SYSTEMS & MANAGEMENT
Electronic magazine

IDENTIFICATION AND MEASUREMENT OF QUALITY COSTS AND NOT QUALITY IN A TEXTILE AND APPAREL INDUSTRY

Fabiano Maury Raupp[a], Diane Mafra Gaebler[a]

[a]Santa Catarina State University

Abstract

The textile and apparel industry in Brazil has faced challenges of competitiveness. Work towards continuous improvement and cost reduction are everyday issues for these industries trying to survive in this highly competitive environment. The calculation of the cost of quality can offer the company support cost management together with quality programs in order to guide the prioritization of management actions. This study aims to identify and measure the costs of quality and non-quality in a textile and apparel industry to assist management in decision making. Through a case study were collected through interviews and company documents, quality costs (prevention and evaluation) and non quality costs (internal faults and external faults). The results revealed a cost to the disturbing quality and non-quality cost (faults) higher than the quality costs (prevention and evaluation).

Key-words: quality costs; non-quality costs; textile and apparel industry.

1. INTRODUCTION

Throughout the 2000s, Brazil has lost competitiveness and market in textiles and apparel. According to the report of the National Bank for Economic and Social Development (BNDES) Sectorial, the textile industry and apparel manufacturers in Brazil presents the following challenges: massive entry and often smuggled imports of textiles and cheaper production in the domestic market ; high average age of machines without global competitiveness capacity; large spraying, low technical and managerial capacity and high informality, especially in the production link; business practices between companies of different links in the chain with a predominance of lack of confidence, and low quality of the product and/or services (Costa *et* Rocha, 2009).

In this scenario, it is the company which is the object of study, a textile and apparel industry that was born in 1993 in the town of Jaraguá do Sul, Santa Catarina. To remain competitive in the market, the search for quality and lower costs, it has become vital to survival. Therefore, we perceive the concepts of quality and non-quality costs as an important way to support the cost management together with quality programs and continuous improvement through information that enables managing the programs so as to prioritize the implementation of programs in the most critical areas in terms of costs (Wernke et Bornia, 2000). Such concepts may favor the integration of cost reduction needs with improved quality, which are essential actions to textile and apparel companies.

Thus, the objective of the study was to identify and measure the costs of quality and non-quality in a textile and apparel industry to assist management in decision making. On the importance of knowing the costs of quality and non-quality, Crosby (1990) estimated that the waste in industrial companies, on average, account for 20% of sales, while the service providers get to reach 40% of operating expenses. For Harrington (1991), any costs of quality value that exceeds 6% of sales (without taking into account the costs of poor quality of the administrative areas), should concern the direction and that the average of 10 resolved complaints, three customers will never come back to buy from the company if they have another alternative. In terms of benefits

PROPPI / LATEC
DOI: 10.20985/1980-5160.2016.v11n3.1104

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

to meet the costs of quality, the author cites the following: reduction of the manufacturing cost; improving administrative management; reduction in scrap; improvement in the activities planning and programming; improvement in productivity; and increase of profit.

According to Feigenbaum (1994), using more accurate measures for quality, companies have productivity losses ranging from 15% to 40% and a quality program can completely eliminate these lossses. It also points that control failure costs represent 65-70% of total costs of quality, while controlling costs range from 20% to 25%. Corradi (1994) highlights that 20 to 30% of annual sales of a company are dissipated in bad quality costs, i.e. internal and external failures. Already Heldt (1994) states that the gainfrom the elimination of failures can be multiplied by four without the need to increase sales.

From the academic point of view this study is relevant because of the scarcity of publications about quality and non-quality costs. On the last five years, as bibliographic publication, there are a few published books among the largest publishers in Brazil. By 1999 the researches on quality costs area represented only 1% of the researches made on costs in Brazil, only on the years from 1996 to 1999 appeared the first research on quality cost area in Brazil (Pinto *et* Gomes, 2010).

