must be updated periodically to demonstrate itself and the interested parties, a good management of the processes, responsibility of each of those responsible for the operation or its applicable position within the organization in order to create a sense of belonging and approval for the company.

Therefore, with this project we want to provide a Quality Management System for each of the company's processes, contributing to the advancement of actions and activities focused on obtaining and managing the document base for the improvement of Service processes Desk

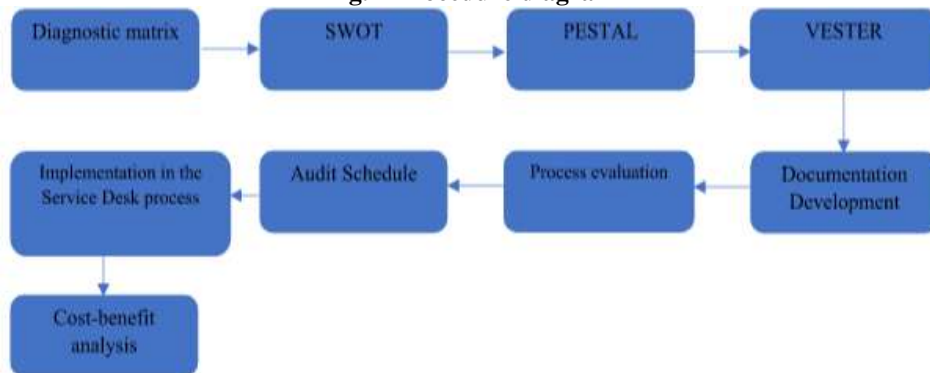
For this, the review of some documents previously made by other authors is used, which are taken as a reference in the development for the quality management system and the documentation for all the processes of the company that allow to solve the existing problems, achieving thus, an improvement in the response time to customers, so an increase in the company's profits and 100% compliance in the parameters of the standard are expected.

In the article called "Study on the application of 6σ method in shoemaking enterprise quality improvement" he mentions, [4] "taking into account the development of science, technology and the influx of footwear manufacturing companies abroad, our companies Traditional shoe manufacturing faces greater pressure to survive, and product quality problems urgently need improvement. With the objective of the quality problems of the shoe manufacturing company M, the DMAIC method is used to improve the quality of the product".

An article in the United Kingdom, "ISO 9001 and Supply Chain Integration Principles Based Sustainable Development: A Delphi Study", presents a study based on the Delphi method, which focuses on the improvement and processes of the chain of supply. This article shows the role of the ISO 9001 methodology and its principles to incorporate and promote the sustainability of the organization, propose the measurement and monitoring of the organization not only in financial KPIs but also at the environmental and social level. As in the case of each organizational transformation initiative, the commitment and vision of senior management remain key to the successful application [5].

## II. Methodology

Fig. 1 Procedure diagram



The diagnosis of the state of the company is made based on the ISO 9001: 2015 standard where qualitative and quantitative tools were used to evaluate the status of this in what the standard presents as shown in Figure 1.

As a first measure, a DOFA matrix is used [6] "is a methodology for studying the situation of an organization or company in its context of its internal characteristics, in order to determine its strengths, opportunities, weaknesses and threats. The internal situation is composed of two controllable factors: strengths and weaknesses, while the external situation is composed of two uncontrollable factors: opportunities and threats." It incorporates elements of environment and articulation that can influence the development of the organization and also generate strategies for internal and external factors of the Organization.

The PESTAL tool is applied to identify environmental factors in general that positively and / or negatively affect organizations. [7] "It is a very advantageous strategic analysis tool to analyze the types of market, the position of the organization and its operational processes. The factors are of type: Political, economic, technological and socio-cultural".

The VESTER matrix is used as [8] "methodology to facilitate the identification and determination of the causes and consequences in a problematic situation, the problems detected are located both by rows and by columns in the same order previously determined".

