



PREVENTIVE AUTOMOTIVE MAINTENANCE: FROM THE WORKSHOP OWNER

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ABSTRACT

The study is classified as descriptive, considering that the intention is to present the definitions of preventive, corrective maintenance, Total productive maintenance - MPT and identify the benefits and advantages aimed at improving productivity, reducing costs and reducing environmental degradation produced by damaged motor vehicle waste. As for the study's approach, it is qualitative, given the purpose of identifying and analyzing the economy promoted by preventive automotive maintenance. In the study, it is also questioned how an auto electrical maintenance and vehicle diagnosis workshop can implement a preventive maintenance plan for its customers' vehicles and verify its financial impacts through an action research. The results of this action research notes that automotive preventive maintenance is still not widely practiced among vehicle owners sought, with only 30% doing so. Regarding the financial return of the analyzed entity, in the periods of December / 2018 and January / 2019, there was an increase in profitability of 48% and 60%, respectively.

Key words: Preventive maintenance. Corrective maintenance. Automotive Workshop.

1. INTRODUCTION

The automotive sector in Brazil represents approximately 22% of industrial GDP, according to the latest official data from the then Ministry of Industry, Technology and Foreign Trade³ of the year 2018, as it drives the growth of other sectors of the industry, such as steel and derivatives, rubber and plastic articles (MDIC, 2018).

In view of this, it develops new technologies, in addition to generating jobs and income. One of the relevant representatives of the sub-sectors of the automotive chain are the auto parts that had an estimated turnover of U \$ \$ 27.1 billion in 2017, with 590 companies in the auto parts manufacturing sector in Brazil associated with SINDIPEÇAS and located in ten states of the federation (SINDIPEÇAS; ABIPEÇAS, 2018).

It is observed that the auto parts replacement sector has a significant share of market share in the country, in addition to a gradual growth in the number of vehicles traveling. According to the National Traffic Department - DENATRAN, the number of vehicles in Brazil was 100,094,725, until October 2018. Therefore, it is assumed that the auto parts trade, including dealerships and independent establishments, even though it does not grow quantitatively, stands out qualitatively.

Therefore, the auto parts replacement sector meets the needs of automotive maintenance and repair. It is recommended that the preventive automotive overhaul should be carried out at a certain time or use, in order to avoid the appearance of failures. In this way, it results in the rational use of resources aiming at greater competitiveness (FREITAS;

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³ Source: <http://www.mdic.gov.br/index.php/competitividade-industrial/setor-automotivo>

RESENDE FILHO, 2005). In the long run, the costs with preventive maintenance are lower than with corrective maintenance (NATO; MACHADO, 2008), since the operational cost is directly related to the adequacy of the vehicle, such as the maintenance of vehicles, tires and fuels (DARIO, 2012).

From preventive maintenance, individuals can feel safer with the vehicle and the surrounding environment, and also identify problems in the car that can cause damage to other parts of the car and, consequently, lead to greater wear and tear. According to Campos and Belhot (1994, p.3) it is difficult "to demand services of good quality and high degree of efficiency when the necessary tools are not available, which is another aspect that makes maintenance planning difficult".

In addition to the increasingly fierce market competitiveness, the teams of automotive technical assistance companies need to be better prepared to face the competition and survive. Knowing the internal environment, understanding its reality, its limits and adjusting management to act according to internal restrictions are of fundamental importance for the success of the entity (CHIAVENATO, 2014).

That said, business competitiveness and the direction of technologies support this work, in which the reduction of disbursements presents benefits and advantages, both for the car user and for the government, since up-to-date maintenance is a benefit for the environment, as it guarantees the reduction of pollutant emissions in the environment, improving air quality and reducing respiratory diseases and avoiding traffic accidents due to electrical outages and mechanical failures (PEREIRA et al, 2010).

In addition to valuing the car by presenting a good state of conservation, its resale price can be valued above the market average (PEREIRA et al, 2010). Avoids accidents caused by lack of car maintenance, such as brakes, steering and other safety items, when they are not in favorable conditions, put the safety of the driver and other people at risk (SILVA et al, 2017).

In view of the above, the question arises: how can a maintenance workshop of the auto electrical type and vehicle diagnosis be able to implement a preventive maintenance plan for its customers' vehicles and what are the financial impacts arising from it? In this study, an action research was carried out, accomplished in an electric car in the city of Uberlândia, in which data were collected in order to verify whether preventive maintenance promotes advantages and profitability, from the perspective of the owner of the automotive workshop.

