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CASE STUDY OF A QUALITY COST MODEL IN A SMALL BUSINESS

Jose Alves da Silva Neto[1], Giorgio Eugenio Oscare Giacaglia[2]

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Taubaté, São Paulo, Brazil

[1] Programa de Pós-graduação em Engenharia Mecânica, Departamento de Engenharia Mecânica, Universidade de Taubaté. E-mail: neto.fa@outlook.com.

[2] Programa de Pós-graduação em Engenharia Mecânica, Departamento de Engenharia Mecânica, Universidade de Taubaté. E-mail: giorgio@unitau.br.

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CASE STUDY OF A QUALITY COST MODEL IN A SMALL BUSINESS

Quality Costs are given by conformity and non- conformity costs, beginning with the initial process or activity work, in order to provide a product or service, with a desired quality. Although large companies usually state the necessity of evaluating costs of quality, in several cases, stating their activity of quality costs evaluation, results are largely under – estimated. Small size companies, in most cases, don´t even have a quality management budget provision neither control their costs of quality. The objective of this article is to show how the implementation of a quality costs evaluation model, in a small size company. The methods used were bibliographical research and documentary, applied to a single case study with qualitative approach. The results showed that the quality costs were reduced by 76% in the first year. It was also concluded that the proposed model is perennial, leading to stability after several months of implantation, showing the scope of system maturity.

Key words: Quality-costs; Optimal quality cost; Machining; Small size company

1. INTRODUCTION

The quality is highly regarded by companies as the main value for the customer, considering this as an essential factor for success in competition, before the competition. Currently, there is a growing awareness that goods and services of high quality can give an organization a considerable competitive advantage.

Good quality reduces rework costs, scrap and returns and, more importantly, creates satisfied customers [1]. To reduce these costs, it is necessary to know, identify, measure and monitor the production chain. Identify and measure the costs of quality, so it is considered an essential activity for managers.

Generally, there is no formula or definition, unique, about the cost of quality, as quality is in accordance with requirements. The quality costs are given for the costs of compliance and non-compliance. However, quality costs calculations are not present, not even the winning companies of the Malcolm Baldrige National Quality Award [2, 3].

Riccio et al [4], in a survey of the costs of quality research in Brazil found that studies involving this issue, started in the year 1996. The use of quality costs is not a concept widely used and companies rarely have a realistic idea of how much of their income are being lost, due to the low quality [5].

The objective of this research is to show results during the first year following the implementation of a quality cost model, in a business, small, machining and industrial tooling. This research tested the premise that, from real data records of production, you can create a mathematical

model, relatively simple, but accurate enough to meet the management needs of quality costs in a small company size, when most of the time, this methodology is applied only to large companies [6,7].

It has been shown that the company managed to reduce its costs and losses caused by the lack of compliance during the manufacturing process of its products and service delivery. The goal, main, this research is to demonstrate that the application of a quality cost methodology in a small business, the machining and tooling industry, is a viable and potentially advantageous alternative, in relation to the limited methods only to financial accounting.

It was shown that a quality cost model, even though simple, was built on proper identification of costs with its main classifications, identifying relevant sources of materials and associated processing. It is expected that the practical and objective approach theme promotes understanding and efficient adaptation of the methodology in other small businesses, the machining and tooling segment. Several case studies, successful, businesses are presented with data and reports on application of quality costs.

Vasconcelos [8] conducted a literature review, composed of 31 articles published in 12 countries, concluding that the importance of implementation and measurement of quality costs, within an organization, is quite diverse, varies greatly from company to company.

Kumar and Shah [9] present the quality of cost studies conducted in several countries. The authors conclude that not all countries accept the means of management and raising the costs of quality.

There are other published work on quality costs, such as the Porter and Rayner [6], who conducted a comprehensive survey of the published literature and presented a review in detail on quality cost models, focusing mainly the PAF model (Prevention, Evaluation and failures) and its limitations. There were also other models such as the Juran or process cost model and integration costs and benefits of quality improvement processes.

Tsai [10], in its publication on cost based on activity, reviews the models and literature on the costs of known quality. Categorization of all PAF models is proposed by Burgess[11] into three classifications: Prevention, Assessment and failures. In the thought of some authors, as Feigenbaum [12] and Campanella [13], quality costs should not have the name, but not quality costs (or cost of poor quality); however, they are known and called the quality costs. This research was developed by a case study on a machining and tooling company, not to show process.

To establish what can and needs to be done, should be considered all the alternatives of how the objectives set can be achieved, taking into account the assessment and environmental forecasting, along with the operational capacity of the company [14]. In the tooling area it is quite difficult to maintain an operational, precisely the following: specific products and outsourcing of

heat and surface treatment operations; machining with electro-erosion wire and other services that the company does not internally. They are pieces of small and medium dimensions, with different geometries and have high quality requirements.

2. LITERATURE REVIEW

2.1 Parameter of quality-cost

As there is no standard set for completion of the survey of the costs of quality, the best parameter to be applied is defined by the company's quality managers, as well as the means and quality data collection models, differing substantially from one company to another in order to meet the particular needs of each company [15].

Many companies conduct Benchmark with other companies that created the cost of quality program, in order to be guided to the identification of the quality cost elements [16]. However, most quality experts report that the cost of quality programs should be developed, as, for each organization, so that integrate the structure and the company's accounting system, and not just be copied [13]. There are several costing methods that have been developed from the management needs of companies. This research is, in general terms, the cost models of quality more likely to apply in the company studied, depending on their activities and needs. For this, we evaluated the following two models:

- Model PAF or Crosby model;
- Model ABC (Activity based Costing).

The cost models have their strengths and their limitations, while the company that intends to use them, find out which is best suited to the information needs and peculiarities of the operations performed. Martins [15] states that:

> *"It is absolutely incorrect to say that a method is, by definition, rather than the other. In fact, one is better than the other in certain circumstances, for certain uses etc ".*

These models can be applied at any cost storage systems, or by process and production order.

