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THE USE OF QUALITY MANAGEMENT TOOLS IN THE MATERIALS SHIPPING AREA: A FIELD STUDY IN A PETROCHEMICAL COMPANY IN DUQUE DE CAXIAS (RJ)

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ABSTRACT

Logistics is one of the most important operational areas in organizations, not only because it involves various integrated activities, but also because it is responsible for operational synchronization with suppliers and customers. In addition, the technological transformations, the structuring of new business models, and the raising of sustainable guidelines allow companies' logistics systems play an important role on costumers satisfaction and on their relationship with their stakeholders. In this context, the aim of this article is to verify the impact of using Quality Management (QM) tools in the materials shipping area within the logistics system of a petrochemical organization in the Baixada Fluminense region of Rio de Janeiro. The research is classified as a field study, with data collected by interviews and participant observation. It was treated qualitatively using discourse analysis. In the end, it was concluded that the main impacts of using these tools in the company's shipping area are increased effectiveness in communication with customers, prevention of recurrence of problems in operations, improvement of operational processes, and evaluation of costs in the area. It was also found that the operation has some challenges to overcome, in the applicability of these quality instruments and in the systems and mechanisms used to do it. The method used made it possible to gather information from a more managerial than operational perspective regarding the use of the tools, since the interviewees were the managers of the logistics operators at the units, and not their teams who apply them. The originality of the research lies in the analysis of the tools based on interviews with the operation managers.

Keywords: Quality management; Logistics; Quality tools; Shipping; Processes.

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INTRODUCTION

In the global context, with technological advances, the structuring of new business models and concerns about sustainability, the logistics area of companies has had a greater impact on customer satisfaction and its relationship with its various stakeholders. According to Lira, Santos Neto and Silva (2018), with the globalization of the economy, the importance of this area has expanded, since logistic costs with transport represent a significant percentage of the total cost of products sold in domestic and foreign markets. In this scenario, Quality Management tools in the logistic systems gain prominence, and consist on techniques that can be used to analyze and solve problems that are eventually found and interfere with the good performance of work processes (Machado, 2012).

Considering not only the scope of logistics activities, but also this area's need for operational synchronization with an organization's customers and suppliers, as mentioned by Bowersox et al. (2014), a structured analysis of logistics problems becomes important, because the presence of failures in one of the processes can compromise the execution of the others, interfering with the achievement of productivity objectives and those related to the delivery of the product to the end consumer. Therefore, the use of tools to identify and analyze the causes of logistics problems is important to provide a better basis for defining strategies to reduce/eliminate non-conformities and for decision-making.

Furthermore, in other cases, the processes conducted may not be defective, but opportunities for improvement capable of reducing costs, wasting less materials or optimizing time and manpower. These opportunities can be linked to the implementation of technological innovations in the process, changing a working method or reducing the number of steps in an activity which do not add value to customers. With this in mind, it is important to apply tools that help identify possible improvements within the logistics system, in order to guide managers in assessing this viability.

Moreover, both when identifying faults and when seeing improvements, organizations need to define strategies to guide their actions. In the first case, the presence of problems at any stage of the logistics flow can impact materials or equipment, generating the need for some correction or rework, or even operators or customers, whether in terms of product or service quality, health and safety or delivery time. In the second case, the definition of strategies is due to the need to allocate financial, human and material resources to the implementation of potential opportunities in logistics. In this way, the application of tools in the formulation of action plans in the area is considered relevant.

Given the complexity of companies' logistic flows, the demand for well-structured planning is increasing. According to Cova (2012), the concepts of logistics and supply chain incorporate the planning of material flows and related information, from suppliers to the end consumer, and can include the return and disposal of materials already used. In this sense, action plans formulated with quality instruments can help correct non-conformities or implement new initiatives, taking into account factors such as setting objectives, targets and performance indicators, defining responsibilities, allocating resources, analyzing ideas proposed by the teams involved and the implementation schedule. These plans can also help to monitor the actions taken.