2. THEORETICAL FOUNDATION

2.1 Preventive Maintenance

According to NBR-5462, the preventive maintenance can be understood as that which is carried out at predetermined intervals, or according to the criteria intended to reduce the probability of failure or the degradation of the functioning of an item or component (ABNT, 1994). The preventive maintenance as what contributes to reduce the chances of failures. Other advantages that preventive review promotes stand out, the gains of effective maintenance include:

greater safety, greater reliability, better quality [...], lower operating costs [...], longer service life of process technology and greater 'end value' (because well-maintained facilities are generally easier to sell second-hand market) (SLACK et al, 2016, p. 607).

This type of intervention is programmed and considered safe, since it prevents the failure from causing greater risks; there is low cost and faster than other types of maintenance (KARDEC, NASCIF, 2009). Preventive repair allows for prior preparation of the service, so that decision making can be better assessed and the predictability of consumption and replacement of parts can be verified (KARDEC; NASCIF, 2009). Preventive maintenance

also seeks to reduce the chances of breakdowns by providing services regularly. Since the more frequent the preventive repairs are, the lower the chances of failure (SLACK et al, 2016).

The disadvantage point of preventive maintenance is the monitoring of the machine, making analyzes, measurements and verifications, therefore, this demands time from the user (SILVA et al, 2013). In addition to presenting loss of productivity due to the machine being inoperative; parts are replaced before they reach their service life limits; need to have qualified repairers to perform periodic maintenance and that have a strategic plan for programs and equipment preservation activities (WYREBSKI, 1997; ALMEIDA, 2000; SILVA et al, 2013).

However, it can be observed that when doing constant monitoring of the equipment, it gives the condition to reduce maintenance costs, avoiding unnecessary repairs and unexpected stops. Making the machine operating safely and for a longer time, since the failure of a machine degrades at a speed proportional to its severity, so when a problem is detected, it is possible to avoid further repairs (WYREBSKI, 1997; ALMEIDA, 2000; KARDEC, NASCIF, 2009; SILVA et al, 2013).

From the National Document made available by the Brazilian Association of Maintenance and Asset Management - ABRAMAN in 2017, it is known that the general average of Preventive Maintenance was 48%, Corrective Maintenance of 42%, and the general average of Other types of maintenance, including predictive maintenance was 9%, from the Aeronautical and Automotive sector.

Figure 1 - Types of maintenance

Setores	Trabalho em Manutenção Corretiva (%)	Trabalho em Manutenção Preventiva Baseada no Tempo (%)	Trabalho em Manutenção Preventiva Baseada no Estado (Preditiva) (%)	Outras Atividades de Manutenção (%)
Açúcar e Alcool, Alimentos e Bebidas	42%	40%	18%	0%
Aeronáutico e Automotivo	42%	48%	4%	5%
Eletroeletrônicos - Energia Elétrica	28%	44%	12%	16%
Químico e Sanamento	25%	50%	20%	5%
Mineração e Siderúrgico	60%	23%	13%	5%
Petróleo e Petroquímico	47%	39%	14%	0%
Papel e Celulose e Plástico	24%	31%	31%	14%
Predial e Prestação de Serviços (EQ e MO)	45%	44%	5%	6%
Máquinas e Equipamentos - Metalúrgico	25%	48%	7%	20%
Média Geral	38%	41%	14%	8%

Source: ABRAMAN, 2017.

Therefore, the highest maintenance index is preventive correction, followed by corrective. Preventive maintenance has a higher cost, probably due to changing parts prematurely and other maintenance expenses, in order to avoid failures at inopportune moments.

