

MAINTENANCE MANAGEMENT MODELS IN A SUPERMARKET NETWORK IN THE SOUTH OF SANTA CATARINA

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ABSTRACT

In a modern world where there is a growing technological expansion combined with globalization, competitiveness among organizations becomes increasingly fierce. As a result, there is a need for these organizations to be prepared to serve their customers in the best possible way. In this context, maintenance management is gaining more and more prominence, as it is an important part of institutions in order to ensure good performance and efficiency of equipment and machines in various sectors, so that they can make the most of their resources. The methodology used has a qualitative approach with some quantitative aspects, descriptive and exploratory in nature. The objective of this study was to investigate the companies of the supermarket network in the extreme south of Santa Catarina in order to get to know the maintenance sector, the selection process for maintenance sector employees, the total number of maintenance personnel as a percentage of the total network employees, employee turnover in the maintenance sector, training, maintenance actions, and budget planning for them. A questionnaire was used to collect data, which was applied to the person in charge of the maintenance sector of eight large and medium-sized supermarket networks in the region. It can be concluded that the study objectives were achieved and based on the information gathered in the interviews, it can be seen that maintenance management in supermarket networks has some aspects that are subject to improvement.

KEYWORDS: Maintenance management, supermarket management, types of maintenance.

I. INTRODUCTION

In the increasingly competitive world of globalization, with ever-advancing technological equipment, organizations need to be prepared to produce at lower costs and in the shortest time possible, attracting new customers and retaining existing ones. The ability of companies to compete and survive will depend on their ability to achieve competitiveness standards. Therefore, companies should seek ways to

produce products and/or services with the desired quality, delivery time, and quantity, and at an appropriate price. (WOLFF, 2001).

In this scenario, maintenance management plays a crucial role since, to achieve all these objectives, companies need to keep their machines and equipment operating in the best possible conditions, reducing losses from unplanned downtime due to failures or breakdowns. According to Viana (2002, apud CARNEIRO, 2016), maintenance today has a significant role in companies. It can be an important source of cost reduction, productivity and competitiveness increase, equipment availability for new requirements, individual and collective safety, and definitely solidifies more and more as an important and fundamental variable for a company's business.

Supermarkets are a peculiar type of company, and their management is somewhat complex. With a variety of sectors and equipment types, many of which are always kept running, such as refrigeration equipment, an efficient maintenance type is required, as a broken machine can cause many financial losses and harm the store's image since it will lose its ability to serve its customers with its usual excellence.

The present study analyzed the maintenance sectors of supermarket network companies, in the retail industry, located in the southernmost part of Santa Catarina with the aim of understanding: the maintenance sector, the selection process of maintenance department employees, the total number of maintenance staff versus the total number of network employees, employee turnover in the maintenance department, training, maintenance actions, and budget planning.

According to Kardec and Nascif (2013), maintenance should prioritize eliminating potential failures by analyzing basic causes, combined with quality repair effort, and with the operation and engineering efforts in search of definitive solutions (apud MEDEIROS et al., 2015, p. 4).

For a long time, maintenance was seen as an obstacle to production. However, it evolved to the point of being considered a fundamental area of industrial activity. Among the aspects related to this area are productive performance, safety, product quality, and production process efficiency (CABRAL, 2006 apud KÜNZEL, 2017).

For Slack (2013), there are many benefits of maintenance, including increased reliability, higher quality, lower operating costs, longer equipment life, and higher residual value of equipment (apud MARCON et al., 2019).

Viana (2002), cited by Künzel (2017, p. 16), states that maintenance became a necessity during World War II, a period in which organization, planning, and control methods for decision-making were being developed.

However, it was between the 1940s and 1950s that companies realized the need to develop the maintenance sector. The factors that drove them to do so were the increase in occurrence records and the high costs of spare parts, which became more evident with the practice of preventive maintenance, thus improving maintenance planning and management, thereby establishing maintenance engineering at the departmental level (CAMPOS JÚNIOR, 2006 apud COSTA, 2013).