Therefore, this paper sought to understand how the use of QA tools impacts the materials shipping area within the logistics system of a petrochemical company in the Baixada Fluminense region of Rio de Janeiro. To this end, the article is structured in five sections. After this first section, which provides an introduction to the topic, the second section presents the theoretical framework, highlighting the principles of quality management, quality tools, business logistics and QA in logistics processes. The third describes the methodology used in this work. The fourth discusses the research results. The last section deals with the conclusions, limitations of the method and suggestions for future studies.

THEORETICAL BACKGROUND

Quality management

Regarding the definition of quality, António and Teixeira (2007) state that it is a complex and multifaceted term that can and should be viewed from different perspectives, because the philosophy of the subject itself adopts a stance that there is no absolute and universal concept. According to Marshall Junior et al. (2012) and Garvin (2002), the concept of quality can be divided into basic elements such as performance, characteristics, reliability, conformity, durability, service, esthetic and perceived quality. For António and Teixeira (2007), despite this multiplicity of concepts, by analyzing the definitions proposed by respected quality authors, it is possible to observe one of the three perspectives of product or service development - process, results and consequences - as shown in **Chart 1**.

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Chart 1. Definitions of quality from the main authors

Author	Perspective	Definition of Quality
Taguchi	Consequences of products/ services for consumers and society after their transfer from the seller to the buyer.	The loss that a product causes to society after being shipped, and not the losses caused by intrinsic functions.
Juran	Consequences of products/ services for consumers and society after their transfer from the seller to the buyer.	Adaptation for use.
Crosby	Results of the product/service before it is transferred to the end consumer.	Compliance with requirements.
Ishikawa	Results of the product/service before it is transferred to the end consumer.	Absence of variation in quality characteristics.
Deming	Process that creates and makes the product/service suitable for transfer to customers.	The process that leads to results through products/ services that can be sold to consumers that will be satisfied.
Shigeo Shingo	Process that creates and makes the product/service suitable for transfer to customers.	Continuous monitoring process and potential feedback instrumentation.

Source: Adapted from António and Teixeira (2007).

Within the historical development of quality, according to Carvalho (2012), an important event in 1987 was the emergence of the ISO (International Organization for Standardization) normative model for the area of Quality Management, the 9000 series, Quality Assurance Systems. According to António and Teixeira (2007), certification according to this ISO ensures that the organization has a quality policy, the standardization of procedures and the existence of preventive and corrective action systems. Carvalho (2012) points out that it was not long before this series had additional guidelines and was strongly related to an important environmental management standard, ISO 14000, published in 1996. In this way, the author mentions that ISO 9000 became a legal requirement for entry into many production chains and brought new elements to QA.

According to António and Teixeira (2007), with the development of the concept of quality, many organizations developed new models for its implementation, which led to the creation of quality awards to evaluate the excellence of these models. Internationally, the authors list three important awards: the Deming award, the Malcolm Baldrige national award and the European quality award, created in 1951, 1987 and 1988 respectively, the first two being established in the United States and the third in Europe. At the national level, the National Quality Award - NQA - was established in 1990 (Miguel, 2012). According to this author, based on the criteria of the international awards, the NQA is a relevant instrument for encouraging competitiveness in the form of evaluating companies that aim to achieve recognition for the excellence of their products or services.

In addition, from a more current perspective on the insertion of QA in the organizational sphere, Machado et al. (2017) indicate that the innovations promoted by Industry 4.0 are increasingly present in companies' quality practices. This is because, in these authors' view, there is a growing search for new technologies and increased efficiency and effectiveness in activities, as well as an adaptation of human culture to the computerization of processes. In this sense, for the authors, the relationship between QA and Industry 4.0 focuses on the organization's self-sufficiency in processes and products and on identifying and satisfying customer needs.

Thus, analyzing the trajectory of QA, according to Ishida and Oliveira (2019), it is of great importance in organizations, as it helps to identify problems and their causes, with the purpose of eliminating failures, maintaining quality monitoring, and searching more effective results. Barbosa et al. (2019) emphasize that consistent improvements to an already structured QA system make it possible to boost organizational learning processes, stimulating an environment favorable to incremental innovations and to the definition of standards of excellence. On the other hand, Oliveira (2020) argues that, despite the evolution of quality thinking, there is still a long way to go in this field, especially in less developed countries, including Brazil. According to Oliveira, this is due to the delay in accessing and implementing these concepts that have been developed over the years.

