

## Impact of quality costs applied in manufacturing SMEs and Metal-Mechanical Automotive in North Aguascalientes: Municipality of Aguascalientes

### Impacto de los costos de calidad aplicados en pymes manufactureras automotrices y metal-mecánicas en el norte de Aguascalientes Municipio de Aguascalientes.

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Received January 11, 2017; Accepted April 23, 2018

#### Abstract

This research is the result of 4 investigations Carried out in the northern region of Aguascalientes. The municipalities on Which esta research is based are Aguascalientes, San Francisco de los Romo, Rincon de Romos, and Jesus Maria. The objective of esta study is to investigate the costs Incurred by companies in carrying out operations in the municipality Their of Aguascalientes. Likewise, it analyzes the aspects of the companies as They are: Leadership, Strategic Approach, Market Focus, Personnel Management, Process Management and the main area Costs of Quality. The realization of research esta Allows us to know the costs Incurred by companies in order Surveyed These to know in what percentage the highest quality costs applied, Whether in prevention costs, evaluation costs, internal failure costs and external failure costs.

**Quality Costs, Internal Failure Costs, External Failure Costs, Costs Prevention, Evaluation Costs**

#### Resumen

Esta investigación es el resultado de 4 investigaciones realizadas en la región del norte de Aguascalientes. Los municipios en los cuales se basa esta investigación son Aguascalientes, San Francisco de los Romo, Rincón de Romos, y Jesús María. El presente trabajo tiene como objeto investigar cuales son los costos en los cuales las empresas incurren al realizar sus operaciones en el municipio de Aguascalientes. Así mismo, se analiza los aspectos de las empresas cómo lo son: Liderazgo, Planteamiento Estratégico, Enfoque de mercado, Gestión del Personal, Gestión de los Procesos y el área principal Costos de la Calidad. La realización de esta investigación permite conocer cuáles son los costos en los que incurren estas empresas encuestadas para poder conocer en qué porcentaje existe más costos de calidad aplicados, como son costos de prevención, costos de evaluación, costos de fallas internas o fallas externas.

**Costos de Calidad, Costos de fallas internas, Costos de fallas externas, Costos de prevención, Costos de evaluación**

**Citation:** VAZQUEZ-GUTIERREZ, Rosa Inés, FLORES-AGUILAR, Mauricio and NÚÑEZ-MONTALVO, Juan Manuel. Impact of quality costs applied in manufacturing SMEs and Metal-Mechanical Automotive in North Aguascalientes: Municipality of Aguascalientes. Journal-Economic Systems. 2018. 2-2: 1-11

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## Introduction

This report presents an analysis of the situation of quality costs they incur SMEs and companies in the city of Aguascalientes.

Companies that were explored in this municipality were Metal-Mechanical Industries engaged in metal transformation from simple forms such as the machining of metal parts, workshops engaged in the production of windows and doors and other enterprises They engaged in the manufacture of automotive parts.

The research is divided into six areas:

- to. Leadership
- b. strategic approach.
- c. Focus on markets and customers.
- d. People management.
- and. Quality costs.
- F. Process management.

Quality costs are classified as:

- a. *Prevention costs*
- b. *Evaluation costs*
- c. *Internal failure costs*
- d. *External failure costs*

Below are the results of the survey show applied to a sample of 50 companies from a universe of 327 companies corresponding to 15% of metal-mechanical bouquet in this county according to DENUÉ 2016 INEGI.

This project benefits the automotive industry and mechanical metal as it allows to know what the strengths and weaknesses on the implementation of quality costs are as well as you could get to our university, UTNA, what are the courses that can deliver on these topics quality in order to strengthen SMEs and companies in the region.

It is research is important because the quality applied in business is required to meet the needs of customers and in order to remain on the market.

## Methodology

According to Hernández Sampieri (2010) it applied the study was a study "Quantitative Exploratorium" where data recovery tool type survey will be used.