According to TAVARES (2005, p. 20), maintenance managers should have a broad vision and systemic action within their organizations so that the diversity of models and fundamentals of maintenance planning and control, fully consolidated, are useful for maximizing equipment and organization profits (apud COSTA, 2013, p. 14).

Failure can be described as the termination of a condition or the inability of an item to perform its required function. Its appearance invariably leads the item to an unavailable state, either by automatic protection action or emergency unit shutdown. Defect, on the other hand, is an alteration or imperfection in the state of an installation/equipment that does not cause the termination of the ability to perform its required function since the installation/equipment can operate with restrictions. The difference is that in the case of a defect, there is the possibility of programming preventive maintenance, called "non-systematic preventive maintenance", thus avoiding equipment failure (SANTOS et al., 2007).

According to Almeida (2000), corrective maintenance is a reactive management technique as it waits for the machine or equipment to fail before repairing it. It is also the most expensive method of maintenance management since it requires high costs of spare parts inventory, extra work, machine idleness costs, and low production availability. He also notes that in almost all cases, industrial plants perform basic preventive tasks such as machine lubrication and adjustments, even in a corrective maintenance environment (apud COSTA, 2013).

According to Paskocimas (2010) cited by Medeiros et al., (2015), preventive maintenance is based on the scheduling of regular maintenance that is programmed through the analysis of the historical behavior of equipment and parts failures. With this data in hand, maintenance is performed before there is a machine stoppage due to failures or parts breakdown.

Branco Filho (2008 apud MARCON et al., 2019) says that preventive maintenance is all maintenance work carried out on machines that are still in operational condition, even if they have some defect.

In detective maintenance, there is periodic monitoring of the operating parameters of equipment and machines to detect, predict the probable occurrence time, and, if possible, diagnose the type of failure so that maintenance operation can be planned on the occasion and in a convenient way (TEBALDI, 2004 apud MAGALHÃES et al., 2019).

Freitas (2016) cites as an example of the application of detective maintenance, a circuit that controls the entry of a generator in a hospital. If it fails and there is a power outage, the generator does not turn on. For this reason, such a circuit is tested from time to time to verify its functionality.

According to Almeida (2000), predictive maintenance is a means of improving productivity, product quality, profit, and overall effectiveness of our manufacturing and production industrial plants. Due to its approach that uses more effective tools to obtain the real operational condition of production systems, it can provide data on the mechanical condition of each machine, determining the actual average time to failure (apud COSTA, 2013).

The goal of predictive maintenance is to determine the correct time for the maintenance intervention, thus avoiding disassemblies for inspection and using the component up to its maximum service life (VIANA, 2012 apud MARCOM et al., 2019).

Total Productive Maintenance (TPM) began in Japan in the 1970s at one of Toyota's group members, Nippon Denso KK, but only reached Brazil in 1986. The objective of TPM is the company's effectiveness through greater qualification of people and improvements introduced in equipment. Operators perform simpler tasks that were previously performed by maintenance personnel, such as measuring vibration and temperature, changing bulbs, cleaning and changing filters, among others (ALVES and OLIVEIRA, 2014).

Maintenance management has been increasingly considered important in organizations. Minimizing costs, ensuring that resources are available for optimizing processes and generating quality and reliability are some of the reasons why this occurs (GOMES et al., 2011 apud MAGALHÃES et al., 2019).

In a scenario where there is a real demand for operational excellence, maintenance is a relevant tool as it contributes as a competitive advantage. Its rise occurred from the 1980s with technological advancements, which ensured the absorption of sophisticated techniques, management, quality tools, customer and supplier relationships, statistical and cost controls (VERRI, 2007 apud MAGALHÃES et al., 2019).

ABRAMAN (Brazilian Association of Maintenance and Asset Management) surveyed 151 companies from various segments in the country, such as oil, services, electricity, automotive, industrial, and metallurgical. This survey has been conducted every two years since 1995, and one of the topics addressed is the company's maintenance staff, which measures the percentage of maintenance sector employees in relation to the total number of employees in the companies. This research generated the document where the results obtained are found. The average of the total maintenance for the total of the companies was 23.45%.