In the second place, the documentation is developed based on the gathering of information obtained with the managers of the company, managing to standardize the information that would be implemented by the organization.

Once the process standardization has been carried out, a risk analysis of the company is generated, where the different situations that may affect the company's ability to meet its mission, strategic and quality

objectives are evaluated. The standard provides the principles and guidelines for risk management and the process implemented at the strategic and operational level of the organization.

Thirdly, for the measurement of statistical control in the Service Desk area of the company, the X-R graphic was used, which is [9] "it is a very important quality tool. Statistical measures are registered properties of the product obtained as a result of inspections randomly taken samples of products at the determined place of the process. The objective of the type of XR control chart is the observation and recording of the capacity to change the characteristic of the investigated element of the production process." In the X chart, the measurement of the tickets (customer requirements) that enter To the area, in the R chart, the compliance of the tickets was measured in the billing module of the organization's computer program; This was done with the objective of having a vision of the failures that the company incurred.

On the part of the project developers, the company executives were provided with an internal audit plan with the objective of ensuring quality and continuous improvement over time.

Thanks to the results obtained in the diagnosis and in the measurement with XR graphs, it was decided to implement the quality system in the Service Desk process giving the people involved all the results of the study and generating training on the correct way in which activities should be developed; in order to demonstrate the impact on the changes made in the company.

Finally, the cost-benefit analysis of the organization was built by studying the benefits that the implementation of the Quality Management System in the company can bring compared to the costs that will be generated to the organization with its development.

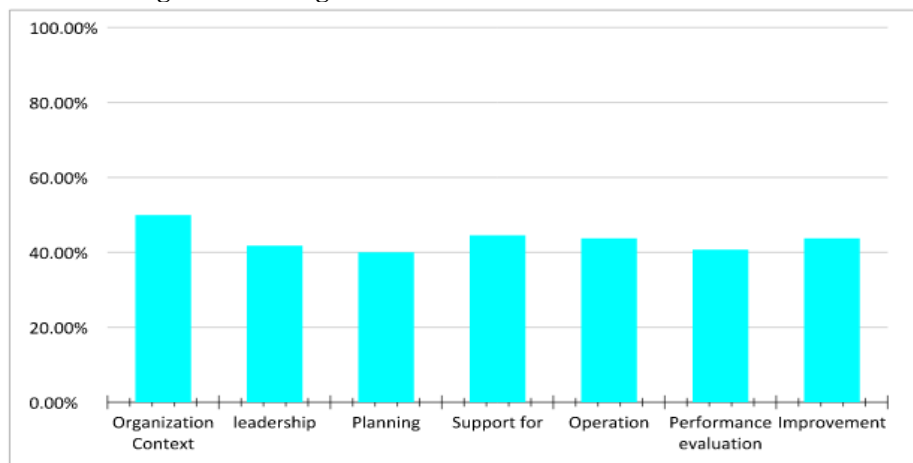
### III. Findings

Of the total activities carried out through the study carried out in the organization, which have been described in the methodology of this article, each of the parameters described below was obtained as a result, analysis and conclusions.

#### Diagnosis

At the beginning of the study, the company had a disadvantage compared to that described in the standard, since in each chapter it was found in 50% development, as seen in Fig. 2, this is because some processes were not carried out in the best way by the company but in a disorganized manner that led to decision-making but there was no documented record that evidenced what was done within the organization.

Fig. 2 Initial diagnostic under the ISO 9001:2015 standard



Good aspects of leadership are evidenced in the company, although in terms of the norm, outdated information was found generating nonconformities in the provision of service to both internal and external clients. Additionally, because the processes were carried out without documentation that allowed traceability, when complaints were incurred due to lack of support or in the development of activities that were canceled lead to loss of income due to non-execution of the same.

#### Dofa Matrix

The company shows weaknesses such as limitation of the client - server in terms of the times in the execution of the activities of the system, which is improved by increasing the technological infrastructure in the cloud. Another of its weaknesses has to do with the limitation in the end users of the product offered by the

organization, because its potential customers are within the same demographic level which hinders their growth in the market.