## Sampling

The sampling to be performed will be stratified, where the total population of each of the municipalities is divided into different extracts. The advantage of this type of sampling is that tends to ensure that the sample accurately represents the population based on some selected variables. It also allows more accurate estimates and its goal is to sample as close as possible to the population in which the or concerns Stratified variables.

The result was a sample of 50 companies from a universe of 327 companies registered in 2016 DENUÉ INEGI

## Background

Quality costs represent the difference between the actual costs of a product or service and reduced cost, if there was the possibility of having a service below standards, product failures or defects in manufacturing.

They can be classified as observable or hidden, the observables are obtained from the accounting records of an organization, are hidden opportunity costs resulting from poor quality. All quality costs are observable and should be available from the accounting records, hidden costs fall into the category of external fault.

These costs can be significant and must be estimated, although it is not easy for this three methods are suggested.

- one. The multiplier method.
- two. The method of market research.
- 3. The function of Taguchi quality loss.

The multiplier method: the total cost of failures is some multiple of the costs of failure. Where the total cost of external failures = k (measured external costs lasfallas. Where k is the multiplier effect and is based on experience).

Meanwhile, the loss function is one that calculates the "quality loss" suffered an aspect analyzed with respect to the quality objective that we will attached thereto. This means that for a feature set on rn the product or process, the loss function will result as it is away from the lens.

The loss function is:

$$L = K * (Y - M)^2$$

Where:

- L is the result of the function, generally measured in monetary units. And it is the ideal value of the property analyzed.
- M is the mean of values obtained from the characteristic analyzed in real situation.
- K is a constant which is responsible for converting (Y - M) 2 monetary units

The market research method is to be applied in this investigation, this is used to evaluate the effect of poor quality. The surveys are based on questions developed from the classification of four types of quality costs quickly explained.

*Prevention Costs:* Are the costs of all activities specifically designed to prevent failures of quality products or services

For example:

- Review of new products.
- Quality Planning (manuals, procedures, etc.)
- Capacity assessment of suppliers.
- improvement efforts through teamwork.
- continuous improvement projects.
- Education and training quality.

*Cost Evaluation:* They are the costs associated with activities to measure, evaluate and audit the products or services to ensure their conformity to standards of quality and performance requirements.

For example:

- Inspections provider and receipt.
- Testing and inspections in process and finished product.
- Audits product, process or service.
- Calibration test and measurement equipment.
- Costs for materials testing.

*Internal Failure Costs:* They are not in conformity with the requirements or customer requirements prior to shipment of the product or service carrying costs resulting from products or services.

For example:

- Waste
- Re-work
- Re-inspection and retesting
- Review non-conforming materials
- Price reduction for reduced quality

*External failure costs:* They are not in conformity with the requirements or customer requirements after product delivery or during and after the performance of the service costs resulting from products or services.

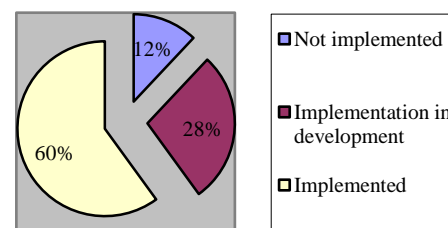
For example:

- Process complaints and claims
- Customer Returns
- Guarantee
- Campaigns for defective products

## Results

### Leadership

In Aguascalientes, the companies surveyed show that 60% have vision, mission, values and clearly defined objectives, while 28% said it is being implemented these tools and 12% do not have it implemented.



**Graphic 1** Implementation of the mission, values and strategic objectives

Also, the companies surveyed stated that 76% of these workers know their responsibilities and actions to be performed, while 12% said it is considering implementing a process for it and the remaining 12% do not have it.

70% of the surveyed companies focuses on the creation of new products and innovation, while 20% considers implementing this process, and 10% have not been implemented.

In addition within this category only 32% of the companies surveyed have a policy to help the environment, seeks to implement 16% and 52% have not considered.

This is reflected in only 6% is certified with ISO 14000, while 10% is considering for this certification and 84% not considered.

