International Journal of Advanced Engineering Research and Science (IJAERS)
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-8, Issue-1; Jan, 2021
Journal Home Page Available: https://ijaers.com/
Journal DOI: 10.22161/ijaers
Article DOI: https://dx.doi.org/10.22161/ijaers.81.27

Quality & Innovation: Quality Tools That Enhances New Products And Services Development

Danilo Martins do Nascimento[1], Vitor Martins Meira[2], Ricardo Reolon Jorge[3], Júlio Francisco Blumetti Facó[4], Luís Henrique Rodrigues[5]

[1]Master Student (Engineer na Innovation Management Post Graduation), ABC University, Brazil
[2]Master Student (Production Engineering Post Graduation), ABC University, Brazil
[3]IC2 Institute, The University of Texas at Austin, USA
[4]Associate Professor, Engineering, Modeling and Applied Social Sciences Center, ABC University, Brazil
[5]Adjunct Professor, Engineering, Modeling and Applied Social Sciences Center, ABC University, Brazil

Received: 29 Oct 2020;
Received in revised form: 12 Jan 2021;
Accepted: 19 Jan 2021;
Available online: 26 Jan 2021

***Keywords*— Quality Tools, Innovation Process, NPD, Banking Industry, Competitive Advantage.**

***Abstract*—** *The purpose of this research is to investigate the possible correlation between quality tools and innovation generation in companies nowadays, with particular interest in the financial sector, governed by strong regulation. Quality Management is one of the main axes of modern management, a movement that had its peak in the '80s and '90s. Due to the high competitiveness of markets and the increasing use of technologies in the development of new businesses and products, innovation and quality have become concerns of the organizations that aim to obtain a sustainable competitive edge. In this way, a bibliographic review allied to the case study was conducted in the retail banking industry, followed by comparative analysis in order to deepen the interpretation of the collected variables. As a conclusion, there is a convergence towards a positive correlation between quality tools and innovation processes underpinning the discussion the measurement of competitive advantage from the perspective of quality and innovation in the banking industry.*

I. INTRODUCTION

In the current economic scenario, marked by globalization and accelerated technological and cultural transformations,

organizations have made use of quality tools and innovation to improve processes, satisfy customers and ensure their competitiveness in the market.

Innovation has long been on the agenda of companies. A decade ago, the consultancy Mckinsey [1] identified - while interviewing more than 1400 executives, that innovation is among the three highest priorities to leverage growth to 70% of respondents. At the same time, total quality management (TQM) has been one of the main pillars [2] in the management practice of organizations since the 1980s [3]

Whether in the universe of quality or innovation, their respective tools, methodologies, approaches and techniques have a huge scope and are applicable to virtually all industrial sectors. In the specific case of this research, the focus was to understand this apparent duality between innovation and quality in the context of Brazilian Retail Banks with their uniqueness [4].

Retail banks were chosen as an object of study for being an extremely important sector in the national and international scenario. As stated by S&P Global Market Intelligence (2017), in a ranking of the 50 largest Latin American Banks (according to the value of their assets), five of them are Brazilian.

Thus, the main objective of the study was to evaluate whether or not there is a correlation between the use of quality tools and the process of generating innovations in

retail banks. A decade ago, a research has already addressed this relationship within the manufacturing industry [3] finding evidence of a positive correlation among them. Notwithstanding the opportunity to investigate such relationship, the present research sought to identify any traditional or new quality tools/techniques that could be employed in the innovation process in banks.

The literature review of this research is based on three pillars: quality and competitiveness, innovation and intersections amongst quality tools and the banking industry.

II. COMPETITIVENESS AND QUALITY

Competitiveness in terms of quality can be understood [5] as the main reason for the success or failure of business organizations. Competition is responsible for the adequacy of a company's activities to customers' needs in the business ecosystem in which it operates.

Additionally, increased competition is a phenomenon not only restricted to developed markets; it is present all over the world. Thus, to facing it, organizations must have an increasingly sophisticated and thorough analysis, as well as greater agility between the planning task and the courses of action necessary for its materialization [6].

A foundation present in this approach is the ephemerality of advantage competitive, which cannot be sustained forever; and will become outdated over time [7].