Taking into account the analysis of the DOFA tool, 6 problems with greater impact on the company were detected within the Service Desk area, described in Table 1.

**Table 1: DOFA matrix results**

Code	Variable
P1	lack of control over processes
P2	Increase in operation costs
P3	Lack of documentary and methodological organization
P4	Lack of post-sale support with customers
P5	Market scope limitation
P6	Competitors with advantages in the sector

**Vester Matrix**

With the data obtained in the DOFA matrix, the problems found were extracted and an evaluation was carried out with the help of the VESTER matrix to determine which was the most critical for the company, as shown in the values in Table 2, the total costs of the operation that together with the other diagnostic tools is evidenced that it was due to the lack of methodological organization in the company.

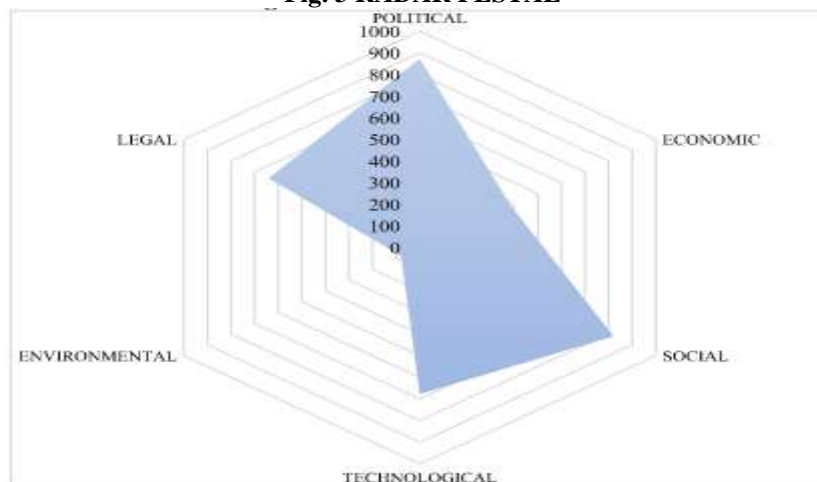
**Table 2: VESTER matrix evaluation**

Código	Variable	P1	P2	P3	P4	P5	P6	Influence
P1	Lack of control over processes	0	3	3	2	1	1	10
P2	Increase in operation costs	3	0	3	3	1	1	11
P3	Lack of methodological organization	3	3	0	2	2	3	13
P4	Lack of customer support post-sale	2	2	2	0	2	1	9
P5	Market scope limitation	1	1	2	2	0	3	9
P6	Competitors with advantages in the sector	1	1	2	2	1	0	7
DEPENDENCY		10	10	12	11	7	9	49

**Pestal**

In fig. 3 it is observed that the company has a great commitment to the political field since it had covered the regulatory and legislative aspects in a fundamental way, generating an adequate performance, in the technological field it is well in the present time however in the measure of time if not investing in this aspect can hinder your daily operation, finally the organization has minimal environmental compensation since a large amount of resources are spent that are not returned in due manner.