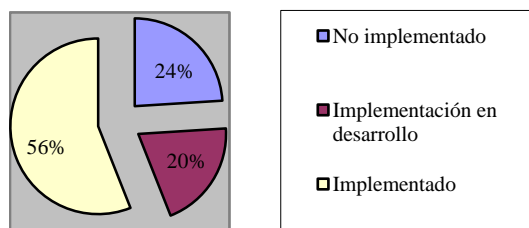
**Strategic Approach**

In the area of strategic planning, 58% of the companies surveyed said they have a process to consider the expectations of markets and customers, while 16% and 26% looking to implement it have not considered.

56% of companies surveyed have a planning process where aspirations are considered shareholders, while 14% want to implement it and 30% do not have it.

In addition 62% of these companies have a planning process which considers the capabilities of the company and its employees, while 16% do not have it and 22% are looking to implement it.

On the other hand, only 56% of these companies have a planning process which is considered the capabilities of their suppliers, 20% are looking to implement it and 24% do not have it.

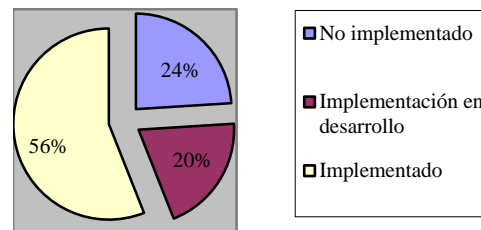


**Graphic 2** In Aguascalientes, 56% of companies surveyed have implemented a planning process which is considered the capabilities of their suppliers, 20% carry out searches and 24% do not have it.

**Focus on markets and customers**

In the area of approach to markets and clients, these companies resulted that 64% have a procedure to determine the markets where its most important customers will be, while 22% are looking to implement this procedure and 14% do not have it.

Likewise, 56% and these companies have a method to investigate what are the requirements of customers according to the products and / or services offered, 20% are looking to implement, and 24% do not have it.



**Graphic 3** Method to investigate what are the requirements of customers according to the products and / or services offered.

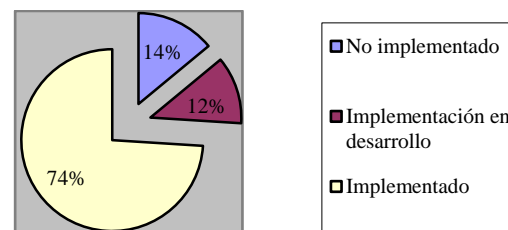
On the other hand, 32% of companies said they have a market research method to detect new business, while 34% want to implement it and 34% do not have this method.

In addition, only 48% have a formal procedure to ensure that complaints and grievances are resolved in a timely manner, however 20% seeks to have it and 32% do not have it.

**People Management**

In the area of managing people, 80% of these companies plan to choose their workers, while 6% and 14% looking to implement does not have it.

Also 74% of these companies plan training and development of employees, however 14% do not have this planning and 12% seek to implement it.

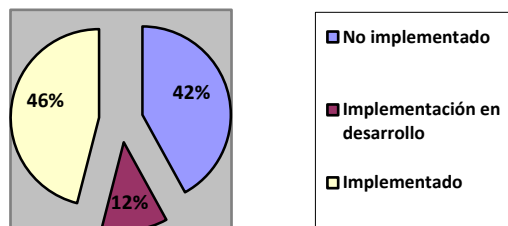


**Graphic 4** Training and development process of their workers.

Furthermore 70% of them, has a process which communicates assignments clear goals and work to guide staff in their action, 20% and it does not have 10% looking implement.

Likewise, 54% of these companies have a policy and pay structure covering all jobs that ensure the quality and competitiveness of the company, while 14% are looking to implement it and 32% do not have it.