Quality management is seen today, both in the academic and in the business world's, as a strategic factor for improving competitiveness and productivity. The traditional quality tools are widely used in the corporate world and quality academic studies [8]. They can be used to point out and provide industry improvements, minimizing waste and optimizing productivity. These traditional quality tools were selected as the object of this study and are briefly explained below:

- **Stratification**: Division and organization of a group into several subgroups based on distinguishing or stratification characteristics.
- **Check sheet**: Printed or digital forms used to record and assemble data in a simple way that facilitates its further use and analysis.
- **Pareto diagram**: Vertical bar graph that organizes the information in a way that makes evident and visual, in order of importance of problems and their causes.
- **Cause and Effect Diagram (Ishikawa)**: Graphic representation that organizes logical, and in order of importance, the potential causes contributing to an effect or particular problem.
- **Histogram**: Indicate the frequency and distribution with which certain values occur.
- **Scatter diagram**: Check whether there is indeed a correlation between two parameters or variables of a problem, and if so, what type it is.
- **Control chart**: Visualization of the statistical control state of a process and the monitoring of location and dispersion of process control items.
- **DMAIC**: Establish best practices to ensure that permanent solutions are deployed, and that they can be replicated in other businesses or similar operations.
- **FMEA**: Prevent unacceptable failures and help resource management more efficiently increasing reliability, or decreasing the likelihood of product/process failure.
- **Flowchart**: Graphical representation of a procedure, problem or system, which facilitates the visualization to identify problems and propose improvements.

III. INNOVATION AND INTERSECTIONS WITH QUALITY TOOLS

Innovation can be defined as the introduction of new products, production methods, markets, sources of supply, forms of organization or processes.

The Oslo Manual defines innovation as the implementation of a new or significantly improved product, process, marketing and organizational method in business practices, in the organization of the workplace or external relations [9].

A review of the literature that discusses the relationship between total quality management and innovation suggests that there are conflicting arguments between such methodologies.

There is a positive correlation between Innovation Management and Quality Tools [10]. In order to study this relationship, it is necessary to identify their intersection. Based upon the literature review, we understand that both concepts, have a common purpose concerning competitiveness: to continuously improve products, processes and applications in the company to please their consumers.

This relationship proves to be crucial to align short- and long-term quality strategy plans, integrating with the company's current and future actions in an evolving process in order to achieve a level of business excellence.

Seeking for this relationship, McAdam, Armstrong and Kelly [11] conducted a survey of 15 small businesses between the Republic of Ireland and Northern Ireland. In order to generate quantitative results, evaluation questionnaires based on the Likert scale were applied (grades 1-6, 1 being the worst and 6 being excellent). As a result, they were able to construct a graph inferring that organizations which had good evaluations in innovation also had great evaluation in quality management and vice versa. Regarding the qualitative results, directors, managers and employees of each of the companies were interviewed by McAdam, Armstrong and Kelly [11] and as an upshot, they obtained a correlation between companies with low level of innovation and bad attitudes of the managers. In conclusion McAdam, Armstrong and Kelly [11] attested that organizations that have achieved high scores in innovation and overall quality tend to have built an innovative culture in an established quality program of continuous improvement and those that have achieved low innovation results, are the ones that still need improvement in these practices.

It is doubtful that an innovative company can be competitive if it does not produce with quality. Literature [2] also point to a significant and positive relationship between quality management performance and innovation performance, especially in the Process Innovation subdivision.

On top of all, there are conflicting arguments in many studies. Various research suggests that quality tools can provide an excellent environment to encourage innovation due to their consumer orientation and continuous improvement, on the other hand, some authors indicate that this relationship generates only incremental innovation, not having such a positive return. However, after analysis of the innovation and quality activities in 451 Spanish companies [12], there is evidence that TQM can in fact provide an excellent business environment to promote innovation through collaboration in business performance.

Another study [3] that also used statistical tools (regression) in a database of 2,278 Brazilian companies to identify the influence of TQM on innovation in business growth, concluded that the use of TQM is more related to process innovation than to new product development (NPD).

TQM can be fragmented into two main components: hard and soft [13]. As hard elements, practices such as the process control and products to meet specifications can be an example; and as soft, were mentioned training, learning, teamwork and cooperation, promoting the human angle of the quality management system.