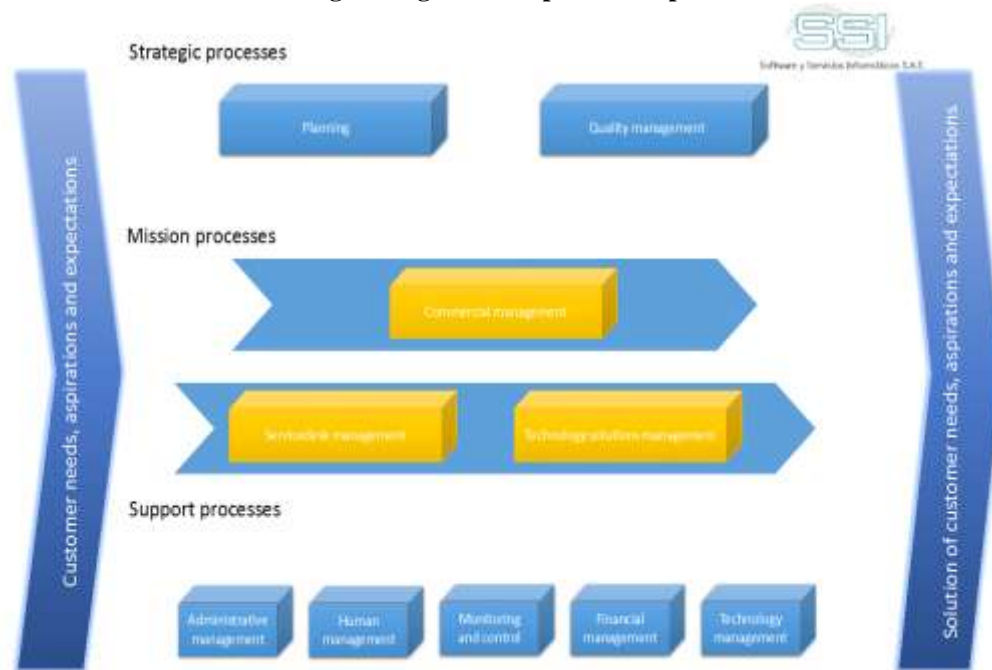
**Fig. 3 RADAR PESTAL**



#### IV. Processes And Procedures

The results obtained in the tools described above allowed establishing the processes and procedures necessary to implement the quality management system based on ISO 9001: 2015, adjusting to the needs and expectations of the organization, generating the necessary documentation for the company I can carry your processes properly. Among these documents, the main thing was the generation of process characterization [10] "which is a tool used to describe how a process works and thus give the requirements of the standard" 10 key processes [11] were defined "which are those that have a significant impact on the strategic objectives and are critical for the success of the organization" (which are shown in fig. 4) 35 sub-processes are defined [12] "which are well defined parts of a process. Its identification can be useful to isolate the problems that may arise and enable different treatments within the same process".

Fig. 4: Organization process map



This documentation was made because [12] "allows us to improve processes consistently. The documents must serve the processes, not the processes to the documents, a well-designed process must have a good documentary flow". Finally, with the standardization of processes, we sought to solve problems to serve the development of each person and the company; influence customer service, the quality of services provided, the speed of decision making and effectiveness in general. In addition to improving the efficiency among the resources available in each area, as technical support to the strategic objectives of the institution.

#### Estadistic Control

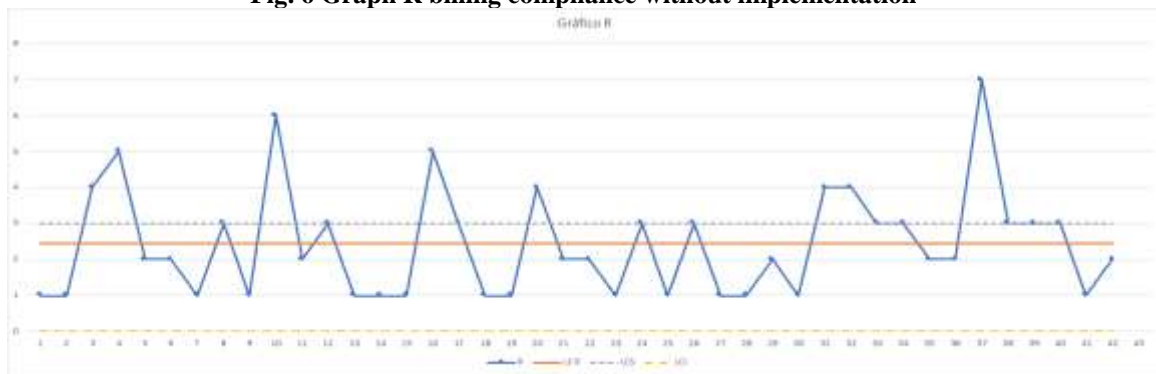
XR charts were developed to analyze the situation of the Service Desk area where 10 cases were found outside the upper limit of control, which means that these customers were responded to their requirements in a time greater than 7 days as observed in fig. 5; This did not match the goals the company had as its objective was to serve everyone before this period.