2.2 Model's quality-cost

2.2.1. Model PAF (prevention-appraisal-failure)

The PAF model is the most common used in determining the costs of quality [17,18]. The goal of this model is to emphasize that investments in prevention and evaluation, minimize spending on external and internal failures. Companies usually start the calculation of quality costs seeing the "tip of the iceberg" of the problem. Later, as they mature the system, start to increase

your coverage.

- Prevention: costs of actions taken to ensure that a given process provide quality products and services;
- Appraisal: costs of measuring and monitoring the quality levels achieved by the process;
- Failure: costs of product quality and correction services, both before and after shipment to the customer.

The classical view of the PAF model behavior is to maintain that a great economic quality will exist when the costs charged to guarantee a higher quality are up to keep improving the quality costs. However, this view is often challenged because it argues that there is an economic plan of quality, in which spending on prevention can always be justified, in addition to optimal levels of quality, which should be zero defects [19]. These and various other references [6, 20] discuss both the conflicting views about the economic cost of quality level, illustrated in Figures 1 and 2.

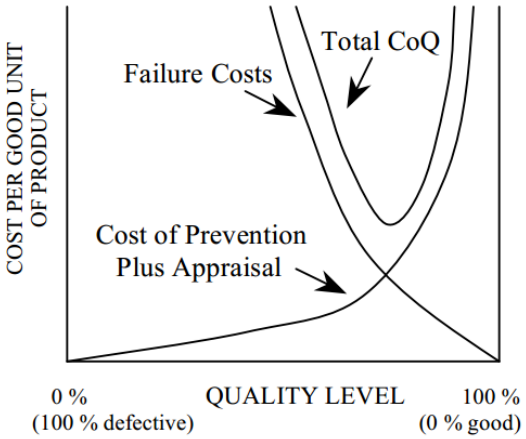

Figure 1 Model of great quality cost

Figure 1 shows that with the optimal cost - quality, does not reach 100 % of the desired total desired level of quality. To achieve this level, investments in prevention and evaluation increased significantly to the failure costs are reduced completely.

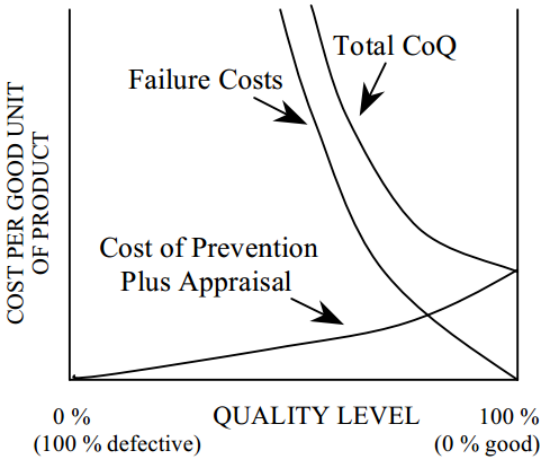

Figure 2 - Cost model great quality and zero defects

Figure 2 shows that with the great cost of quality is achieved 100% of the desired total level of quality through continuous improvement, achieving a reduction in failure costs without the need for a significant increase in prevention and evaluation costs.

The finding that to reach 100% of pre-established quality prevention costs and evaluation are larger than the failure cost, as illustrated in Figure 1, contrary to what Burgess [11] and Kumar & Shah [9]. These authors performed comparative analysis of quality costs with non-quality between companies, concluding that the non-quality costs were above the results of quality costs. Further argue that the failure costs may continue to decline over time without a corresponding increase in prevention and evaluation costs.

2.2.2 Model ABC (Activity based Costing Model)

Wood [21] points out that quality management is based on the elimination of activities that do not add value and result in unnecessary costs to the organization. In this context, quality costs should be obtained from the ABC costing model. To Nakagawa [22] the costing model ABC (Activity Based Costing ABC) was developed as a methodology to facilitate the strategic checks costs, more related to the most impactful activities in the consumption of company resources. The purpose of this system is to minimize the loss caused by other costing systems, as disclosed by Martin [15]. For Leone [23], rather than focusing on the products, the criteria for distribution of focuses costs directly development activities and manufacturing the product.

Some author [24,25,26,27], among others, support the idea that one of the main factors that favored the development of the ABC costing method, was discontent with the data costs, determined by traditional systems, which alter the costs of goods or services by allocating indirect costs to products, according to bases of assessment out of place. Considered by many authors as a method difficult to implement and, by others, as the solution to all the problems of a company, this

method assumes that you are not the goods or services that consume resources, but the resources are consumed the activities and these in turn are consumed by the goods or services.

The ABC model is identified with the absorption costing, to not separate the fixed costs, but rather appropriating them to goods or services, making it a disadvantage [26].

2.3 Means cost of quality measurements

The means of quality value measurements must contain suitable indicators and feedback, so showing the overall and detailed results, representing the elements of the cost of quality and performance of the measurement. Detailed indicators can be measured, for example, the prevention costs, cost percentage of rejection and defects, late delivery cost, cost of complaints received, among others, the organization itself must identify and evaluate among the most important to they are monitored. Already, as a global indicator, the most mentioned of the quality cost of context is the return on the quality resulting from the division of the results of increased profits at the cost of quality improvement program [28,29]. The first authors claim that successful companies demonstrate the return on quality, as a premise to accept the quality improvement projects.

2.3.1 Using of indicators to manage results

Quality management based on quantitative indicators, monetary aspects, may be more effective for generating greater questioning and awareness on the part of senior management [30]. The only indicator that has this requirement, are the costs of quality which, according to Feigenbaum [12] is the common economic denominator through which the senior management of companies, and members of the quality system, establish communication, clearly and effectively in business terms.

The classification of the studied company quality component costs has been set, and is listed in Table 1.

Table 1: Classification of components for measuring quality-cost

Cost Type	to contain
Quality Planning	costs associated with the planning team, and management project, aiming to guarantee to meet the requirements and standards according to customer requirements.
product quality assurance and service	costs associated with quality control and measurement during the manufacturing process and final inspection.