Regarding the maintenance cost in relation to the gross revenue, ABRAMAN (2017) presented the sector data Aeronautical and Automotive which is estimated at 3%, as shown in Figure 2:

Figure 2 - Comparison between maintenance costs

Setores	Custo Manutenção / Faturamento (%)	Custo Manutenção / Valor Imobilizado (%)	Custo Relativo Pessoal Próprio (%)	Custo Relativo Material (%)	Custo Relativo a Contratação (%)	Outros Custos Relativos (%)
Açúcar e Alcool, Alimentos e Bebidas	4%	6%	40%	40%	20%	0%
Aeronáutico e Automotivo	3%	13%	54%	32%	15%	0%
Eletroeletrônicos - Energia Elétrica	7%	6%	44%	29%	27%	4%
Químico e Sanamento	5%	5%	46%	38%	16%	0%
Mineração e Siderúrgico	5%	10%	50%	37%	14%	0%
Petróleo e Petroquímico	4%	15%	41%	31%	28%	0%
Papel e Celulose e Plástico	3%	8%	39%	49%	12%	6%
Predial e Prestação de Serviços (EQ e MO)	4%	4%	49%	23%	28%	2%
Máquinas e Equipamentos - Metalúrgico	3%	1%	51%	37%	12%	3%
Média Geral	4%	7%	46%	35%	19%	2%

Source: ABRAMAN, 2017.

It is observed that the general average of maintenance / billing costs in Figure 2, in all sectors, is small in view of the advantages of billing and availability of machinery.

2.2 Corrective Maintenance

According to NBR-5462, amcorrective maintenance occurs after a breakdown or even breakage of the equipment and is intended to replace an item or equipment in conditions to perform a required function (ABNT, 1994). That is, corrective maintenance is that which consists of unplanned maintenance, in which it corrects failures, after their occurrence and which will perform less than expected (KARDEC; NASCIF, 2009; SILVA et al, 2013). This type of intervention restores, repairs the operating conditions of the machine, but there is no planning for maintenance (KARDEC; NASCIF, 2009).

This type of revision leads to increases in repair time, in addition to raising indirect maintenance costs. With regard to maintenance costs, Almeida (2000) states that a corrective repair will have an average cost three times higher than a scheduled or preventive repair. As Kardec and Nascif (2009) argue, who note that the cost of unplanned corrective maintenance is at least twice the cost of planned maintenance.

There are situations in which corrective maintenance has benefits, such as when the failure is not critical, that is, repairers are able to detect the failure quickly and efficiently; when the asset is easy to repair; when the machine has a low maintenance and / or replacement cost, in addition to the fact that there is no requirement for strategic planning to preserve the machine or periodic inspections, and there is no need to waste resources to replace parts that have not yet reached the end of their useful life (LUCATELLI, 2002; BRANCO FILHO, 2008).

When considering the lack of preventive maintenance and poor maintenance of a motor vehicle, it can be verified that it is a serious violation provided for in the Brazilian Traffic Code - CTB, according to Law No. 9.503 / 97, art. 230, which adds up to five points in the driver's license, generates a fine and vehicle retention for regularization. Bad tire conditions refer to items of the vehicle that compromise safety, in addition to the R \$ 195.23 fine.

According to Atlas of Accidentality in Brazilian Transport, in 2017, there were 89,396 accidents in Brazil. Statistically, 75% of traffic accidents are caused by human error, that is, the driver, and 12% are due to problems related to car breakdowns (TRANSITOBR, 2019). Vehicle breakdowns refer to factors such as worn tires and calibration outside the manufacturer's specification; damaged lighting system; mechanical failures; cracked windshield; misaligned bumper, among other traffic risks (VIAS SEGURAS, 2019).

In a general context, if maintenance is not scheduled, the failure of a machine will occur in a random and unexpected way, which can cause damage to other components, causing additional costs (KARDEC, NASCIF, 2009; SILVA et al, 2013). Therefore, corrective maintenance has high costs in repairs, since the problem was not identified before

the failure, losing production time because the equipment was paralyzed for a period, to correct the machine's defects (WYREBSKI, 1997; ALMEIDA, 2000; SILVA et al, 2013).

2.3 Total Productive Maintenance (MPT)

The Total Productive Maintenance - TPM or Total Productive Maintenance - MPT management system derives from preventive maintenance originally from the United States, but was developed and perfected in Japan, starting in 1950, with the purpose of eliminate losses and waste; reduce production interruptions due to breaks or interventions, in addition to guaranteeing quality and reducing costs in entities with continuous processes and without stops (KARDEC; NASCIF, 2009). In the 70's Nippondenso, which is a Japanese company belonging to the Toyota group and a worldwide manufacturer of automotive components, was the first organization to introduce MPT throughout the factory (NAKAMURA, 2016).