2. QUALITY AND NON-QUALITY COSTS

Crosby (1990) and Gryna (1998) has associated with optimizing the inputs application, impproved in the performance of people and failure and losses reduction in the productive process to adoption of quality management. The concern to ensure the realization of a net financial gain in the application of quality management resulted in the creation of a costs management system called “quality costs”. Although designed to guide de manager on identifying priorities for it’s operation, this system provides some insights about the mechanisms involved in quality management and inorigin of the verifyed gains.

Inittialy the concept of quality costs addresses only the total of quality avoidable costs. Over the years, the concept has evolved to encompass all costs necessary to achieve the required quality, in addition to internal and external failure costs. Control procedures and quality improvement (inspection, process control, training, implementation and monitoring of quality systems, among others) have a certain cost, which usually referred to as “quality costs”. Such procedures constitute, in fact, the company’s efforts to promote and monitor compliance of the product or service to established specifications.

The absence of such compliance, on the other hand, will result in a number of failures (non-conformities) in the product or service, with the consequent need for corrections and any loss of man-hours in rework of errors, raw materials to redo products, additional space for inventory, or costs of product supply or customer service imperfect: dissatisfaction, distrust, returns, contractual charges and so on. These situations involve costs to be assessed, we call the “non-quality cost”. The implementation of quality procedurescan raise the quality costs. In contrast, the non-quality cost will be reduced by eliminating failures and waste.

For Feigenbaum (1994), the goal of competitive industry is to provide products and services with quality designed, developed, marketed and maintained within the lower cost rates that allow full customer satisfaction. Crosby (1990) mentions that in order to be assessed the cost of quality, is to call the attention of management and provide a quantitative reference, or benchmark, to verify the quality improvement. Robles Jr. (2003) cites the following measurement objectives: to know the actual losses of the company for the lack of quality; making quality a strategic goal of the company; know the distribution of the costs by promoting better targeting linked to improvement projects; increase profitability; increase productivity; facilitate the preparation of budgets and allocation of resources; design products in order to reduce orts and scraps.

Bottorff (1997) presents the advantages of a quality cost system, such as the data are more easily accepted because they are collected and analyzed by teams with employees from various areas, as well as participation of the company’s accountant; the quality cost system is meant to help in decision making about investments that need to be made in the company; the cost system helps to justify and direct investments in prevention so it will not become opportune internal and external failure cost reductions also contributing to assess and justify investments in quality improvement efforts; the cost system leads to the development of advanced performance measurement techniques in customer satisfaction areas, production and development of products to improve the focus on reducing total cost of quality; occurs the improvement in return of investment and sales, the reduction in costs of products or services of the organization and the system cost can be used by the organization to manage and sustain their quality improvement programs.

In terms of categories, can be found in various literature ratings for quality costs. Based on the review by Wernke et Bornia (2000), was elaborated Table 1.

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

Through the proposals of the authors analysis, although some distinctions found, we can summarize the ratings of quality costs at: prevention costs, evaluation costs, internal failure costs and external failure costs. Thus, Table 2 was constructed from studies of Robles Jr (2003), Calixto *et* Oliveira (2006), Horgren *et al*. (1997) and Castro Junior et Gonçalves Filho (2011) to present the concepts that will guide the study of categories.

It is important to also be aware that there is an interaction between the categories presented so that they are influenced by each other, for example: the costs of prevention reach an ideal point when failure costs have been reduced to a tolerable value for the company; the evaluation of costs can be considered optimal when the failure costs have been reduced to a tolerable level by the company, and the products manufactured and the purchased parts are in accordance with the specifications according to the inspection plans and the tests; the failure costs have reached a great point when it is difficult to identify profitable projects to reduce them.

3. METHODOLOGICAL PROCEDURES

According to Yin (2005), the preference for the case study of the use should be given when the study of contemporary events, in situations in which the relevant behavior can not be manipulated, but where it is possible to make direct observations and systematic interviews. Despite the limitations, the case study is the most appropriate method to know in depth all the nuances of a particular organizatio-

Table 1. Classification of Quality Costs according with the researched authors.