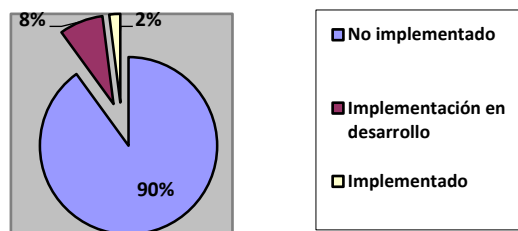
On the other hand, only 46% of companies surveyed have methods of recognition and reward for the achievement of objectives that ensure the quality and competitiveness of the company, 12% are looking to implement these methods but 42% do not have it.



Graphic 5 Implementation of methods of recognition and reward.

Only 38% have a health and safety department, 18% of companies are looking to have one and 44% have no such department.

In addition, only 2% of these companies have OHSAS 18001 certification, seeks to implement 8% and 90% do not have it.



Graphic e 6 Implementation of the OHSAS system

**Quality Costs**

This category was divided into four stages for investigation, then the results of each of these steps will be explained.

**I. Prevention costs**

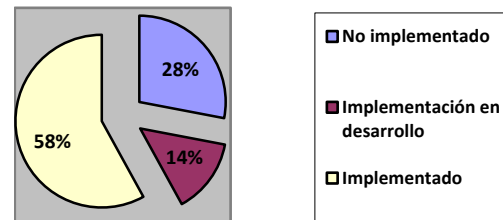
90% of companies surveyed inspects the material when it reaches ground, while 10% said no.

Likewise, 70% of them have distribution plant, however 12% are looking to implement it and 18% do not have it.

Only 50% of them applied 5'S, while 32% are looking to implement it and 18% do not have it.

Only 36% of companies have quality management system applied, seeks to implement 20% and 44% do not have it.

Within the quality system considering the use of check list or check sheets, 58% of companies said that if you use this tool, while 14% are looking to implement it and 28% do not use it.

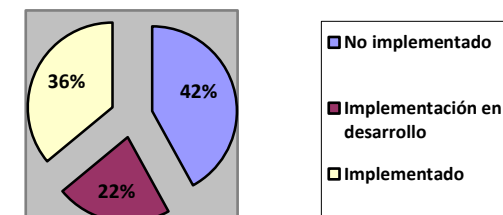


Graphic 7 Using Check List

58% said that if you have implemented formats, however 30% do not use it and 12% not implemented.

72% had to have procedures, only 8% are looking to implement it and 20% of them do not have it.

36% of companies have implemented a manual of quality, while 42% do not have it and 22% are looking to implement it.

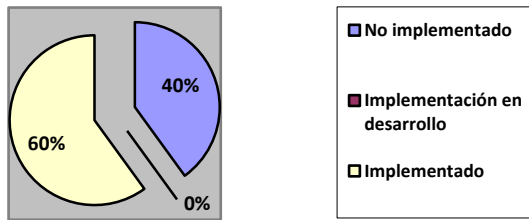


Graphic 8 Implementation of Quality Manual

On the other hand, only 46% maintain internal quality audits, however 48% do not apply and 6% are looking to implement it.

These companies also stated that keeps external quality audits by 40%, only 58% of them do not keep these audits and 2% are looking to implement them.

60% of companies have recruitment area, while 40% do not have it.

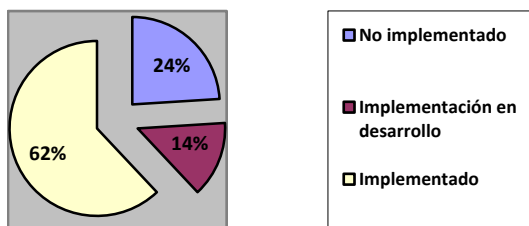


Graphic 9 Implementation area Staff Recruitment and Selection

Also, 60% said that has to recruit trained staff, 2% seeks to implement this tool, 38% do not have it.

70% of companies have a product design area, however 22% do not own it and 8% are looking to have one.

62% of companies there is an area of metrology, 14% seeks to have this area and 24% of them do not have it.