Quality Management Tools

According to Longaray et al. (2017), mapping processes and identifying management tools are key points in the search to identify the most appropriate methods for creating products and services. In line with this, Paladini (2012) says that quality tools play an essential role in

the successful practical application of QA principles and definitions. Ishida and Oliveira (2019) mention that the proper use of these tools helps to reduce the costs of internal and external failures and, consequently, the continuous improvement of organizational processes and total customer satisfaction. **Chart 2** describes some of the main QA tools.

Chart 2. Quality tools

Quality Tools	Description
Pareto Chart	Charts that "can be used, for example, to classify causes that act in a process with greater or lesser intensity, or even with different levels of importance" (Paladini, 2012, p. 362).
Brainstorming	It is a group process in which individuals express their ideas freely, without criticism, in the shortest possible time (Marshall Junior et al., 2012).
Ishikawa Diagram	It consists of a representation of the possible causes of a certain effect, which are grouped into categories and similarities previously established or perceived during the process of classifying the cause (Marshall Junior et al., 2012).
Five Whys	A method that consists of asking "Why?" five times to understand what happened, in order to identify the root cause of the problem (Costa and Mendes, 2018).
5W2H	An efficient management tool that is simple to apply, it helps to develop a qualified and structured action plan with practical and well-defined steps (Corrêa, 2019).
Flowcharts	They are a representation of a process using graphic symbols to describe its nature and flow step by step (Corrêa, 2019).

Source: Based on Marshall Junior *et al.* (2012), Paladini (2012), Costa and Mendes (2018) and Corrêa (2019).

Paladini (2012) states that the implementation of QA tools usually follows an operational logic, generally based on the Plan–Do–Check–Act (PDCA) cycle, a management method aimed at continuous improvement. According to Cardinali, Silva and Poker Junior (2022), when used correctly, this cycle can bring benefits such as easier decision-making, distribution of activities and cost reduction. According to Nunes, Servare Junior and Gomes (2022), teams are a key factor in transforming any scenario, and quality tools and controls need to be used with commitment and discipline. According to Corrêa (2019), when the use of these tools follows the PDCA logic, the problem analysis and solution methodology - Masp - is applied, a process of Japanese origin aimed at obtaining optimized results with a reduction in operating costs, and is represented in **Figure 1**.

Logistic

For Bowersox et al. (2014, p. 32), business logistics "refers to the responsibility for designing and managing systems to control the transportation and geographical location of stocks of raw materials, work-in-process and finished at the lowest total cost". Ballou (2007, p. 26) emphasizes that, although logistics activities have been performed by individuals since the dawn of humanity, this area "is a relatively new field of integrated management study, from the traditional areas of finance, marketing and production". The author states that this novelty lies not only in the concept of the coordinated management of interrelated activities, replacing the historical practice of managing them separately, but also in the understanding of logistics as an important area for adding value to products and services that are essential for consumer satisfaction and increasing sales.

Authors such as Ballou (2007), Novaes (2007) and Grant (2017) state that there are various discussions in the academic and professional spheres about the relationship between the concepts of supply chain and logistics. For Ballou (2007), it is difficult in practice to separate business logistics management from supply chain management (SCM), as both have the same mission of getting products and/or services to the right place, at the right time and under the right conditions. According to Novaes (2007), SCM is an evolution of logistics, responsible for strategically and systemically integrating the elements that take part in the supply chain, improving traditional logistics practices. Grant (2017), on the other hand, presents an inclusivist view, which considers logistics to be a subset of SCM, with a broader perspective of it as a supply chain and business processes.

In addition, according to Novaes (2007), the evolution of business logistics with the adoption of a vision of strategic integration encompasses other perspectives that go beyond traditional logistics. **Chart 3** shows some examples of these approaches.