Supermarkets are present everywhere, being of extreme importance to society and commercial economy. They have the characteristics of generating employment, technology, high production, innovation in products, capital, and branches in different locations aiming at approaching the consumer and economic and productive development (FERREIRA JÚNIOR, 2012).

The first supermarkets in Brazil emerged in the 1950s, and the first establishment appeared in 1953 in the city of São José dos Campos - SP (CARVALHO, 2006 apud FERREIRA JÚNIOR, 2012).

Parente (2003) comments that globalization that affected the food retail sector after the establishment of the real plan in 1994 brought a series of rapid and profound changes in the retail structure and also in the modernization of the management techniques of these companies.

Technological advancements bring increasingly modern and complex systems and equipment to facilitate the pursuit of desired objectives. In this context, maintenance management plays an important role within organizations because all this technology needs to be fully operational to provide what it

intends to do. As poor maintenance will cause losses and waste of potential, resulting in delays and lack of quality in the end process.

This study was developed with the purpose of understanding how supermarket network companies, in the retail sector, in the extreme south of Santa Catarina, work on the issue of maintenance of their machines and equipment.

II. METHODOLOGICAL PROCEDURES

The research was divided into two stages. In the first part of the study, a literature review was conducted to present relevant concepts related to the proposed topic. The study was conducted in retail supermarket companies in the southernmost region of Santa Catarina with the aim of analyzing and understanding how these companies handle maintenance issues.

The second part of the study consisted of applying a questionnaire that addressed the main aspects of maintenance management, considered relevant based on the previously conducted literature review. According to Parasuraman (1991), as cited by Moysés and Moori (2007), a questionnaire is merely a set of questions designed to generate necessary data to achieve the project's objectives. He also states that constructing questionnaires is not an easy task and that dedicating adequate time and effort to constructing a questionnaire is a favorable differentiation factor.

Interviews were conducted in person, on-site, or by phone with those responsible for the maintenance department, ensuring a high response rate and reducing the error of interpretation of the questions posed.

After data collection, data and information analysis was conducted followed by presentation and discussion of the results.

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2.1. Methodological frameworks

The approach used in the study is characterized as a qualitative research, since its objective is to understand maintenance management, but also with some quantitative aspects. According to Locke, Spirduso & Silverman (2013), in qualitative research, the intention is to understand a certain social situation, event, role, group, or interaction (apud BRIZOLLA et al., 2020). It is also descriptive and exploratory in nature, as it aimed to describe the behavior adopted by the surveyed companies. The data collected were obtained from a questionnaire elaborated with relevant questions on the maintenance topic, based on the literature review conducted.

2.2. Data Collection and Analysis Procedures

The data collection was carried out through a questionnaire applied directly to the person in charge of the maintenance department of each retail supermarket chain. For some questions, such as the number of employees in the chain, it was necessary to contact the company's HR as well. The companies selected for the research were chosen based on their size and relevance in the region where they are located. The questions were formulated based on a review of the theoretical framework covering the main concepts related to equipment maintenance. The questions were direct and informal with the specific objective of collecting data in order to obtain an overview of the subject matter.

The interviews were conducted between May 06, 2021, and June 02, 2021. For this, contact was made by phone and when possible, a meeting was scheduled with the person in charge, in their work environment, to apply the questionnaire. Nevertheless, the vast majority of the interviews were conducted via phone, as they had an overloaded schedule. The interview time lasted on average 10 minutes with each respondent and the collected information was recorded in a notebook.

III. PRESENTATION AND ANALYSIS OF RESULTS

The selection of companies eligible for the research was based on the parameter of the size of the supermarket chain and its relevance in the community where it operates. Interviews were conducted in

8 large and medium-sized companies located in the region of Criciúma - SC. The distribution of their branches throughout the state of SC, and even some outside it, as well as the number of employees, were considered as parameters to define a large or medium-sized company, according to Table 1.