Author	Year	Classification
Crosby	1990	Differs from Feigenbaum classifications by including the two failure categories in one and keeping the other.
Townsend	1991	Adopt four categories of quality costs: Prevention, referred to training in new procedures and testing system; Detection, that covers revisions regarding work balance and control; Correction, encompassing review of wrong works and the repetition of processing computer; Failures, i.e. "remedial activities resulting from delays and mismatches, that require corrective actions, work redo and/or special explanation, but when, in addition, the item was received by the end customer".
Nakagawa	1993	Three important aspects should be considered in accounting quality: 1. Compliance with the specifications, which is to collect data and information on the costs associated with reprocessing activities, generation of waste, service guarantees and other, that occur during the manufacturing process and continue even after the delivery of product. 2. Develop projects to ensure the manufacturability of the product and emphasizing the importance of engineering function in designing products to minimize or prevent quality problems. 3. Prevention of defects, which is the implementation of the principle of "doing things right on the first time" in order to prevent the occurrence of defects during all stages of the manufacturing process
Feigenbaum	1994	Classifies into two groups: control costs and control failure costs. These groups are subdivided then into segments. Control costs are segregated in costs of prevention and evaluation costs, while control failure costs are separated into internal failure costs and external failure costs.
Coral	1996	Investments in quality, to justify, should bring recurrence to the organization. Thus, quality programs should be guided by measures that provide support to transform losses into gains in productivity and profitability. As a result, defines two categories for the quality costs: quality costs acceptable (which are those that the company plans to spend) and costs of unacceptable quality (those that the company wants to eliminate or avoid).
Sakurai	1997	Quality costs can be of three types: 1. Costs incurred to be achieved environment in which employees can work efficiently; 2. Costs incurred by the expectation of failure, which would cover the costs of prevention and inspection and evaluation; 3. Costs incurred by faults occurred (internal and external failure costs). Also classifies the costs of prevention and evaluation as volunteers costs because they can be controlled by a decision of the company and the internal and external failure costs as involuntary costs.
Gryna	1998	Classify the costs of quality in prevention costs.
Robles Jr	2003	Quality costs can be grouped into categories that are interrelated. Generally.

Source: Elaborated based on Wernke *et* Bornia (2000)

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

Table 2 - Concepts, general examples and detailed examples for each category

Category	Prevention Costs	Evaluation Costs	Internal failures costs	External failure costs
Concept	Spending on activities to ensure that defective products, unsatisfactory or not accepted are not produced.	Spending on activities for product identification or defective services before reaching the customer, internal or external.	Design failures, purchasing, supplies, programming and production control, observed prior to shipment to the customer.	Costs generated by problems that occur after the delivery of the product to the customer, associated with returns, complaints and customer complaints.
General Examples	Project Engineering; Quality Engineering; Evaluation of suppliers; Preventive maintenance of equipment; Training; Technical support for sellers; Inspection of purchased components.	Inspection; Product testing; Self-inspection by operators; Performance inspection of the product/service in the customer environment.	Losses; Reprocessing; Waste; Repair maintenance; Discounts on defective product selling prices; Overtime for rework	Fines; Revenues; Lost sales; Replace the item / service; Technical assistance; Damage to company image (lost sales).
Detailed examples	Preventive maintenance: management (M.O); inputs (parts and equipment). Training: Resources (instructor, travel, teaching materials etc.), cost MO (man/hours) x average salary; M.O area of training/development. Total quality costs (TQC): Consultancies and personal + many. Technical assistance: Fixed cost (M.O. + resources - phone etc.) Prevention worker health. Health programs (health care, social assistance), ppe, cpe and uniform. Software development. Supply/Logistics (freight on sales).	Quality control in the process: M.O .; consumables and new equipment. Quality control in the receipt: M.O., consumables and new equipment. Measurement and calibration instruments. Final inspection.	Reprocessing: improper storage. Waste: waste in general spinning, weaving in general. Loss of efficiency: unplanned downtime, errors in production scheduling, operational errors. Corrective maintenance: management (labor) total cost and inputs (parts and equipment). Reclassification. Turn-over: stressed, spontaneous > 90 days. Absenteeism: Absenteeism, work accidents (payment on the first 15 days). Overtime. Labor litigation.	Contractual penalties: tax and labor. Customer complaints: return, sending fabric credit, purchase parts, travel/stays, transportation/meal, location and post office. About sale. Market loss: volume of customers who do not buy anymore and price policy.