Cost Type	to contain
staff training	costs associated with conducting the training and qualification of employees, as well as internal training of the quality department.
Inspection	costs associated with incoming inspection of materials in the aspect of quality, quantity and price, which are materials of direct or indirect use.
Calibration and maintenance of instruments	costs associated with calibration of the instruments and means of control, such as instruments of metrology and production equipment (manometer, etc.).
Waste	costs of raw materials and product lost and wasted during the manufacturing process.
Rejection	products and services costs rejected for not being as the company's quality standards and / or customer.
Rework	costs in discarded products and services, requiring additional processes to achieve the standard of quality, since it was not done right the first time.
Exceeding the needs	loss costs overzealous and unnecessary operations in the operating process.
Packing	costs associated with rejection caused by improper packaging.
process Outsourcing	costs associated with the results service providers because they fall below the standard required time and quality to meet customer specifications.
Purchase materials	costs associated with poorly budgeted amounts above the market price quotations, delivery time not respected, poorly clarified technical specifications.

Thus, the data necessary to carry out the company's quality cost reports, and are collected by the accounting, are also drawn from other sources, such as management and quality control and production management department. All activities that generate costs (purchase, acquisition, rework, rejection, assessment and external services) are directly connected to the OS number of the specific product in question; all purchase order records have quotes OS.

2.4 Use of quality cost models

As a result of various researches and studies, it is confirmed that the cost of quality is not a concept widely used [9,31,32]. A literature review conducted by [8], composed of 31 articles published in 12 countries, achieved in international academic journals from 2004 to 2014, with the theme related to the cost of quality in organizations, concluded that the importance of implementation and measurement of quality costs, within an organization, is quite diverse, varies greatly from company to company. This analysis shows the different methodologies used to measure the cost of quality as well as their different results, difficulties encountered and dissemination of the importance of management of quality costs.

Rarely, organizations have no idea how much they lose by the poor quality and small companies, in most cases, even have any budget for the management of quality and do not tend to control the costs of quality [6]. Silva [33] examined the quality of management in traditional small and medium companies in the manufacturing sector, concluding that little practiced in this category of organizations. In addition to having training staff and poor communications, the goals and objectives of the organization are still defined and concentrated in senior management in 70% of small businesses, that is, the prevailing functional organizational practice.

Large companies usually affirm the need to evaluate the costs of quality [34]; However, according to Tatikonda and Tatikonda [28] and Morse [31], only a small number of managers actually measure the results of quality improvement programs.

In many of the companies that advertise have the custom to measure the costs of quality, the results are very underrated [6,28,34].

Few of the companies, which monitor the quality costs, have an established framework for data collection of all categories defined these costs [32]. It is a fact that companies often measure the visible and quantifiable costs, ignore significant costs such as lost sales due to dissatisfaction and withdrawal of customers [6,28,34].

Therefore, a large proportion of the costs has demonstrated its difficulty be dimensioned and thus remain unknown [35].

3. METHODOLOGY

In this study, we adopt the Diehl rating and Atim [36], which is organized under the logic of research bases, the approach to the problem, the overall objective and the technical procedure. The approach used was qualitative research to describe the interaction of certain variables, understanding and classifying the costs of the company's quality. According to Vergara [37], the case study is one of the main recommendations for qualitative approach. Nature is an applied research because the main objective is the implementation of a method in a company so that it can

be used by its managers and bring valid results to aid in decision making. The technical procedure adopted was the case study, by presenting a problem that does not have a pre-defined solution, requiring commitment of the studied company management to identify the problem, analyze evidence, develop logical arguments, evaluate and propose solutions. The methods applied were the literature due to research on materials and articles published, and documentary research, as part of the investigation focuses on data obtained from restricted documents of the company studied. These documents were prepared according to the needs of the company, which is consistent with its total quality management requirements.

The method employed in this study characteristics are described in Table 2.

Table 2 - Methods used in this research

Rating Search	Applied methodology
approach	qualitative
Nature Search	Applied
Technical procedure	Case study
Method	Bibliographic research; documentary research

4. CASE STUDY

4.1 Development of the methodology in a real case study in business

The records of this case study, conducted over twelve months was specifically related to a small business. The company studied is the machining segment and industrial tooling, in the state of São Paulo. It is a tooling company and provider of metrology and quality inspection services.

The products supplied by the company studied are specific to order and does not apply to serial production in its scope of supply.

During the period of this study, the number of employees was around 52.

The company studied externally acquires the heat treatment processes, surface treatment and calibration of measuring devices. It has a certified quality management system according to the requirements of the standard ISO 9001: 2008.

4.1.1 Methodology applied to the case study company

The company studied adopted the PAF model to associate a measurement model to suit your process.

Due to its operating conditions, specific processes and not series, for the studied company, the best funding model needs to enable data collection in order of service, that links costs to each

manufactured product, independent of the process to maintain multiple items produced at the same time. For this reason, the costing model based on activity ABC was chosen to be associated with the PAF classification system.

The ABC model has a tendency to suit the needs of the company, because it absorbs the costs by activity (product), leaving the departmental vision and entering the productive field, making it an advantage for the company. In the ABC model, the activities are directed as an assessment of the processes carried out, called driver cost. Thus, for the studied company, one driver specific cost for each type of activity was created. With the ABC model you can use multiple apportionment basis. The disadvantage of this model is that, being a much more accurate and objective method, needs to be treated with more attentive criteria; However, this disadvantage is the smaller, compared to the other systems presented above.

4.1.2 Formulas and targets applied in measuring the company's quality cost

Table 3 presents formulas and defined goals, applied by the company studied in the first year of implementation of the quality cost model. These formulas had its development, to enable measurements of each type of cost of the specific quality of the company studied. Many formulas have been exploited and enhanced internal data of the company's quality management system. Thus, many surveys information to generate the mathematical model and formulas, were removed from the company's quality manual studied. Also, it has been established the goal for the second year, based reconfigured and the results presented in the first year.