Table 1 - Company size classification.

Supermarket chain	Company size	Number of employees	Region of operation
Company A	Large	9500	SC and PR
Company B	Large	5500	SC
Company C	Large	4500	SC and RS
Company D	Medium	1000	Southern region of SC
Company E	Medium	900	Southern region of SC
Company F	Medium	500	Southern region of SC
Company G	Medium	260	Criciúma - SC and region
Company H	Medium	-	Criciúma - SC and region

Source: Authors (2022).

Regarding the question about whether there was a specific maintenance department in the network, the response was positive for the 3 largest networks. All of them have a structured department consisting of a person in charge for the entire network, and in each unit, professionals from the electromechanical, electrical, and electrician areas. In two of them, maintenance or automation mechanics are also part of the department. In one of them, all internal professionals are electricians, as it is the area that requires more work. For better understanding, see table 2. Specialized third-party companies are hired for other types of problems. As for the refrigeration and air conditioning department, two of them have outsourced service to maintain the equipment's operation.

Table 2 - Composition of maintenance department in large companies.

Supermarket chain	Maintenance department manager	Maintenance department professionals
Company A	Building technician	Engineer, civil engineer, electrical engineer, electrical technician, electromechanical technician, automation technician, electricians.
Company B	Civil engineer	Electrical technician, electromechanical technician, industrial maintenance mechanic.
Company C	Civil engineer	Electricians.

Source: Authors (2022).

Of the 5 medium-sized companies, two of them do not have a maintenance department, per se. In one of them, maintenance work is entirely outsourced, while in the other, they are starting to implement it. In this latter company, although there is no declared maintenance department, there are already professionals who work in the function within the network.

The other 3 medium-sized companies already have an active maintenance department. It includes technicians in electrical engineering and electricians. In two of them, an electrical engineer is also part of the staff, as shown in table 3. For the refrigeration and air conditioning part, a specialized outsourced company is hired for equipment maintenance.

Table 3 - Composition of maintenance department in medium-sized supermarket chains.

Medium-sized supermarket chain	Has maintenance department?	Formation of maintenance department responsible	Professionals in maintenance department
Company D	Yes	Agricultural engineering	Electrical engineer, electrical technician, and electricians
Company E	Yes	Accounting	Electrical engineer, electrical technician, and electricians
Company F	Yes/New	Information technology	Electrician
Company G	In the process of implementation	High school	Electrician
Company H	Maintenance outsourced	-	-

Source: Authors (2022).

When it comes to hiring employees for the maintenance sector, the vast majority of interviewed companies open internal selection and if there is any qualified candidate, the vacancy is filled. Regarding qualification, the requirements are mainly that the candidate has a technical course in electrical or mechanical areas. Experience in the function is an advantage, but not necessarily mandatory when it comes to internal hiring. If the candidate is a good employee, proactive, motivated, and has only a technical course in the area or is already studying, this gives them a great chance of being contacted for the new position.

If it is verified that there is no qualified internal candidate, then HR opens external selection for hiring. Most vacancies are actually filled by external candidates, precisely due to the job requirements. In addition to a technical course in the area, experience in the function is also required for external hiring.

Regarding the employees allocated in the maintenance sector, each unit has some people who work directly in the sector and all of them have specialized third-party companies to make repairs that they cannot handle, either due to high demand, difficulty in finding a solution, or the nature of the problem.

Looking at the ratio between maintenance sector employees and the total number of employees in the entire network, it is noticeable, as shown in table 4, that in all the surveyed supermarket chains, this number does not exceed 1%.

Table 4 - Percentage of maintenance department employees.

Supermarket chain	Total number of employees in the chain	Number of employees in the maintenance sector	% of employees in the chain
Company A	-	9	-
Company B	5500	44	0,80%
Company C	4500	19	0,42%
Company D	100	9	0,90%
Company E	900	9	1,00%
Company F	500	2	0,40%
Company G	260	1	0,38%

Source: Authors (2022).