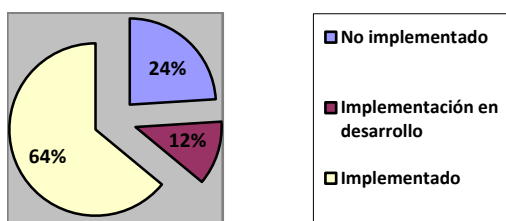


Graphic 10 Metrology area

56% of the companies it has quality circles within company seeks to implement 12% and 34% do not have it.

52% have continuous improvement projects, while 32 do not have it and 16% are looking to implement them.

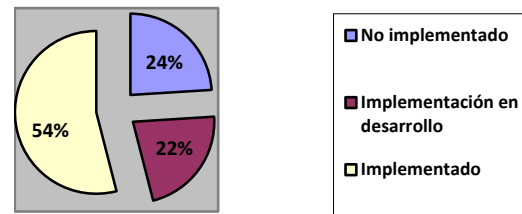
Likewise, 24% of surveyed companies implement Kaizen day, only 12% seek to implement it and 64% do not have it.



Graphic 11 Kaizen day

These companies, 26% of them have a marketing department, 20% seeks to have this department and 54% do not have it.

Only 24% of these companies conduct marketing research, 22% are looking to implement it and 54% do not have it.



Graphic 12 Market research

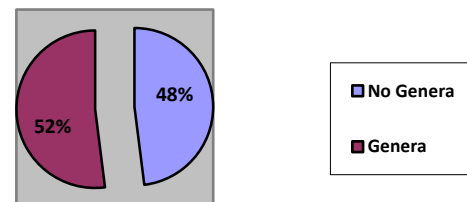
Sellers these companies have 28% with some kind of certification, while 62% do not have it and 10% are looking to have some certification.

II. Evaluation Costs

Companies consulted in 72% of them mentioned that there is an inspection with the supplier, seeks to implement 16% and 12% do not have it.

90% indicated that there is an inspection of raw material before moving to production, while 10% did not have it.

52% of businesses will generate cost raw material returned damaged, while 48% do not.



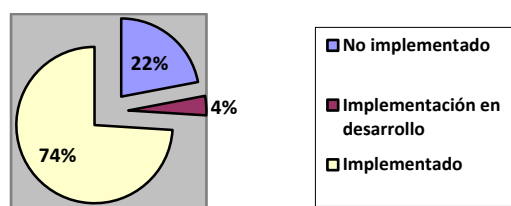
Graphic 13 Generation Costs

64% implements the use of inspection within the packaging, while 2% are looking to implement it and 34% do not have it.

In addition, 66% have check list or check sheets to meet the conditions of its products, seeks to implement 2% and 32% do not have it.

Similarly, 78% of companies said there product evaluation before hitting the market, while 22% do not have it.

74% of companies maintains communication between the client and the supplier to establish the conditions of the product before it reaches the company seeks to implement 4% and 22% do not have it.

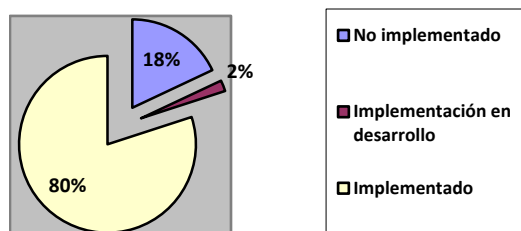


**Graphic 14** Communication process between the client and the supplier of the product where conditions are set before you reach the company

In prototyping 82% said that if you make any type of inspection, seeks to implement 2% and 16% do not have it.

On the other hand, they stated that 80% of companies have product audits, while 20% do not have it.

80% of them have audits of the process, while 18% do not have it and 2% have them looking.

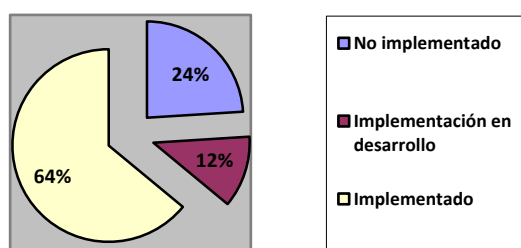


**Graphic 15** Audit process

Furthermore 42% have audits customer service, while 14% want to implement and 44% do not have it.