MPT, too, can be defined, according to Slack, et al. (2013) as maintenance management, being carried out in periodic regimes. MPT adopts team work, in which it gives people autonomy regarding organization and planning. Given that MPT aims to improve the efficiency of equipment, machine, tools, etc., in which the individual plans maintenance, taking responsibility for improving his performance and preventing failures at inopportune moments (SLACK et al, 2016).

RIIS et al. (1997) argues that MPT maximizes the overall performance of the machine, preserving and extending the life span, in order to reduce the losses that occur during production, that is, minimizing the effects of damage, which ends up encompassing the participation of everyone involved, for better maintenance productivity.

According to Monteiro et al. (2012, p.2) MPT activities focus on improvements and optimization of the use of machines, with low production costs, competitive prices, and a trained, motivated and results-focused production team. In addition to the fact that MPT presents cost reduction, higher quality and meeting deadlines, its implementation is therefore relevant (MCKONE et al., 2001).

According to Wyrebski (1997), the essence of MPT is that individuals participate in maintenance and assist repairers in the correction of machines, equipment, vehicles, tools, among other instruments and, together, work as an integrated system that seeks economics, where the maintenance produced yields profits.

According to Nakajima (1989), the MPT allows maximum performance and good conditions for using the machine, thus conquering the "Zero Break" or "Zero Failure" of equipment, machines, vehicles and other instruments. Therefore, it represents zero loss of resources, optimizing the production process, with the maximization of machine efficiency.

2.4 Economic and Financial Aspects of MPT

MPT implies autonomous maintenance in which it allows operators to conserve the machine, performing some maintenance tasks and anticipating future problems, thus avoiding unexpected downtime and increasing the cost of inoperative equipment. Therefore, MPT by itself, already presents aspects of economy when predicting the future by predicting failures, performing preventive maintenance and improving the efficiency of the machine (SLACK et al, 2016).

It can be seen that with the introduction of MPT, the number of failures is reduced gradually, with this there is an increase in productivity, improvement of the quality of the machine, greater integration of the subject with the equipment, better working conditions and reduction of accidents (ORTIS, 2004). The opportunity cost is to carry out maintenance training, from operators who deal with the machines on a daily basis, to those responsible for the maintenance department (SLACK et al, 2016).

The authors Slavov et al. (2011, p.12) highlight that Management Accounting integrated with Lean Manufacturing originates Lean Accounting, in which it helps to make wasting time and money difficult. Lean Accounting helps managers to observe failures and errors during the processes, aiming to eliminate or reduce losses, waste and other hidden costs (SLAVOV et al, 2007).

To identify waste from production and, consequently, burden the costs of products and / or services, the Toyota production system methodology - STP or known as lean production (LEAL et al, 2016). In STP, the action of an individual contributes to the production process and helps to increase overall productivity, which avoids storage, defects, waiting time, bottlenecks in production and transportation (SHINGO, 2007).

Thus, there is a reduction in costs by eliminating waste and other waste. Therefore, productivity improvements occur through the organization of processes, such as logistics, technology, innovations, systems and management models (SLAVOV et al, 2011).

In general, MPT presents better cost-benefit, maintenance monitoring, quick search for fault solutions, multidisciplinary workgroup, machine reliability and environmental preservation.

2.5 Environmental Management

Waste is produced in automotive workshops, such as metals, plastic packaging, oil filters, tow, used lubricating oil (JACOBY et al, 2015). Such debris is harmful to biodiversity when not disposed of properly. Therefore, environmental management allows to manage waste reduction, in addition to increasing the competitiveness and social responsibility of an organization (ISO 14001, 2015).

The National Environment Council - CONAMA approved CONAMA Resolution No. 362/2005, which makes the collection, collection and final disposal of used or contaminated lubricating oils mandatory. Since NBR-10004 classifies the lubricating oil used as a hazardous waste, as it is toxic. Therefore, its improper disposal can cause environmental impacts, both on the soil, water and air, in which the combustion of these oils already consumed can produce residual gases harmful to the ecosystem and public health (ABNT, 2005).

The Vehicle Technical Inspection Program was instituted and regulated by Resolution No. 716/2017 of the National Traffic Council - CONTRAN, to verify the controls for the emission of polluting gases and noise. Since this resolution obeys a requirement of CTB law No. 9.503 / 1997, art. 104, in which it determines that motor vehicles make a mandatory inspection in order to be able to drive.