Table 3- formulas and targets for implementation of quality costs

Class	Cost Type	formula	Goal 1st year	Goal 2nd year
Prevention	Quality Planning	$P = \frac{FEP}{OSP}$	0%	0%
	product quality assurance and service	$Q = \frac{FEM}{OSP}$	0%	0%
	staff training	$T = \frac{QFE}{VT}$	management	management
Appraisal	Inspection	$I = \frac{FEI}{OSP}$	0%	0%
	Calibration and maintenance of instruments	$C = \frac{VC}{QIE}$	management	7%

Class	Cost Type	formula	Goal 1st year	Goal 2nd year
Internal failure	Waste	$D = \frac{CMP}{CMA}$	0%	0%
	Rejection	$RJ = \frac{QR}{QP}$	3%	1%
	Rework	$RT = \frac{QT}{QP}$	5%	3%
	Exceeding the needs	$CEN = \frac{AR}{AE}$	management	+ 2% - 8%
	Packing	$E = \frac{FE}{OSP}$	0%	0%
External failure	process Outsourcing	$F = \frac{FF}{OSP}$	0%	0%
	Purchase materials	$CM = \frac{CP}{CG}$	0%	0%

AE= Estimated theoretical pointing at time of quotation in the month
AE= Estimated theoretical pointing at time of quotation in the month
AR = Royal appointment in month
C = Calibration and maintenance of instruments and means of control
CEN = Exceeding cost Needs
CG = General value of the cost of all purchased materials
CM = loss ratio derived Materials Purchases
CMP = kg cost of each type of raw material lost in the month
CP = Value of Lost materials costs due to purchase error
D = Waste / scrap production
E = loss ratio derived Packaging
F = loss ratio derived from processes Suppliers
F = loss ratio derived from processes Suppliers
FE = Failure arising packing the month
FEI = Failure by receiving inspection error in month
FEM = Failure by measurement error during the process in the month
FEP = Failure by error quality planning in the month
FF = Failure originating from processes Suppliers
I = Inspection
OSP = Order Scheduled Service in month
P =Quality Planning
PMP = Kg of each type of raw material lost in the month
Q = product quality assurance and service
QFE = Company Employees table in quantity
QFE = Company Employees table in quantity
QIE = Total amount of active instruments in the Company
QP= Produced amount of pieces in the month
QR = Rejected parts of amount in the month
QT = parts amount worked in the month
RJ = Parts Index Rejected
RT = Parts Index Reworked
T = staff training
VC = Amount spent on calibration in month
VT = Investment value in training the month

5. RESULTS AND DISCUSSION

To perform the evaluation of performance and results, may obtain comparative values before and after the implementation of the quality cost model, the company was required to have knowledge of all the initial costs. In the first month of study, we collected all the values of spending quality costs and transformed into percentage. The initial costs were represented as 100 % of the quality costs of results of the studied company.

Figure 3 shows the evolution of the cost of quality in the company, during every month of the first year of implementation. At the end of twelve months from the implementation of quality cost, proven to be a significant reduction of 76 % of the cost of quality.

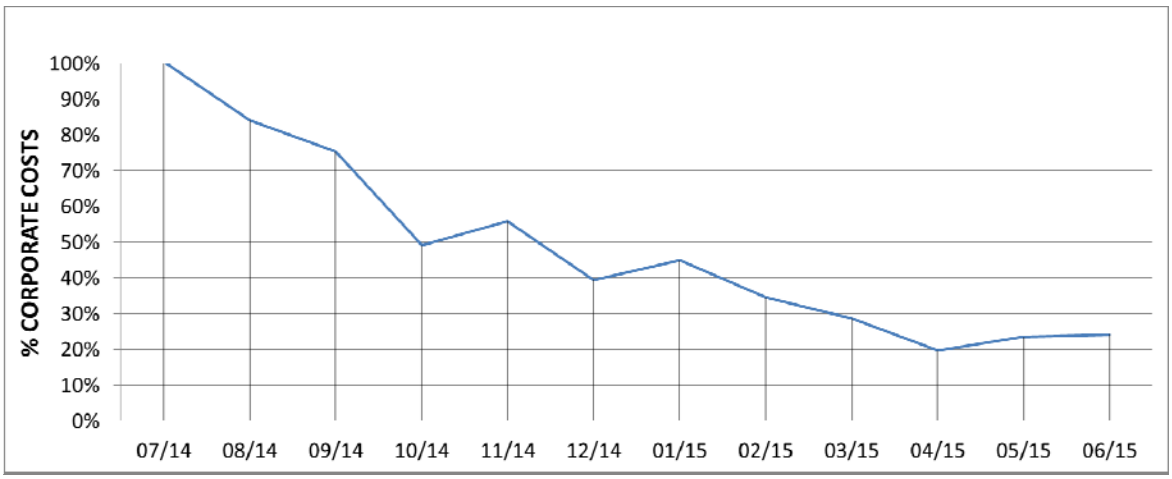

Figure 3 - Indicator assessment of quality costs

The figure 4 shows the ratings of the company's quality cost by category. It is observed that, of the four categories, internal failure cost element was the one that had the greatest result. Its initial value represented 38.9% and after 12 months, 5.6% of the costs of quality, representing a real reduction of 33.3%, and specific improvement in performance of 85% in this category.

The second category, the best result was the external fault class. Its initial value represented 17% and after 12 months, 0% of the cost of quality, representing a real reduction of 17%, and specific improvement with 100% performance in this category. This demonstrates that the failure costs are the most representative for the studied company. The third category, the highest result was the evaluation class. Its initial value represented 30% and after 12 months, 14.3% of the costs of quality. Representing a real reduction of 15.7% and specific improvement, with 52% performance in this category. The last place, but not least, was the class prevention. Its initial value represented 14% and after 12 months, 4% of the cost of quality, representing a real reduction of 10%, and specific improvement in performance of 71% in this category.