**Fig. 5 Graph X Ticket compliance**



Graph R evaluated the compliance attribute in the company's billing module, in fig. 6 it is observed that 18 clients are found outside the control limits, that is, that they were answered in more than 7 business days, their cause was that the company did not prioritize this module as necessary, this caused complaints from users as it also affected their internal operation.

**Fig. 6 Graph R billing compliance without implementation**



**Audit Plan**

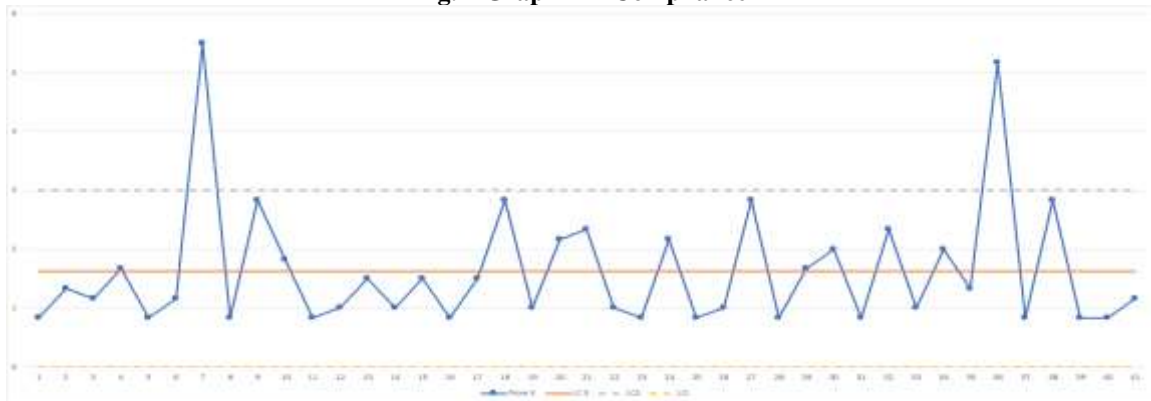
A plan and a schedule for the current year were made where the dates of internal audits were contemplated for each of the organization's processes, which contain the standardized guidelines that must be contemplated in each of the periodic exercises where each of the activities in the areas of the organization are challenged ; With this, a thorough review is achieved within a period of time to establish the total opportunities for improvement dictated by the action plans that lead to process improvement. This was executed under a review of the step by step that should be followed in the development of this, consequently establishing a template that implies what should be taken into account for the preparation of audit reports.

**Implementation In The Service Desk Process**

Thanks to the tools used in the diagnosis and the study carried out in the statistical control, the process of implementing the quality management system in the Service Desk process was processed, since this is one of the most important and it is also evident that it was one of the most critical for the company; The implementation was executed for two months and then this period was determined to reapply the X-R chart to assess the impact it had when introducing the standard.