CONTRAN defined, in principle, the date of December 31, 2019, as the deadline for implementation in Brazil, as it is regulated by CONAMA in Resolution No. 418/2009. However, DENATRAN suspended, indefinitely, the resolution that made Vehicle Inspection - ITV mandatory, as published in the Official Gazette - DOU, inpage 156 and Section 1, on April 6, 2018.

If you take into account that there are vehicle owners who do not carry out preventive maintenance on their cars, after instituting mandatory inspection, they will carry out periodic inspections. Whereas passenger vehicles with a capacity of up to seven passengers will need

to carry out inspections every two years, as well as trucks and automobiles for professional use. Buses, cargo vehicles over 57 tons will have annual inspections and school transport cars and motorcycles that transport cargo or passengers will be inspected every six months (CTB, Resolution nº 716/2017, Cap. V, Art. 11, 2017).

In view of this, it may increase the demand for auto repair shops across the country and, consequently, increase sales of parts and components, especially those from trusted brands, since the car must pass the mandatory inspection in order to renew the license. vehicle and obtain the Vehicle Registration and Licensing Certificate - CRLV.

In the city of São Paulo, Empresa Controlar was created, a pioneer and holder of the City Hall's license to carry out Vehicle Inspection. Studies by the Atmospheric Pollution Laboratory of the University of São Paulo reveal that, daily, between 10 and 12 people die in São Paulo because of air pollution (LIMA et al, 2014). According to data from the World Health Organization - WHO, pollution killed 51,820 people in 2016, in Brazil, due to respiratory problems caused by poor atmospheric quality (CETESB, 2018).

One way to reduce the impacts generated by the use of fossil fuel are electric vehicles, which generate almost zero noise and zero pollutant emissions. Therefore, electric automobiles reduce the impacts on human health and have the advantage of not transporting flammable and toxic fuels (CARDOSO, 2018; MAIA, 2018). Although electric cars use renewable and sustainable sources, there are few charging stations in Brazil, the purchase price is still very high and specialized maintenance, in addition to having a very high cost, is also very limited, with the risk of hazards related to the electrical system, especially in the battery (CARDOSO, 2018; MAIA, 2018).

Electric vehicles in Brazil correspond to 2% of licensing (ANFAVEA, 2019). The Brazilian government to stimulate the production and import of this category of vehicles, according to decree nº 9.442 / 2018, reduced the tax on industrialized products - IPI from 25% to a minimum of 7% and a maximum of 20%, but PIS / COFINS of 11.6% and ICMS of 12%, overloading the value of the car.

In general, it is necessary for the workshops to define practices that make it possible to reduce waste, such as the correct separation of these wastes, to properly dispose and treat them, in order to avoid possible environmental impacts and public health, in addition to regular training and updates of new ones. automotive technologies (PAULINO, 2009; GERHARDT et al, 2014).

3 METHODOLOGICAL PROCEDURES

Based on Gil (2002), this research can be classified as descriptive, in which it describes the characteristics of a given population or phenomenon. Bearing in mind, in this study, the intention to present the definitions of preventive, corrective maintenance, MPT and to identify the benefits and advantages aiming at improving productivity, reducing costs and reducing environmental degradation produced by damaged motor vehicle waste.

As for the study's approach, it is qualitative, given the purpose of identifying and analyzing the economy promoted by preventive automotive maintenance, since it is not concerned with numerical relevance, but with detailed observation regarding the perception of a social group or an organization (GERHARDT; SILVEIRA, 2009).

For that, an action research was carried out, in which it requires the active involvement of the researcher and action by the people or groups involved in the

problem (GIL, 2002). This work was carried out in an electric car in the city of Uberlândia, where data were collected in order to verify if preventive maintenance promotes advantages and profitability, from the perspective of the owner of the automotive workshop, since, according to Slack et al (2016, p. 608) preventive maintenance "will be expensive, but will reduce the cost of having to provide maintenance due to failure".

The information was collected during the period of December 2018 and January 2019, which are the months with the highest flows of service provision, being considered a time of high season, motivated mainly by school holidays. Contacts were made, by telephone and Whatsapp, with 20 customers among these months, in order to schedule preventive maintenance. The criteria for selecting customers were based on the two main MPT indicators, which are time and mileage.