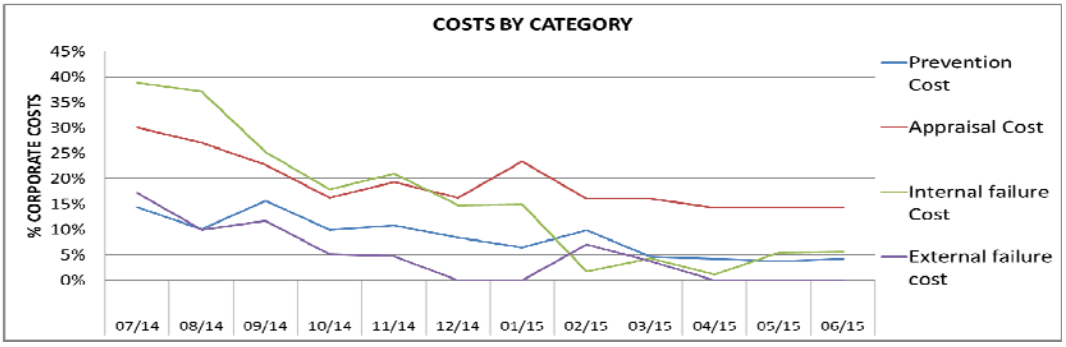

Figure 4 evaluation indicator of the quality costs by category

The figure 5 shows the results of quality planning measurements. In the first month of deployment, measurement resulted in a rate of 8% failure, quality planning resulting oscillating

until the fifth month. From the sixth month, the goal was achieved and maintained without new faults by quality planning error. With all staff working to ensure the verification of action plans and reports, all potential faults and questions have been addressed previously.

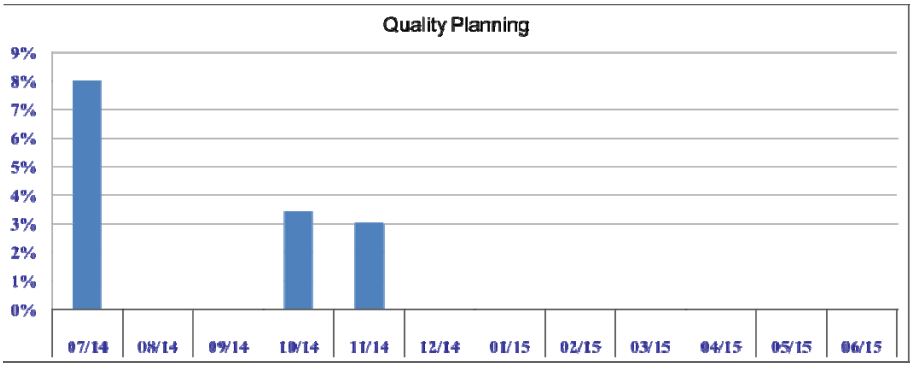

Figure 5 Indicator assessment of quality planning quality costs

The figure 6 shows the measurement results of the quality assurance of product and service. In the first month, a measurement resulted in a 0% loss rate, however, in two consecutive months, the trend showed a 4% and 8% rate.

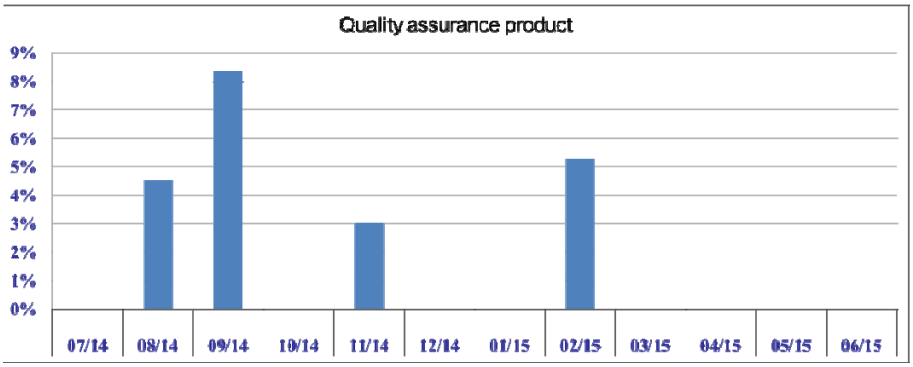

Figure 6 Indicator assessment of quality costs in quality assurance

The figure 7 shows the results of measurements of the training costs. In the first month, a measurement resulted in an index above 6% of quality cost accounting training. As this indicator is managerial and there is not a goal but a monitoring to assess trends, you can see that in the first half of the implementation, the costs of training had a great swing, reaching its maximum at around 8%.

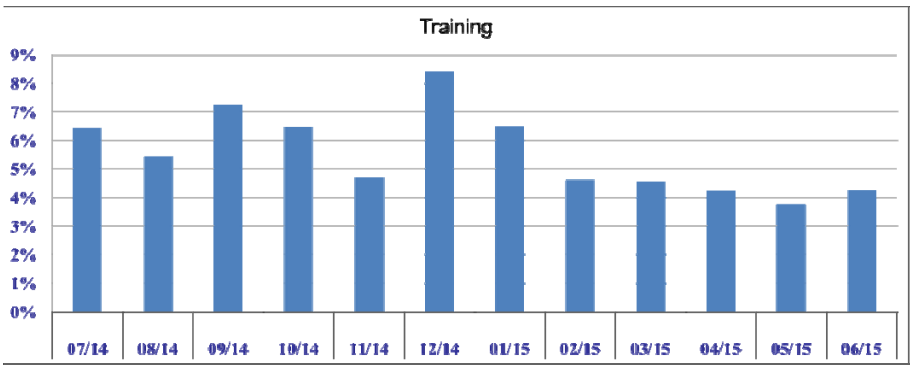

Figure 7 - Evaluation indicator of quality costs related to training

The figure 8 shows the measurement results of inspection costs. In the first month, a measurement resulted in an index of 12% loss by inspection failure. From the eighth month it managed to achieve and maintain stable target.