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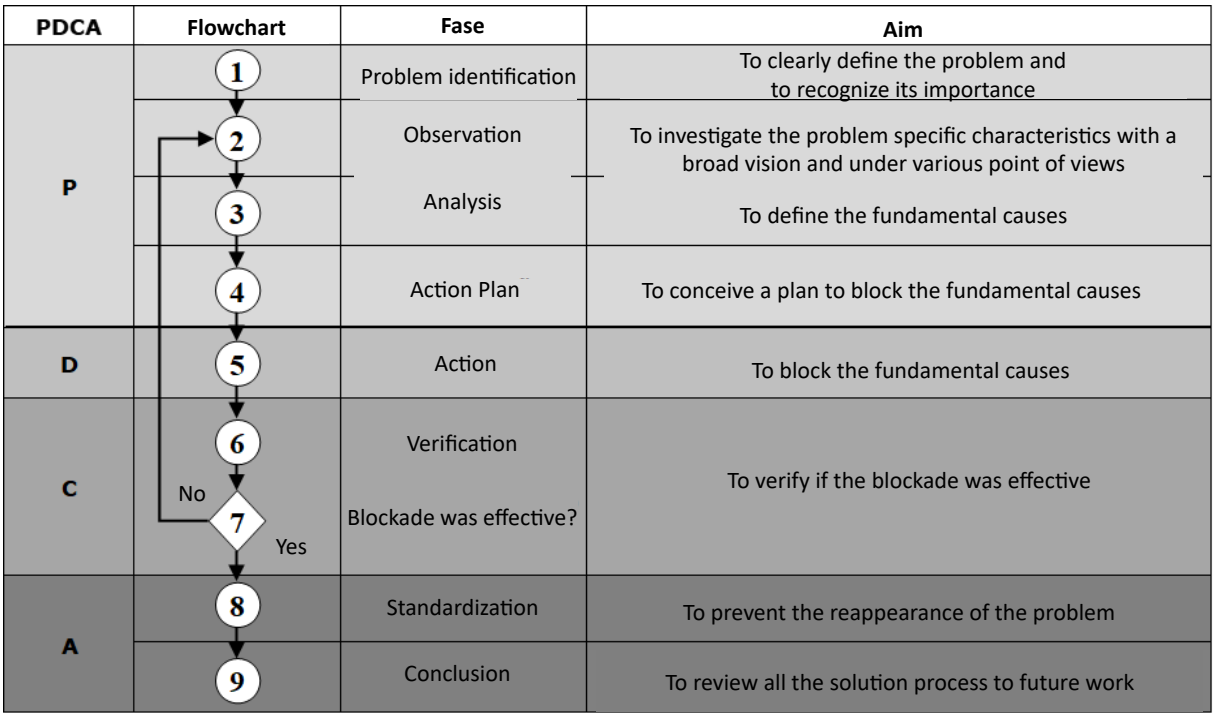

Figure 1 - Problem analysis and solution methodology (Masp)
Source: Adapted from Corrêa (2019).

Chart 3. Other approaches beyond the traditional logistics

Approaches	Description
Reverse Logistics (RL)	This perspective is based on the view that, for logistics, a product's life does not end when it is delivered to the consumer, but can be returned to its point of origin for repair or disposal, or because of environmental legislation or because its reuse makes economic sense (Ballou, 2007).
Green Logistics (GL)	GL is not essentially based on new logistics activities, but on the inclusion of environmental concepts in its performance, in order to minimize the negative effects of environmental impact, such as redesigning new packaging models with less use of materials, selecting the most efficient mode of delivery and reducing energy and pollution from transport (Moura, 2006).
Logistics 4.0	According to Pacheco and Reis (2019), this approach consists of logistics within Industry 4.0. For Wang (2016), Logistics 4.0 is the use of advanced network technologies through information processing and network communication in the logistics system, aimed at improving the management and service level of the industry and reducing costs and the consumption of natural and social resources.

Source: Based on Moura (2006), Ballou (2007), Wang (2016), Leite (2017) and Pacheco and Reis (2019).

Regarding logistics activities, Ballou (2007) says that they vary according to the organizational structure and management visions of companies, and can be divided into main (or key) and support activities. The author says that the former are in the "critical" circuit of an organization's immediate physical distribution channel, usually representing the majority of costs or being essential to the efficient coordination and completion of the logistics mission. As an example, he cites the following: cooperation between standardized customer services and marketing, transportation, inventory management, and information flow and order processing. For him, support activities are considered contributors to achieving the logistics mission, such as warehousing, materials handling, purchasing, packaging, cooperation with Production/Operations, and information maintenance.