Source: Elaborated by the author based on the authors Robles Jr. (2003), Calixto et Oliveira (2006), Horgren et al. (1997) and Castro Junior et Gonçalves Filho (2011)

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

nal phenomenon. Thus, the case study was carried out in a textile and apparel industry, medium-sized, headquartered in Jaraguá do Sul, Santa Catarina. The company has a brand known nationally and offers fashion products for public from baby to juvenile aged.

The company has a Quality Management sector, which is responsible for testing and inspections in receiving the jerseys, for testing new products and raw materials, for monitoring the internal quality and outsourced and by actions that help the company to achieve a level increasingly high of manufactured products, and, of course, to monitor the quality indicators. To know the current state of quality costs the company has conducted a survey of data from January to September 2014. This survey was conducted based on the theoretical basis and evaluated according to the experience of some employees to verify the need to include one more item according to the particularity of the company (Table 2).

From this analysis, there was an interview with the company's quality coordinator to assess whether the items are made in the company and by whom. They were also provided materials to query historical data, which helped in the calculation of quality costs of the raised items. It was also necessary to find data in the human resources sector of the company (such as turnover, absenteeism, overtime, training, health programs, labor disputes etc.) and in the commercial area (items on external failures and with the people responsible for prevention and evaluation actions, how much were devoted to each activity). Since people do not engage in a single activity, it has not determined the precise time for each activity and therefore this value was estimated by who are involved in the process. The quantities of raw materials intended for testing were also estimated. Similarly, it was found the costs in the accounting reports and some values that were hours were converted into reais. Because it is confidential data, all analysis was transformed into percentage in relation to what they want to evaluate.

4. RESULTS

The company has a brand known nationally and offers to the new Brazilian middle class fashion products for target audience from baby to youth. Installed in an industrial park of 7,000 m², it offers approximately 450 direct and indirect jobs and has a production capacity of 240,000 pieces/month. In its production process, the company counts on internal weaving sectors, cutting, clothing (a small branch), review and folding. The processing sector, decorations, and about 90% of sewing and laundry sectors are performed through outsourced processes.

In the evaluation of quality costs (preventive and evaluation cost) versus the cost of non-quality (cost of internal and external failures), it was found the results of Figure 1, which express that the non-quality costs exceed the quality costs.

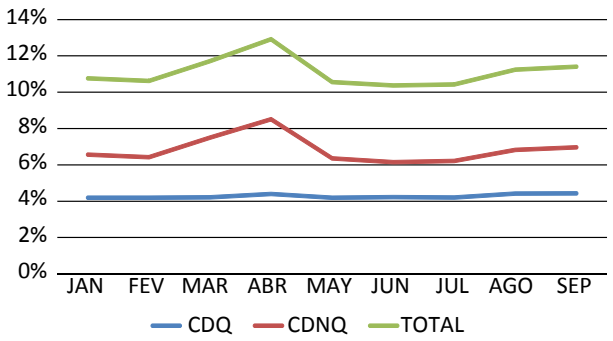

Figure 1 - Comparison of quality costs (CDQ) versus non quality costs (CDNQ)
Source: Own elaboration

Robles Jr. (2003) comments that "as soon as it is discovered a potential defective unit, the greater the chances of retrieving it and lower your costs lost in processing and, consequently, the lower the cost of failure." High non-quality costs reveal that defects are being caught late, being thus higher costs to repair them and revealing a cost saving opportunity by investing in quality costs (prevention and evaluation). Noteworthy is the constancy of quality cost values, demonstrating that the procedures have been maintained and are sporadic additional investments in quality costs.