López-Mielgo, Montes-Peón and Vázquez-Ordás [13] have chosen as their research object Spanish companies that use hard elements of quality control and have verified the effect on the result of innovation in the generation of new products and processes. To this end, a review of the theoretical literature demonstrated a positive relationship between quality management and innovation, since the high capacity for innovation can reduce costs to implement a high-quality standard. Thus, its conclusion emphasized the importance of these departments working together and overcoming differences in their traditional activities, in order to implement quality management tools to standardize the creation of new products and services.

Fernandes [14], in an analysis of the relationship and impact on the organizational performance of TQM and the innovation tools, found that this is a two-way relationship in which the use of TQM can positively or negatively influence innovation, while outputs can be used to improve quality management. Thus, the use of TQM in companies may work to support or to prevent/limit innovation, however most cases have shown a positive impact.

Schniederjans and Schniederjans [15] subdivided the quality management tools into two types: social and technical. Social practices include training, functional cooperation and the relationship with the supply chain. Technical practices were defined as administrative innovation and use tools such as Just-in-Time and Design for Manufacturing. So, practices help each other. Social quality management increases the likelihood of organizational innovation through agile sharing and dissemination of ideas within the organization. However, despite understanding that organizational size and managerial ethics are variables that can positively affect the relationship between technical quality and innovation practices, the authors stated that it was not possible to find sufficient data to prove this correlation [15].

IV. BANK INDUSTRY

Quality management contributes to the process of competitiveness by offering the market flawless products and fast deliveries, associated with operational programs that can fully contribute to serving their consumers.

The banking sector as any economic unit aims to achieve productivity gains that enable it to achieve levels of efficiency equal to or greater than competitors. Nowadays, Brazilian banks face competition from technology companies in financial services, also called Fintech's, that are creating innovation with technology-based processes from differentiated business models

In accordance with a recent research conducted by the Brazilian Federation of Banks (FEBRABAN), the main representative body, the innovation promoted by the Brazilian banking sector is highlighted worldwide, as a result of solid investments and constant care to attain improvements of the system. With the pursuit of maintaining competitiveness, deep transformations in the banking sector have taken place over the past five decades [16].

V. METHODOLOGICAL PROCEDURES

The literature review serves as the basis for the empirical part of the research. The preparation for field research is presented, with the selection of the case and the elaboration of the data collection protocol. Followed by data collection and analysis of responses. Finally, comparative analysis of the cases is carried out in the light of the literature review. Figure 1 illustrates the main stages of the work. We created research protocols to be used both on a large scale in the banking sector and to grounding research in the case highlighted by the survey.

The interviews were conducted from direct observation techniques with several employees in assorted positions, working in product development, innovation or quality control areas of two major retail banks in Brazil, which the sum of participation in the national market represents more than 20% of the total market assets, what illustrates the representativeness and importance of the sample studied for the academic and business world.

VI. RESULTS

All respondents agreed somehow on the importance of using quality tools in order to achieve a competitive differential in the retail banking sector.

From then on, the following questions sought to investigate with the interviewees the tools used in development environments in retail banks and among them, which stand out. It is possible to observe the use of the tools as Pareto diagram (52%), histograms (47%), dispersal diagrams (42%), cause and effect diagrams or Ishikawa (37%) and control charts (37%). Table 1 expresses the form and purpose of the quality tools used.

Thus, it was noted that quality tools are generally not used alone, but together or associated with other tools/methodologies, in order to take advantage of the best characteristics of each one.

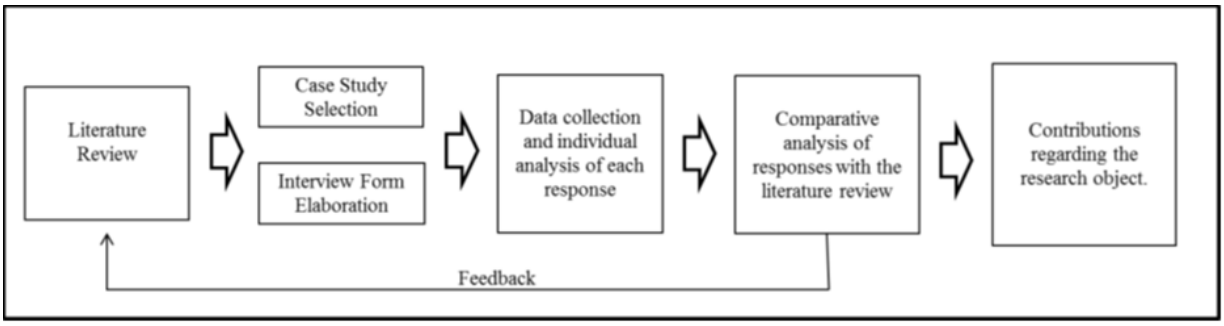

Fig. 1: Grounded Research Method for this Research

Comparing the results with the bibliographic review, some tools have greater potential than they are currently employed. Table 2 compares the potential versus actual utilization of each of the quality tools cited in field research.