In order to better organize the data of the customers' vehicles, spreadsheets were prepared and used, which contained information such as: the name, telephone, address, license plate, make and color of the vehicle, date of the services performed and the technician (s) who answered it. The purpose is to better systematize the information and lower the cost of its application during action research. As an integrative action between the student and the management of the company, it was established that one of the owners of the entity used their time to organize and put into practice the action plans, not needing to hire a person for this purpose, avoiding increasing the operational costs of this procedure. . Therefore, the next topic addresses the analysis of the study results.

4 ANALYSIS OF RESULTS

4.1 Characterization of the Company

The present study was carried out in an auto electrical workshop in the city of Uberlândia in the state of Minas Gerais, being a family company, in which management is carried out by the owners, who have the administrative, financial, people management and commercial functions, in addition to coordinating and performing the services provided. The entity studied has been in the market since 1994 and received an average of 237 monthly visits in 2018.

The company has on its staff two employees in the administrative area and three technicians for the automotive repair area. The company's work activities consist of diagnostic services and engine operation assessment, electronic injection, electronic control unit repair, automotive air conditioning and electrical parts in general, with specialization in embedded electronics.

4.2 Identification of Items with Higher Frequencies of Vehicle Problems

Among the average of 237 monthly vehicle attendances in 2018, it was found that automobiles had one or more electrical problems. Here are the items with the highest frequency of breakdowns during the periods of December / 2018 and January / 2019:

Table 1 - Items with higher frequency of breakdowns

19% with one or more burnt-out headlamps;	4% with the cooling system malfunctioning;
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18% with one or more faulty beacon lamps;	3% with problems in the operation of the plate light;
13% with one or more damaged brake lamps;	3% with alternator belt problems;
9% with damaged or expired battery;	3% with fuel marker problems;
8% with starting problems;	2% with cleaner problems;
7% with one or more damaged reversing lamps;	2% with horn problems;
6% with one or more defective arrow and flashing lamps;	1% with fuel pump problems;
6% with engine operation problems;	1% with problems in embedded electronics (ABS; Air Bag);
6% with alternator problems;	1% with air conditioning problems.

Source: Own authorship

From these data, it is observed that most of the items identified with malfunctions imply the vehicle's lighting system, which is responsible for signaling and making itself visible to pedestrians and other drivers, as to the driver's intention, such as changing lanes, stop the car, see signs, etc. That is, provide good visibility of the road and ensure safety for other traffic users, since the lighting and signaling system is essential for vehicle safety, according to CONTRAN Resolution No. 227 of 02/09/2007.

4.3. Elaboration of the Action Plan

The months of December / 2018 and January / 2019 were the dates chosen to schedule preventive maintenance, as it is considered the high season season, marked by holidays and school and collective holidays. During the period preceding these dates, the last half of November 2018 was used to elaborate and plan the actions to implement a preventive maintenance plan for the vehicles of the studied electric auto customers.

With the use of an electronic spreadsheet, customer information was detailed in detail, such as: the name, telephone number, address, license plate, make and color of the vehicle, date of services performed and the technician (s) who attended it, noted the mileage of each vehicle when the service was performed and the duration of each maintenance. From the organization of this form, it was possible to analyze and structure the revision plans.

Among the 50 customers who were included in the spreadsheet, 20 car owners were contacted in order to explain about preventive maintenance and schedule a time for the review. In which the service consisted of checking items, such as: battery level, conditions of the ignition and injection systems, state of the cooling system, checking the alternator belt, filters and external lights.

4.4 Result of the Action Plan

In relation to the operating costs involved during these two months, there was an average increase of 3.53% in the telephone bill, to call and schedule preventive maintenance with customers and also to give budgets.

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Among 20 clients, six people actually came to carry out the reviews. This little adhesion was due to the lack of time; for presenting little and / or lack of financial resources; for finding preventive maintenance unnecessary and for having recently reviewed it.

With regard to people who performed preventive maintenance, 67% are from companies that depend on vehicles for the use of labor activities, such as product deliveries; corporate travel and; passenger transport. Therefore, entities that depend directly on the fleet for their operational activities, tend to monitor and make periodic reviews, in order to optimize and enhance their productivity and, reduce costs with emergency and unscheduled repairs.