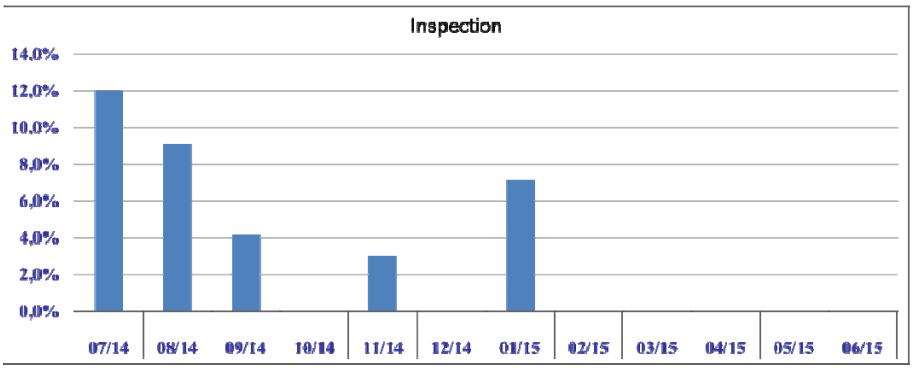

Figure 8 Indicator assessment of quality costs relating to inspection

The figure 9 shows the results of measurement of instrument calibration costs. In the first month of deployment, measurement resulted in a rate of around 18% of the costs of quality, representing calibration and maintenance of control and measuring instruments. For the second year, the target was revised and changed from management to 7%.

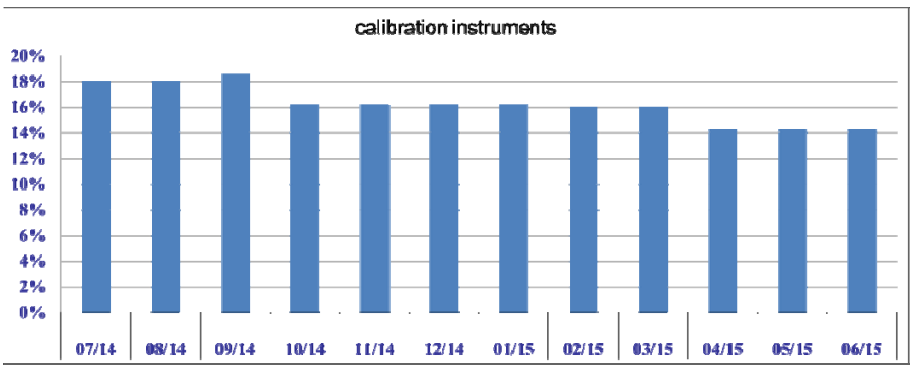

Figure 9 quality costs of the evaluation indicator with calibration instruments

The figure 10 shows the results of measurement of waste costs. In the first month, a measurement resulted in an index of 1.6% loss, significantly increasing to over 3% in the third month. This caught the attention of top management. The company management has assumed that the management entered a comfort zone, because the index soared 1.6% in the fifth month, to 3% in the sixth month, a jump of 87% in 30 days. Therefore, a new approach has been applied with some corrective actions. Following this approach, there is a continuous and steady decline in the last six months, closing with 0.8%.

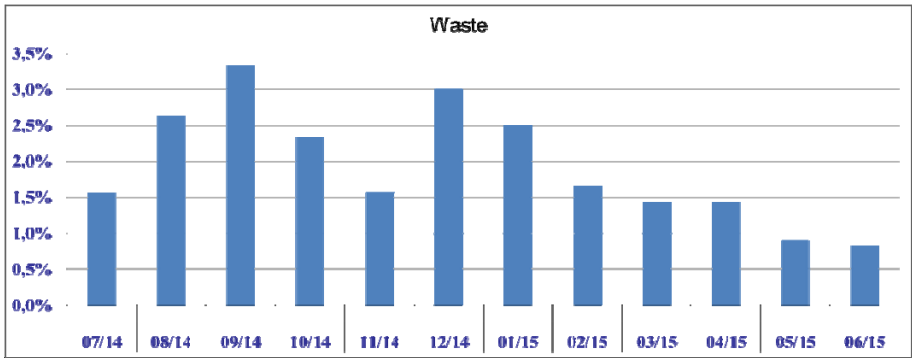

Figure 10- Indicator assessment of quality costs related to waste

The figure 11 shows the measurement results of the rejection costs. In the first month, a measurement result in a content more than 6%. Therefore, in the third month was 3.5%, a very satisfactory reduction beginning with the applied improvements. For the second year, the company revised its rejection of acceptance goal to minimize and limit 1%.

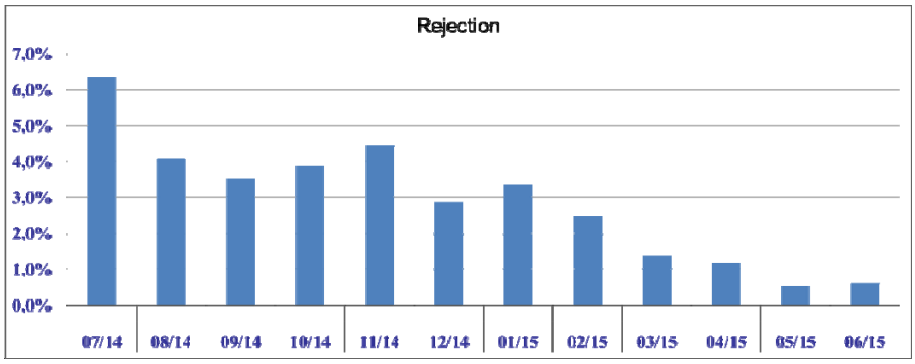

Figure 11- Indicator assessment of quality costs related to rejection

The figure 12 shows the measurement results of rework costs. In the first month, a measurement resulted in an index above 7% loss. In the last four months of the study, he closed with trend around 2% and in the last month, 1.3%, within the 5% target. For the second year, the company revised its Rework acceptance goal to minimize and limit 3%.