Table 1: Quality Tools for Competitiveness

Quality Tool	Approach for Competitiveness
Scatter Diagram	(1) Correlation analysis between the amount of training hours for the bank manager and the fulfillment of the sales goal; (2) Analysis for the generation and introduction of new credit models; (3) Analysis of correlation between error and the cause of the problem; (4) Optimal goal definition for bank managers.
Pareto Diagram	(1) Identify bank branches with the highest number of customer complaints; (2) Analyze the main operational errors and problems that impact the largest number of customers; (3) Analyze various sources to identify the most relevant products; (4) Check which products bring the highest return to allocate marketing money.
Histogram	(1) Verification of the cost distribution curve x volume for the identification of budget offenders; (2) Future consumption forecast; (3) Checking the level of service or error analysis; (4) Analyze the customer's income in order to adjust the supply of products according to the salary range.
Control Charts	(1) Control of expenses for identification of outliers; (2) Analysis of credit product claims; (3) Check the customer profile and its purchase history; (4) Control sales of products and identify deviations in projection and failures in the supply channels; (5) Operation control.
Cause and Effect diagrams	(1) Analyze the root cause of the operational problems pointed out by the analysis made via the Pareto diagram; (2) Analyze the root causes of factors that have effect or a change in the cost of an activity (drivers); (3) Analysis and discussion of the root cause generating new ideas.
DMAIC	(1) List improvement plans to increase the level of customer satisfaction.
Stratification	(1) Check the customer profile and their purchase history.
Flowchart	(1) Process mapping aiming for continuous improvement (As is/To be).
FMEA	(1) Implementation of projects and technical revisions.
Check Sheet	(1) Sales goal analysis

Table 2: Use of Quality Tools for Innovation Purpose

Quality Tool	Potential to create innovation (literature review)	Real use to create innovation (interviews)
Stratification	◕	◔
Check sheet	◔	○
Pareto diagram	◕	◕
Cause and Effect Diagram	◕	◕
Histogram	●	●
Scatter diagram	◕	◕
DMAIC	●	●
FMEA	◔	◔
Flowchart	◐	◕

○ ◔ ◐ ◕ ●

Low Potential ---------- High Potential

After analyzing the quality tools, it was necessary to understand the role of innovation to achieve a competitive edge, in this case, 94.7% of respondents agree that the management of innovation is indispensable for such achievement in the Retail Banking sector.

With this, deepening the reason of the previous answer was possible to realize that the respondents believe that it is essential to innovate/break paradigms in a highly regulated sector, aiming at customer loyalty and engagement, delivering products and services with high added value, as well as increase the efficiency of internal and external processes.

As a next step, the interview aimed to analyze the possible correlation between the use of quality tools and innovation management, where 89.5% of respondents agree, partially or totally, that tools can be used as input to generate innovation in products and processes. In addition, 68.4% of respondents have been able to observe this use in practice.

Quality tools can also guide needs for change and improvements during the creation of a new digital channel. For example, one of the largest banks in Brazil identified the need to create an application (app), with the same features, but in a lighter version, aiming to contain a high level of uninstallation of the original application.

In that wise, it is possible to realize that the responses of the form corroborate the studies analyzed during the literature review. In Table 3 it is possible to verify that most studies point to a positive correlation between the use of quality tools and the process of generating innovation. Although the "traditional" quality tools exposed in the literature review are useful to ensure continuous improvement of processes, some applications require new approaches [17]. Knowing the real needs of the customer, what defines an attractive customer service, what vision of the future motivates employees to have self-initiative and the documentation systems and methods used to increase

the success of the project activities are some examples of needs that cannot be met by traditional quality tools.

So, there is a demand to create new methods to achieve new standards and requirements, such as: (a) gathering creative ideas; (b) a plan to enrich ideas and solutions; (c) cooperation between people and (d) innovation in products, services and processes.