In company A, it was not possible to gather sufficient data on the total number of employees working in the surveyed region due to internal privacy policies. Nevertheless, it is still possible to verify that it probably would not exceed the value of 1%, considering it is one of the largest companies in the industry and has nine employees working in the maintenance sector.

Regarding the frequency of employee turnover, it was unanimously verified that there is a low turnover rate. In most cases, it was attributed to the technical nature of the job and also to the appreciation that maintenance employees have within the organization. It was verified that the length of service for these employees is quite high, with some having been in the position for 20 to 25 years. There are also new

employees, but they are usually due to demand or the need to replace retired employees. However, the majority have been there for at least 4 or 5 years.

As for the age of maintenance employees, the staff is usually composed of more experienced people, as they have been with the company for a long time. The average age is around 36 years old. There are employees over 55 years old and also some younger ones, such as a 19-year-old and a 22-year-old, who are rare exceptions.

Regarding the training provided by the companies to the maintenance sector employees, all six companies that have a maintenance department responded positively. In all of them, courses are provided to update the NR's: NR10, NR12, NR35, and training of the SESMT (Specialized Services in Safety Engineering and Occupational Medicine). However, one of the interviewees said that they find the training provided to be insufficient and that it could be improved.

When asked about the maintenance actions used (preventive, corrective, predictive), all were emphatic in stating that the majority used is still corrective maintenance. One of them said that sometimes when they notice something is about to break down, they try to get ahead of it, but it's nothing planned. Another commented that lubrication and equipment cleaning are done, but they couldn't be considered a type of preventive maintenance, as they do not follow a specific schedule and do not guarantee that the equipment will not fail, causing its shutdown.

All interviewees also stated that maintenance related to refrigeration and air conditioning, which is carried out by a specialized third-party company, is indeed scheduled, thus constituting preventive maintenance. One of them stated that generators, which ensure that essential equipment for the supermarket to function in case of a power outage, also undergo preventive maintenance by third parties.

Regarding budget planning, only one of the companies that participated in the research works with this management tool. In this case, 1.5% of the gross revenue is allocated to the maintenance sector in general.

In the other companies, the budget is guided according to demand. When a piece of equipment breaks down or presents a malfunction, the maintenance department officials request quotes from suppliers of parts or even new equipment, if necessary, and the final approval is the responsibility of the general management.

IV. CONCLUSIONS

Based on the work carried out, it was possible to observe the subdivision of maintainers within the maintenance department in the supermarket chains that were the object of the research. In relation to this topic, it became clear that in all supermarkets where there is a structured maintenance department, there is a certain hierarchy. A supervisor, who is normally responsible for all units of the network or for several units that make up a region, and in each store there are people responsible for maintenance. In many of them, the department consists of only one person, who is the only one responsible for the entire store.

Regarding the ratio of total store employees to the total directly allocated to the maintenance department, it was possible to see that in all surveyed stores the number does not exceed 1% of the total. Even in large companies, this number is not higher. It can be said that it is a very low percentage compared to companies in other sectors. For example, data from the survey conducted by the Brazilian Association of Maintenance and Asset Management, where the average maintenance employee to total employee ratio is 23.45%.

It was possible to verify with the study that only one of the seven interviewees who have a defined maintenance department works with budget planning allocated to maintenance. The vast majority, around 85%, depends solely on management approval for the acquisition of any material or equipment needed.

It can be concluded, although not delving deeply into the subject, that the study's objectives were achieved, which were to understand how companies in this industry manage the maintenance of their equipment and machinery. Based on the information gathered in the interviews, it can be seen that

maintenance management in supermarket chains in the retail sector has some aspects that can be improved. Therefore, for future studies, it is suggested that an investigation be carried out in order to better understand each item analyzed in this research separately.

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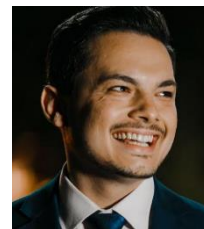
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