Likewise, 68% of companies have calibration of measuring equipment, while 10% of them are looking to implement it, 22% do not have it.

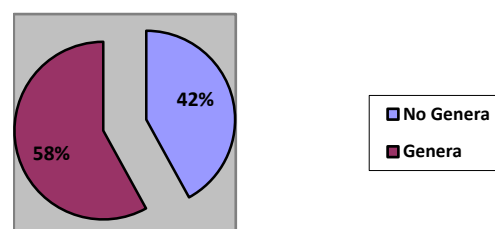
64% of these companies has test equipment calibration, 12% are looking to implement it and 24% do not have it.



**Graphic 16** Calibration of test equipment

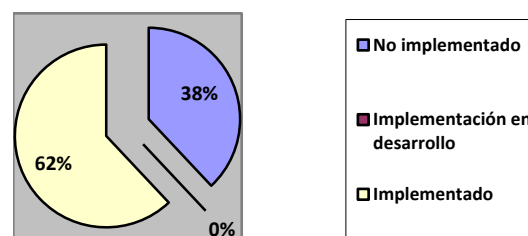
### III. Internal Failure Costs

58% of the companies surveyed reported having some type of waste generated cost, while 42% did not.



**Graphic 17** Waste generation costs

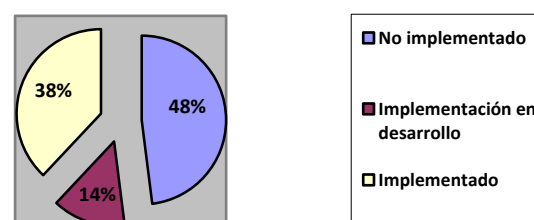
Likewise, 62% reported rework, while 38% did not. In addition, 80% of companies re-performed inspections, while 20% do not.



**Graphic 18** Percentage of companies that perform rework

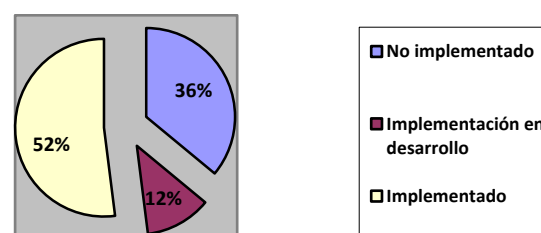
### IV. External failure costs

38% of the companies mentioned verified that features a system within the company to regulate returns and / or product tolerances, while 14% are looking to develop it and 48% do not have it



**Graphic 19** System within the company to regulate returns and / or product tolerances

In addition 52% of the companies mentioned offering discounts to customers, while 12% and 36% seeks to implement do not realize it.



**Graphic 20** Process implementation discounts

78% of companies said it is responsible for the product at the time of delivery, while 22% did not.

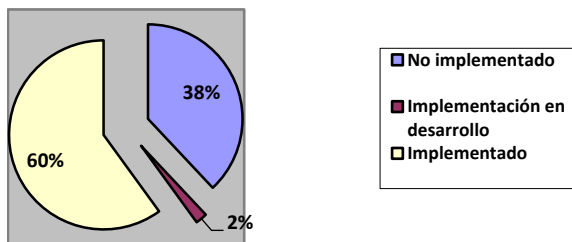
Also, 91% of companies have an implementation of training to improve the working environment, 5% of them keeps it developing, and another 4% it is developing.

Likewise, 32% of companies have complaints department, while 14% are looking to implement it and 54% do not have it.

50% of surveyed companies have a process of recovery defective product, seeks to implement 8% and 42% do not have it.

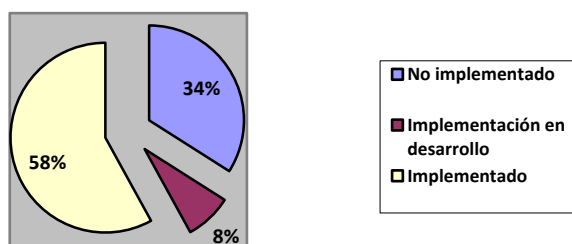
74% reported that generates some kind of cost to recover the defective product, however 24% will not generate cost recovery of bad products, 2% seeks to implement this procedure.