Table 3: Quality Tools and Innovation Intersection

Author(s)	Positive Correlation	Negative Correlation	No Correlation
Kanji (1996)	■		
McAdam *et al.* (1998)	■		
Prajogo e Sohal (2002)	■		
Levesque and Walker (2007)	■		
Martinez Costa and Martinez Lorente (2008)	■		
Facó et. al (2009)	■		
López-Mielgo et al. (2009)	■		
Fernandes (2012)	■	■	
Schniederjans and Schniederjans(2015)			■

Following these four proposed guidelines, the research group investigated the methods used in the areas of operational research, value engineering and methods of creating and selecting ideas. The authors identified seven "new" methods that may be useful to achieve innovation success in aspects involving projects, assurance and reliability, maintenance capacity and process improvement [18] presented in Table 4.

Furthermore, it is possible to compare the use of old and new tools in the innovation process [19], pointing out that the seven new tools are more related to a concept and ideation, or even to a structured way of solving problems. The latter skills are often found in the early stages of the innovation cycle.

VII. CONCLUSION

The present work has been proposed in order to analyze whether there is a correlation between the use of quality tools and the process of generating innovation in retail banks. The study was subdivided into three main optics: (1) potential correlation, (2) collaboration of quality tools to overcome innovation barriers, and (3) contribution of these tools to the role of innovation in highly regulated competitive environments. For this, the chosen methodology was a case study with two main pillars: bibliographic review and interview with employees of the Brazilian retail banking sector.

Although not unanimous, the vast majority of authors agrees that there is a positive correlation between the use of quality tools or quality management with the management of innovation. The hypothesis was also supported by the interview; where the use of quality and innovation tools were seen as a competitive differentiator by the interviewees and both have a positive correlation.

Table 4: New Quality Tools and their Approaches for Innovation

Quality Tool	Approach for Competitiveness
Scatter Diagram	(1) Correlation analysis between the amount of training hours for the bank manager and the fulfillment of the sales goal; (2) Analysis for the generation and introduction of new credit models; (3) Analysis of correlation between error and the cause of the problem; (4) Optimal goal definition for bank managers.
Pareto Diagram	(1) Identify bank branches with the highest number of customer complaints; (2) Analyze the main operational errors and problems that impact the largest number of customers; (3) Analyze various sources to identify the most relevant products; (4) Check which products bring the highest return to allocate marketing money.
Histogram	(1) Verification of the cost distribution curve x volume for the identification of budget offenders; (2) Future consumption forecast; (3) Checking the level of service or error analysis; (4) Analyze the customer's income in order to adjust the supply of products according to the salary range.
Control Charts	(1) Control of expenses for identification of outliers; (2) Analysis of credit product claims; (3) Check the customer profile and its purchase history; (4) Control sales of products and identify deviations in projection and failures in the supply channels; (5) Operation control.
Cause and Effect diagrams	(1) Analyze the root cause of the operational problems pointed out by the analysis made via the Pareto diagram; (2) Analyze the root causes of factors that have effect or a change in the cost of an activity (drivers); (3) Analysis and discussion of the root cause generating new ideas.
DMAIC	(1) List improvement plans to increase the level of customer satisfaction.
Stratification	(1) Check the customer profile and their purchase history.
Flowchart	(1) Process mapping aiming for continuous improvement (As is/To be).
FMEA	(1) Implementation of projects and technical revisions.
Check Sheet	(1) Sales goal analysis

As a second analysis result, it is perceived that tools can be applied to break down barriers to innovation. Thereupon, traditional quality tools cooperate to understand the process (flowchart), view current product results (histogram), analyze market behaviors (scatter diagrams), organize and relate data (stratification) identify the main problems or gaps (Pareto diagram) and point out their causes (cause and effect diagram). Moreover, since they are very focused on problem solving, the new quality tools have shown to be helpful in the initial processes of an innovation cycle.

As a last result, the analysis showed that quality tools are able tocollaborate throughout the innovation processes ensuring positive impacts related to changes. We highlight the use of tools such as Pareto diagram, Histogram and Dispersion diagram, as well as new quality tools that reaffirm how the changes generated by regulation or not, are affecting the competitive environment of the retail bank.

ACKNOWLEDGEMENTS

The authors sincerely thank CNPq for supporting this research and to the Innovation and Sustainable Competitiveness Forum (FICS / UFABC) for their intellectual reinforcement.