Therefore, according to authors such as Silva et al. (2021) and Santos and Araújo (2018), business logistics plays a fundamental role in organizations that deal daily with a competitive market and have to meet the needs of increasingly demanding customers. Cardinali, Silva and Poker Junior (2022) emphasize that logistical problems, such as delivery delays and delivery of the wrong product or in the wrong quantity, can affect the way consumers perceive the company. In addition, according to Cova and Motta (2009), this area takes on a strategic dimension in business, affecting the costs of products and services

and their final prices. Thus, given the scope of the logistics system, Cabral et al. (2020) indicate that it plays a major role in customer satisfaction and organizational performance from the point of view of customer service, strategy and service provision, and can be decisive for business success.

Quality management in logistics processes

According to Silva Filho et al. (2019), the strategic interrelationship between logistics and Quality Management is centered on customer satisfaction with the right product, in the right place, at the right time, at the lowest possible cost, without this interfering on quality. Furthermore, Lizardo and Ribeiro (2020) emphasize that this interrelationship includes the subjective concept of quality that the customer attributes to the product and/or service based on its value and usefulness. Thus, in this sense, Dias and Oliveira (2017, p. 04) argue that "current logistics seeks to bring together all the elements of the process, deadlines, the relationship between sectors of the company and the development of partnerships with suppliers and customers to meet the needs and priorities of end consumers".

Regarding the impact of these QA tools on logistics procedures, Silva Filho et al. (2019) state that, when applied rationally, their purpose is to promote process agility and efficiency. On the other hand, they emphasize that the irrational application of these tools can prevent faults from being identified and corrected, so that this does not happen, it is necessary to understand each of these instruments, analyze where and when to use them and the purpose of their use. In addition, Dias and Oliveira (2017) mention that QA aims for quality awareness in all procedures performed in the company and the satisfaction not only of the customer, but of everyone involved in the organization. Therefore, according to Oliveira (2020), QA is mainly related to a series of changes in the organizational culture and in everyone involved in the production process.

METHOD

Based on Vergara (2004), in terms of purpose, this study is classified as descriptive, since its focus is to expose the phenomenon being researched, describing the aspects involved in its characterization. With regard to the research design, as discussed by Gil (2008), this study can be considered bibliographical and documental, as it used materials from various authors on the theme (books and scientific articles), as well as analyzing company documents related to Quality Management in the logistics area. In addition, in the light of this author's concepts, the research is classified as a field study, since it sought to explore the proposed questions in depth, rather than the statistical distribution of the population's characteristics according to certain variables, as occurs in field surveys.

Data was collected using the interview technique based on guidelines, as discussed by Gil (2008), which consists of a few direct questions and allows the interviewee to speak freely as the topics are indicated. This technique was chosen because it allows for greater depth in researching the phenomenon compared to a fully structured interview. The interviews were conducted individually between March 22 and 31, 2022, lasting an average of thirty-two minutes, with two closed questions and seven open questions on the topic. The interviewees were the four managers responsible for the organization's materials shipping units and for managing the logistics operators, who use quality tools in the operation's processes.

Also at this stage of data collection, we used the technique of participant observation which, according to Gil (2008), consists of the real participation of knowledge in the life of the community studied, and the observer assumes, at least to some extent, the role of a member of the group. This method was adopted because one of the authors of this study is a member of the company's logistics team, and this type of observation facilitates quick access to data on the usual situations in which the subjects are involved - an advantage mentioned by the aforementioned author.

The data were analyzed qualitatively, based on the considerations raised by Vergara (2004), who mentions that this treatment consists of codifying the data collected, presenting it and analyzing it in a more structured way. In addition, the discourse analysis proposed by Zanella (2013) was used, which focuses on the language used in written texts or in the speeches of individuals. Thus, given that the field study was conducted through interviews, this analysis was applied through descriptions and reflections based on the answers collected from the interviewees.

RESULTS

Description of the organization

The studied organization is in the chemical and petrochemical sector and manufactures polyethylene (PE), polypropylene (PP) and polyvinyl chloride (PVC) resins and other chemical inputs. The company's customers are

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found in various segments, including rubbers, the automotive industry, lubricants, agribusiness, and retail applications. The resins produced by the company are used as raw materials in the manufacture of different products such as packaging, toys, syringes, materials used in construction (roof tiles, window frames, cisterns), among others.