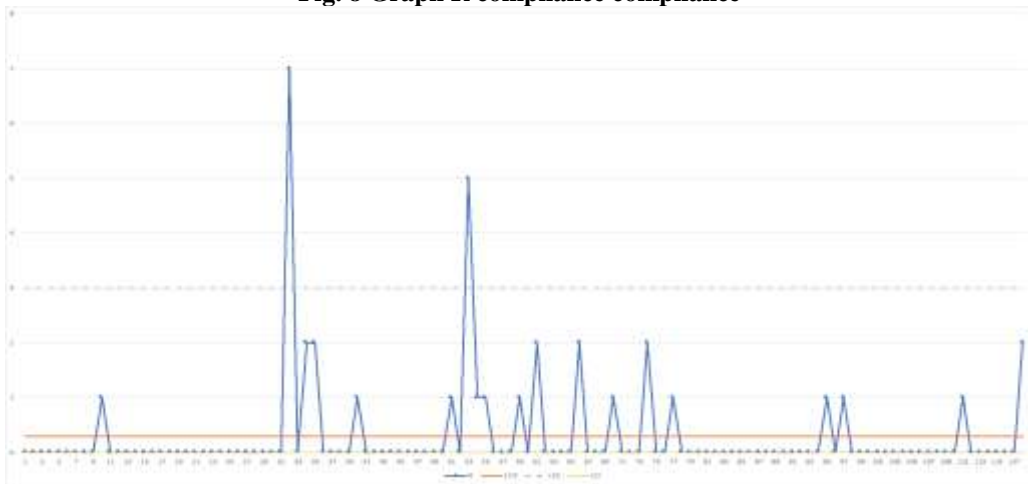
In graph X, very favorable results were obtained, as there was an 80% improvement in the response of the tickets, as shown in fig. 7 The company went from having 10 clients outside the upper control limit to having 2 clients whose services were delayed because they were special requirements.

Fig. 7 Graph X 2 Compliance



Graph R evaluates the compliance attribute in the billing module of the company, which yielded results as shown in fig. 8 reduced by 90% when in the previous measurement there were 17 clients outside the upper control limit, now there are only two clients that were answered exceeding the 7 days proposed as a goal by the organization.

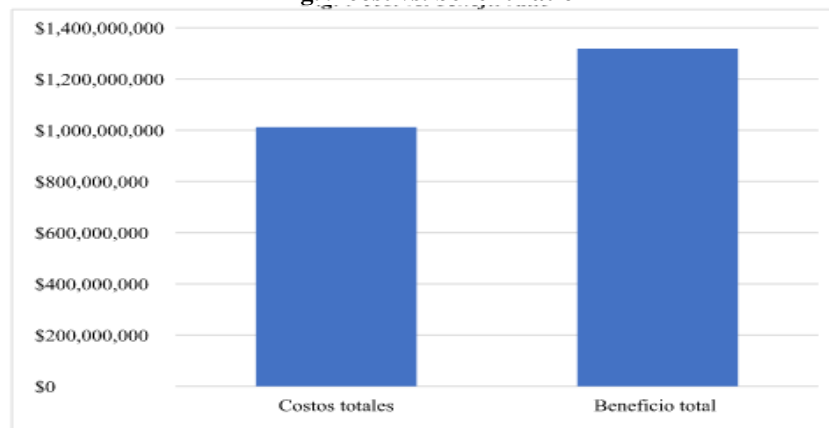
Fig. 8 Graph R compliance compliance



### Cost Benefit Of Implementation

In the cost-benefit evaluation, the costs associated with the implementation of the system and the non-quality costs associated with the company's processes were taken into account, as shown in fig. 9 a cost of \$ 179,604,955 was obtained against a net benefit of \$ 240,000,000 which is represented in an increase in support sales and updates of \$ 5,000,000 per month and in new license sales of \$ 10,000,000 per month. it obtains a benefit-cost ratio of 1.3, which indicates that for each peso generated, there is a gain of \$ 0.3; which shows that the project is feasible. Similarly, the VPN is calculated, which results in a value of \$ 86,340,384, which means that it was feasible for the company to implement the quality management system based on ISO 9001: 2015.