The literature provides several rules of thumb for decision making (Crosby, 1990; Gryna, 1998 and Robles Jr. 2003). When the costs of failure are the most important, as is the case of this study, is needed a logical, planned and collective research of the problem until its complete solution. In this case, they may adopt specific techniques for identifying the causes of the identified failures, such as meetings of analysis and problem solving, inspections, audits or creating task groups.

Analyzing the data on costs of prevention, evaluation, external faults and internal failures, as shown in Figure 2, can be seen that the prevention costs are lower than internal failures, which brings some concern because it indicates that despite all the effort expended on prevention and evaluation, it has not been enough to make this cost, which is the cost that reflects more on the image and sales of the company, the smallest among them. It is also highlights the high cost of evaluation that from the quality costs, still reflects a delayed action of "clear fire" and not to act preventively, which could also bring lower costs for quality. In this case, to reduce the quality costs, it is necessary to improve the procedures for inspection, testing and verification and design validation. This can be achieved through audits of procedures in use, improvements in methods to support inspections and testing, the use of control charts and capability analysis

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

of the procedures in use. The reduction in assessment costs may be due also to a greater emphasis on prevention activities.

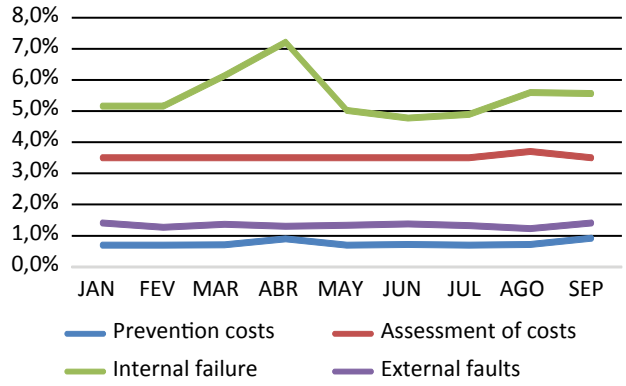

Figure 2 - Quality and non-quality costs by categories
Source: Own elaboration

When evaluating the cumulative result in Figure 5, it is evident the importance of emphasis that should be given in the evaluation instead of prevention and that the cost of internal failures represent almost half of the overall cost of quality and unfortunately more than 60% of cost with quality are due to non-quality.

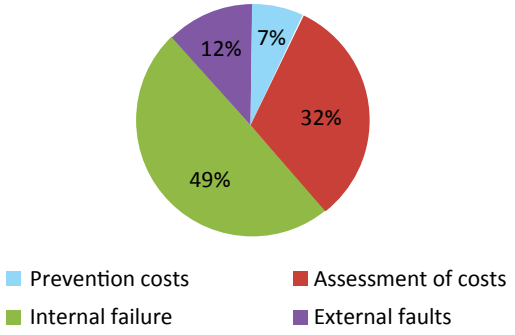

Figure 3 - Percentage of cumulative participation in quality costs
Source: Own elaboration

Feigenbaum (1994) points out that the control failure costs represent 65-70% of the total quality costs, which practically materialized in this study, but the author also points that control costs range from 20 to 25% , showing that in fact the assessment of costs in the research company are above average.

Individually assessing each of the costs shown in Table 1, it is clear that the costs of prevention, the greatest costs are concentrated in health programs and training and that there is a great opportunity to reduce maintenance costs by investing preventively instead of correctively. In the assessment of costs, there is a large investment in quality control, so it is necessary to search for better productivity in these sectors through the use of process control through sampling instead of review processes, as is currently done. You must also train employees in the self-inspection since taking up the defects in the process, the rework is less than after the finished part. In internal failures, the higher costs are on turnover and absenteeism. Here you may want to think about human resource practices that work with these two indicators, for their reduction. Already in external failures, should think of ways to increase the productivity of service (customer support) being through the communication channels, drafting a FAQ (answers to frequently asked questions) and/or other actions.