It is a large organization with more than 8,000 employees and coordinates industrial centers in countries on the American, European and Asian continents. Regarding its operations in Brazil, it has factories in the states of Alagoas, Bahia, Rio de Janeiro, Rio Grande do Sul and São Paulo. The Duque de Caxias (RJ) unit, the focus of this research, is divided into two industrial plants. In addition to these, the logistics area is responsible for managing two distribution centers and six external warehouses, focused on shipping materials to customers and to the organization's other centers, located in Minas Gerais, Paraná, Rio de Janeiro, Santa Catarina and São Paulo. In addition, the management includes three warehouses on the border among Bolivia, Paraguay and Uruguay, helping with foreign market operations.

Characterization of the organization's logistics system

In general terms, the organization's logistics system includes the following activities: bagging, storage, shipping and transport. The bagging activity is responsible for filling finished products. This process is performed on the basis of information provided by the production area, the bagging capacity and modality of each of the company's units, taking into account the type of resin, the packaging (pallet and big bag) and the quantity to be bagged. Another responsibility involved in this logistics stage is the receipt of inputs related to the process, such as pallets, reels, glue and stretch. When the bagging of the products for a given line is complete, they are made available for storage.

Storage is the stage at which the finished product, once bagged, is sent to the internal warehouses of the industrial plants, external warehouses and distribution centers, according to the capacity of each unit and the demands of the customers. Another important point related to this activity is the type of stacking the product has to do: churchy, overlapping or non-stackable. The choice takes into account the technical recipe and the safety and quality risks, such as falling over and damage to the packaging.

The shipping activity, which is the focus of this research, ranges from checking sales orders and stock transfers to shipping the product. The product is shipped in big bag, palletized, bulk, seabulk or single sacks, and its main agent is the logistics operator responsible for the process and the cargo carrier. At this stage, responsibilities for invoicing, stock management, vehicle inspection, checking and loading materials, and weighing the cargo are assumed.

The transport stage involves delivering the product to the end customer, external warehouses or distribution centers. The organization uses various modes in its operations, such as air, pipeline, rail, sea and road, the latter two being the most commonly used. In this activity, the choice of mode of transport and the processes related to the vehicle takes into account various factors, including the distance to be covered, the type of material and customer restrictions.

Purposes of using quality tools in the shipping área

The data survey showed that the main purposes of applying quality tools in the shipping area are: to deal with supplier deviations and customer complaints, to investigate occurrences and to implement and review operational processes.

Regarding to dealing with supplier deviations and customer complaints, this is done when an internal fault is identified in the operation or when a customer complaint is opened. In this process, the tools are used by the quality focal points of the logistics operators in the shipping area to detect the causes of the problem and define immediate actions to correct, prevent or even extend to other processes or locations. Therefore, in this use, the focus is on resolving faults, as well as on the company's accountability to customers, highlighting its action on the problem in order to prevent its recurrence.

Another reason for using quality tools is when there is a safety, health and environmental (SHE) incident within the operation. In this case, these tools are used by those responsible for the area to investigate priority events in terms of frequency and impact, in order to identify the main offenders within the processes and physical structures at the shipping sites. The aim is to assess and improve operational quality, preventing damage to operators, materials, machinery, and the environment.

In addition, quality tools are used to implement or revise operational processes. In this case, shipping managers and logistics operators generally work more closely together, not only to design the processes, but also to plan their implementation in terms of stages, deadlines and responsibilities. In this sense, the application of the tools is aimed at creating and updating procedures, as

well as communicating with other areas to evaluate the operational stages (if necessary).

Quality management systems and mechanisms in shipping

The systems and mechanisms used in the company's shipping area to apply the quality tools are: deviation and complaint handling form, SAP, indicator panel and team meetings.

The form for dealing with deviations and complaints consists of an Excel spreadsheet that includes a description of the problem to be dealt with and some quality tools (Ishikawa diagram, five whys and 5W2H) represented graphically. This form is sent to the shipping managers and the quality focal points of the logistics operators when any deviation or customer complaint is identified. The QA managers of these suppliers then deal with the problem detected by filling in this form. This form is then forwarded to the shipping managers and to the company's quality focal point, who record and monitor this process until it is completed.