Fig. 9 cost vs. benefit ratio



### V. Discussion

Diana Milena Novoa and Lury Yamile Sánchez in their degree work "Design of a quality management system in the company" Siiweb SAS "based on the guidelines of the ISO 9001: 2015 standard." Used tools such as diagnosis in the company the DOFA matrix and the PESTEL matrix in which they obtained as a result [13] "know in depth the strengths and difficulties that SIIWEB has at this time. This was evident with each of the matrices which show us that SIIWEB SAS can implement a quality management system" In the development of this work and as an added value it was decided in addition to implementing these tools to develop a checklist to determine the timely status of the company in terms of the standard and a VESTER matrix in which the problems found in the matrix were evaluated DOFA and thus determine which of these was more critical for the company.

Erik Fabián Cortez in his degree work "Development of the quality management system at Corpar Autopartes Ltda., Under the guidelines of the ISO 9001: 2015 standard", carried out characterizations in which [14] "Each of the activities that are executed in the development of the processes was documented. In this, you can identify information such as objective, scope, responsible, the process providers, the entries, the activities carried out, the identification of the activity within the PHVA cycle, the outputs of the process and the clients of this, you can also identify the necessary resources, references, monitoring and measurement elements, quality objectives that impact the process and the necessary control records." The PHVA cycle contained in the characterizations only mentions which parts of it apply to each activity, in this work each activity is detailed belonging to the sections of planning, doing, verifying and acting.

In addition to the fact that in this work the implementation of this management system was carried out in a critical process of the company, this decision was made when developing the diagnosis and statistical control so that in this way the organization already has a reference when continuing with the implementation in its other processes.

### VI. Conclusions And Recommendations

Thanks to the diagnosis that was initially made, it was determined that the company went from a compliance of 40% to 100% in relation to the standard, this was due to the fact that the actions carried out around the quality management system were developed, but a detailed record of them was not kept, even so it was possible to fully comply with what generates economic and image benefits to the company.

The necessary documentation was built so that the processes and procedures of the organization were correctly presented in terms of the norm, at the time of the implementation of the system in the critical process, the people involved were trained in order to handle Correctly the formats and follow the procedures correctly, so do not incur additional time by repeating processes that were not done correctly from the first moment and in this way they can incur cost over what was one of the main motivations for the development of the study.

A study was carried out to avoid the service desk process in which unfavorable results were obtained as the company intended to reach the goal where all the requirements that were entered would be resolved in less than 7 days. The initial study yielded negative results since 10 clients were given a response in a longer period than the one stipulated by the company, within the billing module of the program, the number of clients that were not answered in the stipulated time was 17. After the implementation of the system, an improvement was presented, since it went to 2 the number of requests that were delayed more than 7 days to respond, and similarly, in the billing module, 2 users went with the That the company exceeded this time. A schedule was made in which 4 internal audits were assigned in the year with the objective of ensuring the quality of the service and the continuous improvement of the organization implicitly if it is a result of these is favorable, a



benefit that is reflected in the income will be maintained in sales by customers as it implies added value for the company.

It was evidenced that before implementation of the system, the costs for non-quality generated in the company were \$ 119'124,955, plus the costs were 60'480,000 this generated a total cost of \$ 179'604,955 against the economic benefits that it brings to the company this system was \$ 240,000,000, an increase in the capital that enters the company of 1.30 points; which means that for every peso generated by the company a profit of 0.30 is obtained, in addition to the benefits such as improving its image before the client and the possibility of entering a globalized market where it is a requirement to have the certification in the norm of This studio .

If the software and the computer services S.A. They decide to choose to apply this improvement process, they will become one of the leading companies in the software manufacturing sector, and will offer a high degree of quality to their customers.

The company is recommended to continue with the implementation of the standard throughout the company following the guidelines given in the service desk process, the documentation delivered and the step-by-step process carried out in the months of October and November in the organization

The company must follow the schedule and the audit plan delivered to ensure quality and continuous improvement in addition to having everything in order for future recertification in the case where the standard presents an update.

The company is recommended that the economic benefits obtained by the implementation of the system be re-invested in growth since it has the opportunity to enter a larger segment which would significantly improve sales, but for this growth to be viable, You need an investment that, as described, can be taken from the profits that the quality management system brings.

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