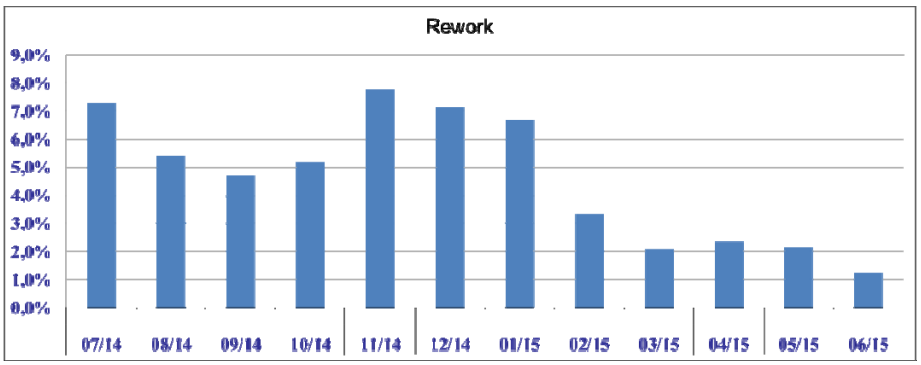

Figure 12- evaluation indicator of quality costs related to rework

The figure 13 shows the measurement results exceed the requirements of cost. In the first month, a measurement resulted in an index of more than 15% loss. The values of this indicator show the percentage of operating time, which is being held above the estimated. So when the indicator values are negative, it means that the actual time is below the estimated theoretical, but does not mean that the process is suboptimal and, yes, it is possible to produce the product as design and quality required, with less time than estimated. With this indicator, the estimator can work in their calculations and reasoning, update yourself, align with the actual production and even perform strategic discounts on time to budget, taking it as an advantage over the competition. As a benefit, the studied company can continue to provide good quality products and opportunities to review their prices. Keep your profit margins and minimize your losses with higher quality. In the second month, there was an increase in this index, followed by a continuous fall, until the results below zero, the seventh to the tenth month. For the company, this period of negative indicator represents gain in operating time. For the second year, the company has set a limit, forming a field goal, allowing an oscillation within the range of 2% to -8%.

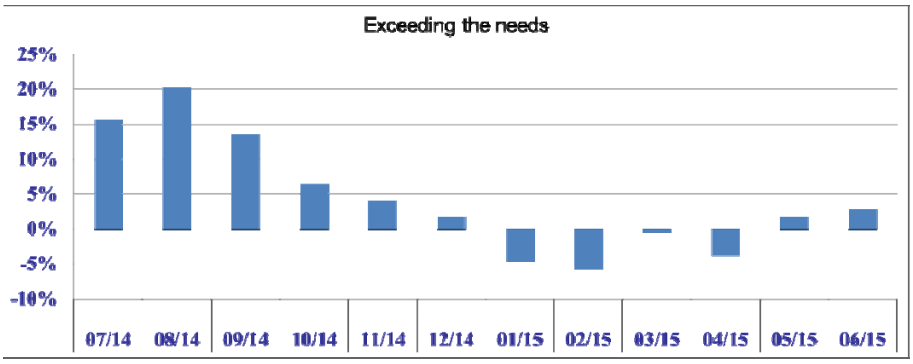

Figure 13- Indicator assessment of quality costs ref. exceed the needs

The figure 14 shows the results of measurement of loss costs arising for packaging problems. In the first month, a measurement resulted in a rate of 8% loss for packaging and inadequate handlings. specific corrective actions were taken to eliminate the root cause. From the

eighth month it managed to achieve and maintain the goal.

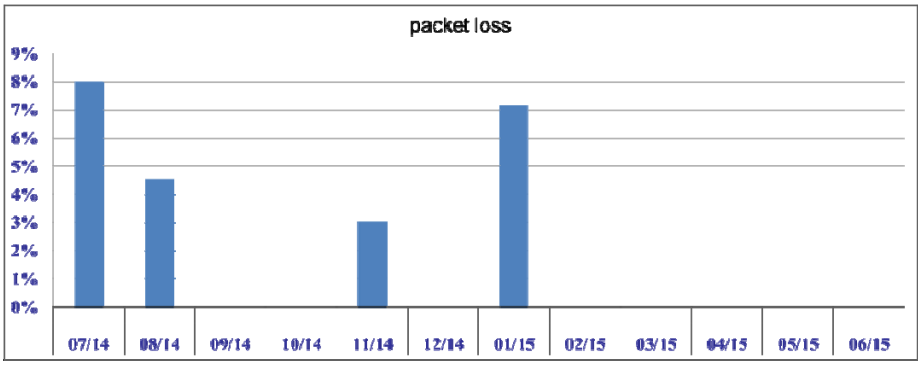

Figure 14- Indicator assessment of quality costs ref. loss on packaging

The figure 15 shows the measurement results of loss costs by subcontracting process. In the first month, a measurement resulted in an 8% loss rate. The greatest difficulty in measuring this indicator is that it would be appropriate if all suppliers were evaluated monthly, but it does not. The contracting of services and processes, subcontractors, vary according to the purchase order that the studied company receives from its customers, as in the case of specific production, there are providers who provide their services once every six months: it has great sway.

In the last three months, the result reached 0%, but the company's management is committed to continuously monitor this indicator, to be able to track the results of the suppliers and are willing, if need be, to replace all, development of new suppliers.

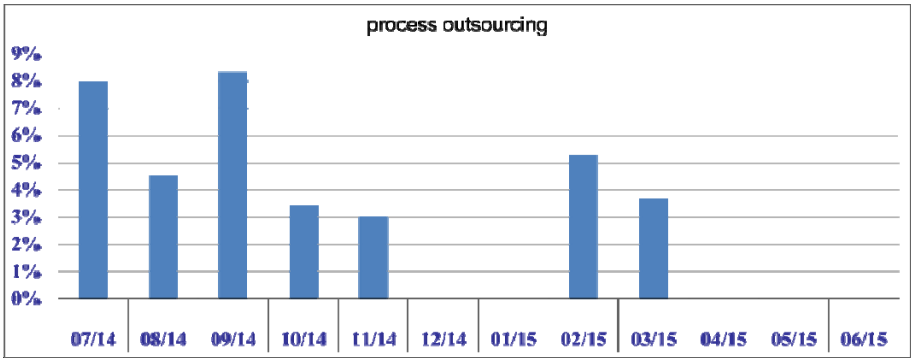

Figure 15- evaluation indicator of quality costs subcontracted process

The figure 16 shows the measurement results of the loss of charge when purchasing process materials. In the first month, a measurement resulted in an index of 9% loss, followed by visibly satisfactory results when, in the fourth month, reached below 2%, thanks to the actions of continuous improvement applied. These costs were related to the cost for loss of material purchases, as the buyer, to close the application, not hearkened to term supplier.