SAP is an integrated management system for processes and information between the various areas of the company. As far as QA is concerned, in shipping this system has the functionality of recording and dealing with supplier deviations and customer complaints, allowing the follow-up of action plans defined in the form mentioned above. It therefore enables information to be accessed not only by the company's quality managers, but also by other areas that are related to shipping, such as the sales and transportation teams.

The indicators panel corresponds to the set of Power BI dashboards used by the organization's logistics area to monitor the various indicators of its operations. With regard to the application of quality tools, this dashboard allows the main deviations and complaints obtained to be represented using a Pareto Chart. This mechanism is interconnected to the database that includes the records made in SAP, allowing the monitoring of the main quality problems within the shipping processes.

According to the managers interviewed, logistics providers also use team meetings as a mechanism for applying the tools. This is because, in these meetings, the quality focal points of these suppliers usually bring together the people involved in a problem or opportunity to be investigated, with the help of brainstorming. Meetings are also held among the managers and focal points of the logistics providers for the monthly evaluation of the SLA (Service Level Agreement), which consists of a contractual agreement to define the level of service that the organization expects from its suppliers responsible for shipping.

Quality tools applied in the shipping area and their perceived benefits

Chart 4 shows the tools used by the company's materials shipping area and the main benefits perceived from their use.

Positive impacts of using QA tools in shipping

The main impacts cited in relation to the use of QA tools in shipping are: more effective communication with customers in terms of quality, preventing the recurrence of problems within the operation, improving operational processes, and better evaluation of costs related to the area.

Regardingto to greater efficiency in the company's communication with its customers, it was emphasized that the use of such tools contributes to this impact by making it possible to deal more fully with quality complaints from customers. This is because these tools not only make it possible to report to the consumer the causes and actions taken to deal with the problems complained of, but also provide information for structuring histories and indicators on the faults dealt with. Therefore, through this flow, the organization is able to show customers its QA process more assertively and, consequently, better manage its satisfaction metrics.

Another impact pointed was the prevention of recurrence of problems in the operation, especially with regard to HSE. In this sphere, the instruments used work with better investigations into occurrences, as they help in the process of analyzing offenders within the operational sphere, as well as directing actions to block or eliminate any non-compliance. As such, the interviewees said that these investigations have helped to reduce the rate of personal and material accidents within the industrial plants and to extend the actions applied to other shipping units as a preventative measure.

In addition, improving operational processes was another effect of using these tools, especially the flowchart. On this point, the managers emphasized that, as well as providing a better design of the processes, it also helps to see bottlenecks in the stages and even opportunities for improvement, either to meet a customer restriction or to simplify the execution of activities. In this way, the company is able to have processes that are more focused on essential stages and to develop more assertive ope-

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Chart 4. Perceived benefits from the use of quality tools

Quality Tools	Perceived benefits from the use
Pareto Chart	Visually represents the priority points within quality
	Identifies vulnerabilities within the operation
	Directs the definition of priorities in processes
Brainstorming	It brings together all the individuals involved in the problem being analyzed
	Provides information to analyze a problem and its causes
Ishikawa Diagram	Makes it possible to allocate the mapped causes to categories present in an operation
	Provides insight into which categories drive the occurrence of the problem
	Provides a start to for investigate the root causes
	Better targeting to define corrective actions
Five Whys	Proposes a deeper analysis of the root cause of the problem under investigation
	It works on dismembering the causes listed in the Ishikawa diagram into sub-causes
	Better targeting to define corrective actions
5W2H	Helps define key items in an action plan
	It serves as a basis for preparing an action follow-up schedule
	Provides information to determine the control and verification items required for monitoring
Flowchart	Helps detect deviations and opportunities for improvement within processes
	Makes it possible to assess whether or not there is a need to communicate with another area in order to understand some stage of the process
	Works as a support in the division of tasks between the team
	Helps train employees in a process

Source: The authors.

rating procedures, so as to make it easier for the people involved to understand the process, communicate with other areas and prevent certain failures when performing the task.