Table 1. Analysis of costs distribution by category

PREVENTION COSTS	
Health programs (health care, social assistance), ppe, cpe and uniforms. Prevention worker health	52,2%
Training	27,7%
Evaluation of suppliers	7,8%
Total quality cost (TQC): Consultancies and personal + many	5,8%
Technical assistance: Fixed cost (M.O. + resources - phone, fax, etc.)	5,2%
Preventive maintenance of equipment	1,3%
EVALUATION COSTS	
Quality control in receiving M. O., consumables and new equipment	66,5%
Quality control in the process: M.O .; consumables and new equipment	22,8%
Test Product	6,1%
Qualification testing of products from suppliers	3,3%
Product samples or materials consumed in quality control	1,1%
Auto inspection by operators	0,1%
INTERNAL FAILURES	
Turnover	39,1%
Absenteeism	29,6%
Corrective maintenance	5,3%
Reclassifications	5,3%
Corrective actions to prevent recurrence of product quality or service issue	5%
Discounts on product sales prices defective	4,7%
Inspection of reworked product	3,6%
Losses and production waste	3,2%
Rework	3,2%
Waste	0,6%
Financial cost of additional stock due to nonconforming product	0,2%
Overtime	0,1%

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

Losses due stop unit or production delays due to equipment failures or measuring instruments	0,1%
Loss of efficiency	0,1%
EXTERNAL FAILURES	
Technical Customer Support	87,8%
Nonconforming product replacement refused by the customer	6,8%
Customer complaints: return, sending fabric, credit, purchase parts, travel / stays, transportation/ meal, location and post office	2,8%
Nonconforming product evaluation returned by the customer	1,5%
Damage to company image (lost sales).	1,2%

Source: Own elaboration

Gryna (1998) argues that there is an optimal point in terms of quality costs. Figure 4 shows what these authors termed the optimal location in the model quality cost.

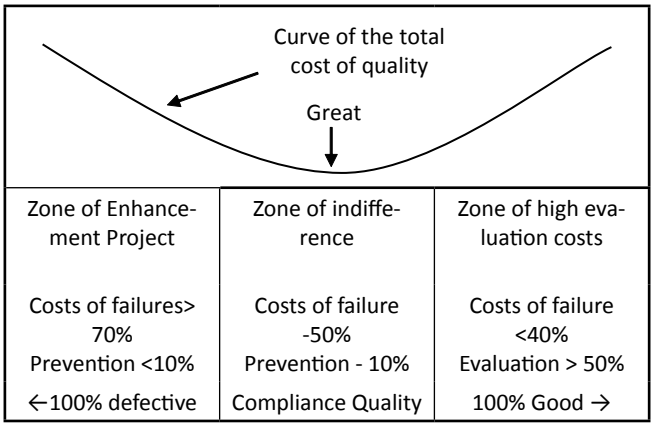

Figure 4. Zone of the great model of quality cost
Source: Gryna (1998)

Figure 4 divides the curve of the total cost of quality into three zones. The area in which is located a company can generally be identified by the prevailing levels of quality costs. The company searched is located more to the "quality improvement zone" since the failure costs represent 62% and the costs of prevention, 7%. In this case, there are opportunities to reduce overall costs by improving compliance quality. One possibility is to identify specific improvement projects and follow them to improve the quality of compliance and, thus, reduce the costs of poor quality, especially the failure costs. As Shank et Govindarajan (1997), the cost of quality will be minimized by "do it right the first time", arguing that the goal of any operation should be zero defects. In this sense, as the company searched the Quality Management sector has about two years, it makes useful this assessment at this time.

5. FINAL CONSIDERATIONS

All total quality programs seek essentially make companies more competitive through continuous improvement of its internal processes to eliminate waste, inefficiencies and rework. However, we see the need to identify and measure in economic and financial terms if the fruits of these efforts are indeed being collected in the form of results for the organization. In the competitive environment in which companies now operate, the pursuit of quality is the way, perhaps unique, for their survival and maintenance in long-term market. Quality costs support the cost management together with quality or continuous improvement programs through information that enables managing programs to prioritize the implementation of programs in the most critical areas due to the costs (Wernke et Bornia, 2000).