Research also showed that 60% of companies perform the corresponding work against the ill will that is in the company, while 38% do not have it, and 2% are looking to implement it.



Graphic 21 A process against the corresponding work against the ill will that have on the company

However, only 58% of companies provides training to improve the work environment, while seeking to implement 8% and 34% do not have it

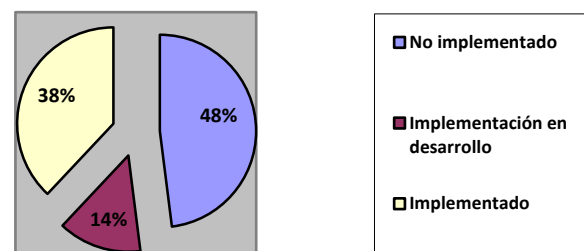


Graphic 22 Implementation of training to improve the working environment

Process Management

In the area of process management, only 42% of these companies define fixed responsibilities documents and processes that make up the value chain, while seeking to implement 14% and 44% do not have it.

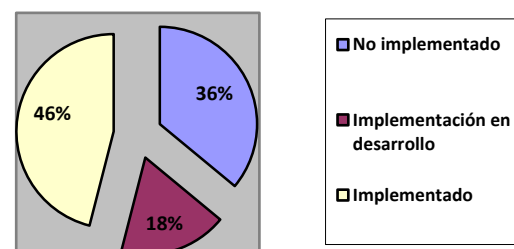
Likewise, only 38% of these companies maintains a system of indicators and metrics competitive process with their references, while 14% are looking to implement it and 48% do not have it.



Graphic 23 System of indicators and metrics competitive process with corresponding references

56% of these companies have a procedure which considers the requirements of customers and market design processes, you lie 8% seeks to implement this process and 36% have no such process.

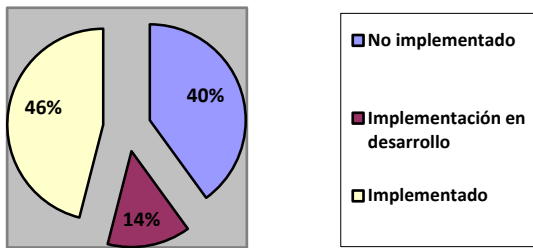
On the other hand, only 46% of the companies surveyed stated that sets standards and indicators of the quality of its processes, 18% are considering implementing such a system, and 36% do not have it.



Graphic 24 Standards and indicators of the quality of its processes

Finally, 46% of these companies develop their established suppliers to monitor quality indicators for specific processes, while 40% do not and 14% seek to implement it.





Graphic 25 Provider development

**Conclusions**

In leadership there is an area of opportunity for implementing conservation policies for the environment, dissemination of knowledge of responsibilities and actions of the members as well as for certification to ISO 14000, as only 32% of companies comply with the above requirements, plus it is necessary for the sustainability of the region with a view to further development with minimal impact to the environment.

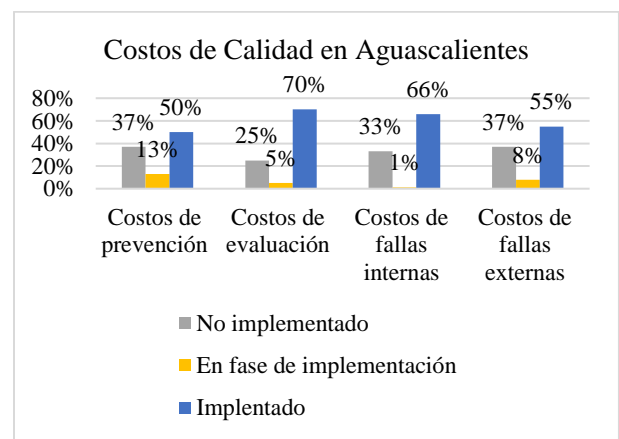
Also, the areas of opportunity focus on developing processes to detect the expectations of the markets and also processes where capabilities of the company and its employees are identified, and the development of planning processes where deemed the capabilities of its suppliers all of the above because more than 30% of companies require it, for with solidar clusters in the region.