REFERENCES

[1] Quarterly, M. (2007). How companies approach innovation: a McKinsey Global Survey. October. Mckinsey Quarterly.

[2] Prajogo, D.I., Sohal, A.S. (2003). The relationship between TQM practices, quality performance, and innovation performance: An empirical examination. International journal of quality & reliability management, 20(8), p.901-918.

[3] Facó, J.F.B.; Duarte, A.L.C.M.; Csillag, J.M, (2009) The Influence of TQM and Innovation on the Growth of Manufacturing Companies in the State of São Paulo, Brazil. RAI: Innovation and Management Review, v. 6, p. 44-57. DOI: 10.5585/rai.v6i2.261

[4] Facó, J.F.B. (2018) Banking Innovation Process: Mapping New Product Development. International Journal of Advanced Engineering and Management Research, v. 3, p. 130-141.

[5] Coltro, A. (1996). A gestão da qualidade total e suas influências na competitividade empresarial. Cadernos de Pesquisa em Administração, São Paulo, 1(2), 1-7.

[6] Lima, A. C. (2016). Prospective Analysis of the Banking Industry in Brazil: Regulation, Concentration and Technology. RAC. vol. 20 no. 5 Sept./Oct. DOI: <https://doi.org/10.1590/1982-7849rac2016150053>.

[7] Day, G.S., Reibstein, D.J., Gunther, R.E. (2004). Wharton on Dynamic Competitive Strategy. Wiley; 1 edition

[8] Mariani, C. A. (2005). Method of PDCA and tools of quality in the management of industrial processes: a case study. Innovation and Management Review, 2(2), 110-126.

[9] Mortensen, P.S.; Bloch, C.W. Oslo Manual-Guidelines for Collecting and Interpreting Innovation Data: Proposed Guidelines for Collecting and Interpreting Innovation Data; Organisation for Economic Co-Operation and Development, OECD: Paris, France, 2005

[10] Gopal K. Kanji (1996) Can total quality management help innovation?, Total Quality Management, 7:1, 3-10, DOI: 10.1080/09544129650035007

[11] McAdam, R., Armstrong, G. and Kelly, B. (1998), Investigation of the relationship between total quality and innovation: a research study involving small organisations, European Journal of Innovation Management, Vol. 1 No. 3, pp. 139-147. DOI: 10.1108/14601069810230216Dasfd

[12] Micaela Martínez-Costa & Angel R. Martínez-Lorente (2008) Does quality management foster or hinder innovation? An empirical study of Spanish companies, Total Quality Management, 19:3, 209-221, DOI: 10.1080/14783360701600639

[13] N. López-Mielgo, J.M. Montes-Peón, C.J. Vázquez-Ordás (2009) Are quality and innovation management conflicting activities? Technovation, 29 (8), pp. 537-545 DOI: 10.1016/j.technovation.2009.02.005

[14] Fernandes, A. (2012). Gestão pela Qualidade Total e Inovação: sua Relação e Repercussão no Desempenho Organizacional. PhD Tesis, Universidade da Beira Interior, Covilhã, Portugal.

[15] Schniederjans, D., & Schniederjans, M. (2015). Quality management and innovation: new insights on a structural contingency framework. International Journal of Quality Innovation, 1(1), 2. DOI: 10.1186/s40887-015-0004-8

[16] Cernev, Adrian and Diniz, Eduardo and Jayo, Martin (2009) The Emergence of the Fifth Wave of Banking Innovation. Proceedings of the Americas Conference on Information Systems (AMCIS), DOI: 10.2139/ssrn.2924727

[17] Toledo, J. D., Borrás, M. Á., Mergulhão, R. C., Mendes, G. H. D. S. (2013). Qualidade: Gestão e Métodos. Rio de Janeiro, Brasil: LTC, 48-62.

[18] Adapted from I. Marshall Jr., A. A. Cierco, A. V. Rocha, E. D. Mota, & S. R. L. Amorim,. (2008). Gestão da Qualidade. Isnard Marshall Júnior, Agliberto Alves Cierco, Alexandre Varanda Rocha, Edmarson Bacelar Mota, Sérgio Leusin.-9. ed.-Rio de Janeiro: FGV.

[19] Levesque, J., & Walker, H. F. (2008). The innovation process and quality tools. Quality Control and Applied Statistics, 53(3), 275.