With this intent, the purpose of the study was to identify and measure the costs of the quality and non-quality in a textile and apparel industry to assist management in decision making. Harrington (1991) argues that any quality costs value that exceeds 6% of sales (without taking into account the costs of poor quality of administrative areas) should concern the direction. In the case of the studied company, this cost was around 11% of sales, which demonstrates that this study deserves attention and that is vital to the company's managers know them. In the comparison of quality costs (prevention and evaluation) versus the cost of non-quality (cost of internal and external failures), the results show that the nonquality costs exceed the quality. From the results, it was found that there are several reduction opportunities of quality and non-quality costs, mainly through investments in prevention processes. It is suggested to the company studied the implementation of quality indicators that help in monitoring continuous improvement, which will certainly help to reduce the costs of quality. Due to the difficulties encountered in the survey data, it encourages the development of future research to work in practice with the structuring of quality cost data, which are easily accounting and linked to the company's cost system, so allowing the generation of monthly management reports.

REFERENCES

Bottorff, D. (1997), "COQ systems: therightstuff", Quality Progress, Vol. 30.

Castro Junior, O. V. et Gonçalves Filho, M. (2014), Análise dos custos da qualidade como ferramenta de gestão da melhoria contínua na indústria têxtil, disponível em: <http://www.polosolucoes.com.br/artigos/analisecustocomoferramentagestao.pdf> (Acesso em 10 de outubro de 2014).

Costa, A. C. R. et Rocha, E. R. P. (2009), Panorama da cadeia produtiva têxtil e de confecções e a questão da inovação, BNDES Setorial, Rio de Janeiro.

Electronic Journal of Management & System
Volume 11, Number 3, 2016, pp. 282-289
DOI: 10.20985/1980-5160.2016.v11n3.1104

Coral, E. (1996), Avaliação e gerenciamento dos custos da não qualidade, Dissertação (Mestrado), Universidade Federal de Santa Catarina, Florianópolis.

Corradi, P. R. (1994), "Is a cost of quality system for you?", National Productivity Review. Spring.

Crosby, P. B. (1990), Qualidade falando sério, São Paulo, McGraw-Hill.

Gryna, F. M. (1998), "Quality and costs", em Juran, J. M. e Godfrey, A. B. (Ed.), Juran's Quality Handbook, New York, McGraw-Hill.

Feigenbaum, A. V. (1994), Controle da qualidade total: gestão e sistemas, São Paulo, Makron Books.

Harrington, J. (1991), Business process improvement: the break through strategy for total quality, productivity, and competitiveness, MacGraw-Hill, New York.

Heldt, J. J. (1994), More than ever, quality pays, quality, February.

Horngren, C. T. et al. (1997), Contabilidade de custos, Rio de Janeiro.

Nakagawa, M. (1993), Gestão estratégica de custos: conceito, sistemas e implementação, São Paulo, Atlas.

Oliveira, O. J. et Calixto, R. (2006), Gestão da qualidade, São Paulo, Thomson.

Pinto, L. J. S, et Gomes, J. S. (2010), "Custos da qualidade: um estudo de caso na panificadora Golden Vital", Revista de Informação contábil, Vol.4 No.3, pp. 57-76.

Robles Jr., A. (2003), Custos da qualidade: aspectos econômicos da qualidade e da gestão ambiental, São Paulo, Atlas.

Sakurai, M. (1997), Gerenciamento integrado de custos, São Paulo, Atlas.

Shank, J. K. et Govindarajan, V. (1997), A revolução dos custos, Rio de Janeiro, Campus.

Townsend, P. L. (1991), Compromisso com a qualidade, Rio de Janeiro, Campus.

Wernke, R. et Bornia, A. C. (2000), "Considerações acerca dos conceitos e visões sobre os custos da qualidade", Revista da FAE, Vol.3 No.2, pp.77-88.

Yin, R. (2005), Estudo de caso: planejamento e métodos, Porto Alegre, Bookman.