On the other hand, there is an area of opportunity for the development of methods to help research the requirements of customers according to the products and / or services offered by companies, and the development of methodologies to detect new business and formal procedures to ensure that complaints and grievances are resolved in a timely manner also it needs to develop policies and pay structure covering all jobs that ensure the quality and competitiveness of companies, since the items listed are covered by less than 50% of the companies surveyed.

For the sake of robust development of enterprises, enterprises need to develop policies and compensation structures to cover the jobs that ensure the quality and competitiveness of the same.

Also, in order to develop work environments work environment that promotes competitiveness companies require methods of recognition and reward according to achievement of objectives that ensure quality and competitiveness as less than 50% of companies on average implement it. Besides creating health and safety departments in companies, with a view also to the OHSAS 18001 certification it is necessary because less than 9% of companies have it.

These are the overall results of the implementation of quality costs.



Regarding prevention costs, companies show implementation levels below 50% so it is important to strengthen the process control, intensify sampling inspection for decision-making., Documenting procedures, implement development areas product and metrology, as this will allow audits deal primarily internal and external and make you more attractive position to present and future customers, as companies showing documented QMS and running can diversify and compete in a variety of markets.

About evaluation costs, companies show a greater maturity, so that only the areas of opportunity are in the process of returning matters to the customer, calibration of measuring equipment and test are below 70% implementation and the need to prevent quality issues after sales thereby reducing warranty costs and become more reliable evaluation processes.

In terms of internal failure costs, 44% of companies have a program in order to avoid costs for waste generated during the process.

At this point there are big areas of opportunity to develop in the control of waste and management of retrabajos because on average 60% of companies have not controlled, impacting on higher closing costs and a lack of control processes, which in short and medium term is unattractive to customers, as well as these prevent competitive proposals for their clients.

In the area of external failure costs, necessary, meet at this point, the creation of mechanisms or systems governing returns and allowances within the company and that 62% of companies do not have such a process and this puts risk quality inside and outside the company, plus 68% of companies do not have a complaint department, which directly impacts on quality after-sales service, also 50% of companies lack a process defective recovering, which also affects the quality of service. 48% also has a training program for job improvement, hindering the process of service inside and outside the company, affecting the service and can hinder relationships internal and external customers, generating uncertainty removing competitiveness to the companies.

Finally, in the area of process management, it is important to develop procedures and documentation processes and thereby create indicators for measuring them, as well as procedures for supplier development, to strengthen the SGC because it is a way to show maturity and process control, which can guarantee reliable products and services for customers.

### Recommendations

It is necessary that these companies begin to apply methods of recognition and reward for the achievement of objectives in order to ensure the quality and competitiveness of the same as they generally lack such methods which in turn motivate staff to continue growing within the company and thus to better fulfill the goals set. Likewise it is suggested that companies begin to certified standards ISO 9001 and IAFT 16949 since the vast majority still do not have an international certification that guarantees the quality of its products and / or services offered as well as the implementation of quality manuals that enable each of its processes to maintain control of the quality required which short and long term may represent the watershed to remain competitive within the market they belong to such organizations.

Organizations must seek new methods, forms and techniques to avoid the high costs of raw returns damaged and waste material costs as this in turn gives rise to non-profit generation within the organization.

It is also recommended that organizations begin implementing indicator systems and process metrics in order to know where they are based and where they want to go in business by ensuring the quality of products and / or services offered.

### Acknowledgement

The collaboration of students Maria Isabel Ramirez Morales and Jose Emmanuel Macías Colis appreciated, as well as the authorities of the UTNA who supported us to do this research.

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