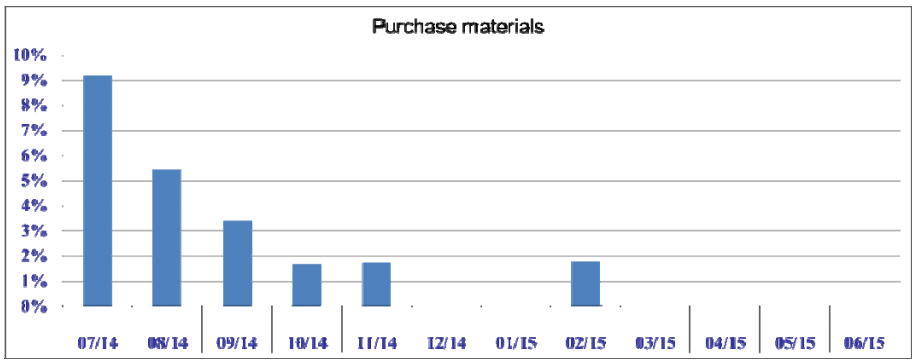

Figure 16- Evaluation indicator of quality costs related to the purchase of materials

5.1 Evaluation of great quality-cost

The figure 17 shows the curve of the total cost of quality, the correlation between control costs and failure costs. In this correlation, you can see the great value of quality achieved in the tenth month of deployment, April / 2015, considering that the level of total quality, desired has been reached. This behavior confirms the statement of Daniel and Reitsperger (1991), shown in Figure 2 that, with the great cost of quality at the level of 100% of the desired total quality through continuous improvement, reducing failure costs is possible without the need for a significant increase in prevention and evaluation costs.

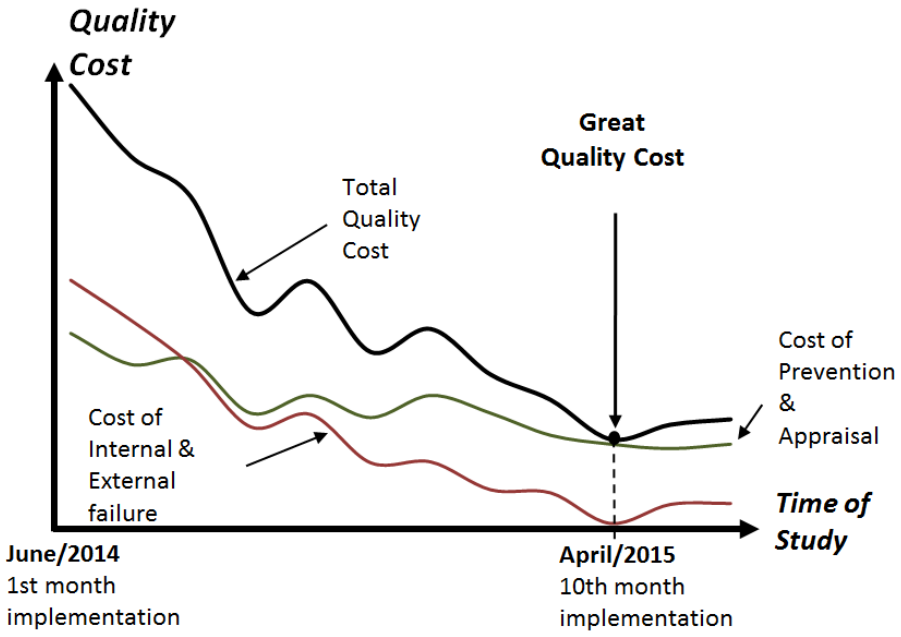

Figure 17- Diagram great quality cost

In Figure 17, the optimal cost of quality to zero defects is limited by the business process. After the tenth month, when it reached the great cost of quality, failure cost values increased, representing, however, a stable effect. Any attempt to improve will be linked to innovation efforts and / or revolution in processes to reduce these failure costs. As for the prevention and evaluation

costs, the company has set new targets for the second year in order to reduce this line and thus achieve lower total cost of quality.

6. CONCLUSION

According to what was done in this study, it was found that the study on the company studied, it was observed that investments in projects of improvement and measurement and monitoring system led significant results in 76% reduction of quality costs, in the first year.

The correlation between the failure costs and the costs of prevention and evaluation demonstrated that the company reached its optimal cost of quality after 10 months of implantation.

It was concluded that the method was an appropriate use, bringing as major benefit for the company, a new tool for decision making, as well as for the control of quality costs and also to the improvement of its process.

The company abandoned the theory of a management under a plant manager and stopped practicing traditional management accounting, which focused efforts to reduce product costs, rather than focus on activities that would reduce the cost of quality and increase profit, made possible with the implementation of quality cost model.

It is suggested that this system developed during the study to be continuously practiced in the studied company, and this released validation as possible applications in other companies in the same segment and its peculiarities in common. Thus, expected to join new information contributing to further studies and applications, aspiring to quality engineering improvement in this type of organization.

6.1 Future studies

Further studies on how companies, successful, make decisions, with regard to improving the quality and how they reduce the quality costs should be performed. Specifically, the more detailed research on the collection and measurement of quality costs in real environments, should yield useful information on best practices of cost of quality.

Encouraging companies to report the data and help them schedule comprehensive systems, as well as measuring the cost of quality must be part of any quality management program.

The methodology is complex and not well documented. quality cost programs provide a good method for the identification and measurement of quality costs and thus specific actions are allowed to reduce the cost of quality.

Intensive education in real levels, it is necessary for managers to better understand the concept of quality cost in order to understand fully the benefits of the approach, in order to increase its ability to deploy a quality cost measurement system and financial savings.

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