Finally, the interviewees mentioned the improvement in assessing the area's costs, whether related to processes already implemented or projects to be implemented. This is because the application of QA instruments acts as a support in analyzing the viability of the initiatives planned for the area, since the costs of the actions, the effort and the impact of this implementation on the operation are often compared when conducting the Masp. In this way, the team involved is able to have a broader view of the potential gains associated with improving a process or implementing an initiative, and can reduce costs, cut waste and make better use of the time dedicated by individuals to analysis.

Difficulties in using QA tools, systems and mechanisms

In order to complement the analysis, we sought to understand the main difficulties perceived in QA in the shipping area. Regarding the use of tools, the first point mentioned by managers is the low priority given to quality issues by logistics providers, as the focal points responsible for meeting these demands also take on other responsibilities within the operation. Another aspect discussed is the difficulty in differentiating a problem from a consequence during the analysis process, which generates the need for constant revision of action plans.

In addition, the lack of depth in the analysis was also cited as an obstacle to the use of these tools, because, according to the interviewees, logistics operators often focus on justifying the occurrence of the problem, rather than really understanding the reasons behind it. Also mentioned was the lack of a holistic view of processes, since individuals generally do not see the process as a whole, but rather as a set of dismembered stages, which

can lead to miscommunication with other areas of the company. Another difficulty mentioned is the failure in the verification and standardization stages of the PDCA cycle, since the shipping managers are more dedicated to operational management fronts, putting QA on the back burner, which compromises monitoring the effectiveness of planned actions.

With regard to systems and mechanisms, one of the obstacles mentioned is the lack of more automatic integration among some systems. This leads to the need to fill in databases manually and, consequently, to a more time-consuming and error-prone process of processing and recording information. In addition, there is a lack of consolidation of these databases between the organization's regional offices, which makes it difficult to take action on the same problem in other locations and to access the history of non-conformities.

CONCLUSION

This study sought to understand the use of quality tools in the shipping area of a petrochemical company in the Baixada Fluminense region of Rio de Janeiro, based on the importance that QA has for the logistics system of organizations. The research methodology, based on a descriptive, bibliographical and documental field study and interviews and participant observation, made it possible to gather information from a more managerial than operational perspective regarding to the use of the tools. This is because the interviewees are the managers of the units and not the quality focal points of the logistics operators who use these QA tools.

Based on the objectives defined to verify the impacts of using these QA instruments in shipping, it was analyzed that, basically, the purposes for which they are used involve dealing with supplier deviations and customer complaints, investigating HSE occurrences and implementing and reviewing operational processes. As for their benefits, it was understood that the use of these QA instruments works from the identification of the problem to the verification of the actions taken and the standardization of processes. As a result, it was found that the application of these tools has an impact on greater effectiveness in communicating with customers in terms of quality, preventing the recurrence of problems within the operation, improving operational processes, and better evaluation of costs related to the area.

However, some of the teams' difficulties in applying the tools and with QA systems and mechanisms were identified. In the use of the tools, the obstacles range from difficulties in prioritizing quality demands by logistics operators to failures in the verification and standardization stages of the PDCA cycle, which ends up influencing the way the teams apply the QA instruments and follow up on actions. There was also an opportunity for improvement in the integration of QA systems and mechanisms and in the consolidation of databases, generating the need for double registers and difficulties in accessing information and records.

According to the research, it can be concluded that the tools, through their perceived benefits and the purposes for which they are applied, have a positive impact on the company's shipping. However, this area has some challenges to overcome in its management. As such, prioritizing quality demands through a specialized and dedicated team, monitoring action plans by logistics operator managers and improving systems and mechanisms can help the organization with these obstacles and, consequently, guarantee a better relationship with its suppliers and customers, as well as greater efficiency and effectiveness in its processes.

In order to gain a more comprehensive understanding of the use of quality tools in the shipping area, it is possible to suggest further research in this area, such as studies using the collection method of interviews and observation techniques with teams that apply these tools, verifying their use in a more operational way. We would also recommend research into the applicability of these tools in cases of Industry 4.0 innovations within materials forwarding, given that new technologies in logistics processes have been a very relevant and discussed topic at the moment. Another suggestion is the development of research into the use of quality tools or methodologies in other logistics activities, such as warehousing and transportation.

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