As for the cost of organization and strategic planning to develop this action plan in the electric car, it took about 40 hours of labor from one of the owners to structure in the spreadsheet information about customer data and their vehicles, such as mileage , last services performed and dates of services.

In relation to the preventive revision services provided from the contact actions with customers from this project, it was found that the total cost of parts was R \$ 1,325.55, with the total resale value being 60% above the total cost of parts. The total labor value was R \$ 1,390.00, shown in Table 2, which shows the Cash Flow for preventive maintenance carried out in the months of December / 2018 and January / 2019:

Table 2 - Cash Flow (Preventive Maintenance)

Cash flow			
Appetizer	Dec / 18	Jan / 19	Total
Service and Parts Revenue from contact action for preventive maintenance	R \$ 1,917.00	R \$ 1,680.00	R \$ 3,597.00
Outputs			Total
Parts sales taxes	R \$ 167.16	R \$ 71.44	R \$ 238.60
Taxes on provision of services	R \$ 12.00	R \$ 27.30	R \$ 39.30
Total costs	R \$ 1,073.68	R \$ 602.34	R \$ 1,676.02
Total expenses	R \$ 130.18	R \$ 174.49	R \$ 304.67
Net cash flow	R \$ 533.99	R \$ 804.42	R \$ 1,338.41

Source: Own authorship

The total costs and expenses include the technician's salary, prorated per hour worked on the vehicles, personnel and administrative expenses, such as telephone, card fee.

Table 3 - Investment decision: NPV and IRR

Date	Return
0	-R \$ 341.37
Dec / 18	R \$ 1,917.00
Jan / 19	R \$ 1,680.00

R \$ 1,597.50
R \$ 1,166.67
VP R \$ 2,624.31

i	50.00%
IRR	466.52%

NPV	R \$ 2,324.31
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Source: Own authorship

In the period of December / 2018 and January / 2019 there was no investment in the purchase and updating of diagnostic tools or in the training of technicians to carry out these preventive reviews. Therefore, the investment was configured only by labor and other expenses to prepare the action plan, which, according to Table 3, was R \$ 341.37. In the analyzed months, there was a positive return on this investment, so the action plan is profitable, as it pays for the initial investment. The Internal Rate of Return - TIR above 100%, as shown in Table 2, reinforces the economic efficiency of the project, since this rate is high, as there was no costly investment in the periods analyzed. Thus, as is the case with positive Net Present Value - NPV, which demonstrates a higher return on investment.

With the data obtained, in this work, it is possible to verify whether preventive maintenance increases the contribution margin of the workshop owner, that is, the difference between sales revenues and variable costs.

5. FINAL CONSIDERATIONS

This work aimed to verify the economic feasibility of implementing a preventive maintenance management program in the vehicles of customers of an electrical workshop in the city of Uberlândia, MG. Clients were listed and by telephone contact a contact was made with the aim of guiding customers on the importance of carrying out such maintenance, the reasons for not carrying out and scheduling services for those customers who agreed to carry out the work.

From the action research, it can be seen that preventive automotive maintenance is still not widely practiced by the customers of the analyzed company. According to this study, among the vehicle owners sought to perform the periodic overhaul, only 30% actually performed the overhaul service. And these users expressed that they were satisfied by the workshop's action, in encouraging preventive scheduled maintenance, since many do not control or manage their car repairs.

Furthermore, most people who performed preventive maintenance on the analyzed electric car, work in companies that depend directly on the fleet for their operational activities. Therefore, they tend to monitor and make periodic reviews in order to optimize and enhance the productive process and, reduce costs with emergency and unscheduled repairs, corroborating with the literature researched in this study.

In general, preventive maintenance increases customer satisfaction and, consequently, loyalty. Thus, the entity can obtain financial advantages and be more competitive in the face of competition. As for the financial return, in these analyzed periods of December / 2018 and January / 2019, there was a return of 48% and 60%, respectively. Therefore, it is observed that preventive maintenance increases the entity's profitability.

The limitation of the research was the updating of customer data, little time to put into action the plans and the sample of the action research. Soon, it is suggested for future studies to expand the sample and also the analysis period. Thus, the investment decision could include: purchase of machinery, refresher courses and / or other types of investments that could have occurred in other periods.

It is hoped that the result of this study may contribute to the reflection and debate on the topic for the community in general, regarding the importance of preventive automotive maintenance, among other financial, environmental and public health benefits.

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