Implementation of a Costing System in the Fleet Management of a Brazilian Public University

Wanderley Nascimento Pedroza
Federal University of Amazonas
Brazil

Dércio Luiz Reis
Federal University of Amazonas
Brazil

Abstract

This work presents the implementation of a costing system in Fleet Management at a Brazilian Public University, applying concepts of cost accounting, engineering, indexes, and maintenance management, as well as using the cost absorption method. As a methodology, an action research is applied to meet the objectives of being exploratory and descriptive; about the nature of the research, and applied research is adopted through a case study procedure in a Transport Coordination. To prepare for this work, the operational data of the fleet were collected during 12 months in the different units and internal control systems. The results of the study showed the operating costs of the fleet such as total fuel spent annually, totally spent on maintenance, as well as their respective indices, cost per kilometer, fixed and variable costs sufficient for accountability with the Official Bodies of Control. It was noted that the study applied in this work provided a basis for implementing a Costing System for fleet management of a Brazilian public university, respecting the guidelines of Normative Instruction No. 3, of May 15, 2008, which deals with the use and accountability, even fully complied with the requirements of the regulations regarding the Performance Control and Maintenance Maps of the Official Vehicle in an individualized manner, providing information on operational costing of the fleet sufficient for the decisions of the managers of the Public Institution.

Keywords: Costing Systems, Fleet Management; Maintenance Management;

1. Introduction

In recent years, the country has been going through a series of changes in the economic, financial, and patrimonial scope, adopting more and more resource rationing policies, such as Portaria nº 179, of April 22, 2019, and Portaria e nº 424, of August 21 of the same year, which provide for measures to rationalize expenses and reduce expenses for the financial year in the sphere of the Ministry of Economy, autarchies and related foundations. In view of this scenario, the adoption of effective management tools in Public Administration is of paramount importance to reach the organ's final activities.

It is known that the public administration has perfected its procedures with the intention of minimizing the stagnation arising from the bureaucratic model. The first attempt at administrative reform of the State was proposed by Bresser-Pereira (1995) through the Master Plan for the Reform of the State Apparatus - PDRAE, which for many was considered a landmark for managerial public administration, causing a change in policies of the government. From the introduction of the Plan, a more efficient positioning was adopted, with a focus on results and the accountability of the public manager.

In this context, the scenario of this research will be the Transport Coordination, linked to the City Hall of the University Campus-PCU of a Brazilian Public University, responsible for the management, conservation, document regularization, and maintenance control, in addition to logistical support and other administrative actions. Its performance is important to enable the displacement of people and goods, in support of the final activities of teaching, research, extension, including support for institutional events, as well as providing administrative assistance to the various decentralized units in the interior of the State of Amazonas.

The Management Report (2018-2019) indicates that with the development of logistical activities, the University has its own fleet, consisting of 76 vehicles, distributed in its 6 (six) campuses in light and heavy types. The research will be applied on the Manaus campus of a Federal Institution of Brazilian Education, which annually receives approximately 6 thousand requests for transfers, in addition to transporting, in 2019 alone, some 34 thousand passengers in the most different academic activities of the institution. The research target Campus holds 73.68% of the fleet, considering active and inactive vehicles. The Transport sector team is composed of 5 administrative-technical servers and 21 drivers.

As the main problem, there is a lack of information on the operational costs of the fleet capable of assisting in rendering accounts with the Control and Inspection Bodies, in addition to the non-compliance with Normative Instruction No. 3, of May 15, 2008, which provides for the classification, use, specification, identification, acquisition and disposal of official vehicles. For this reason, it is necessary to adhere to quality control mechanisms and efficient costs in order to avoid waste, negative impacts, and property losses to the Institution.

The general objective will be the implementation of a Costing System for Fleet Management at the University, in order to make efficient decision making by managers within the Institution. The system to be implemented will allow for compliance with Normative Instruction No. 3, of May 15, 2008, regarding the Performance Control and Maintenance Map for the Official Vehicle; Evidence the operating costs of the fleet in 2019; Identify the main vehicles that most consumed the annual budget, in addition to checking those that spent the most on maintenance in addition to checking their respective indexes; show the current situation of the Institution's fleet.

2. Theoretical framework

The theoretical framework will deal with themes on Higher Education Institutions in the context of Brazilian Public Administration; Public Budget, Costing Systems, and Vehicle Maintenance;

2.1 Public Administration and IFES

According to the Federal Constitution of 1988, the Federative Republic of Brazil is formed by the indissoluble union of States and Municipalities and the Federal District, it constitutes the Democratic State of Law, in which all the power emanates from the people, who exercises it through elected representatives or directly. CF itself (1988) brought in its legal framework that the powers of the Union are independent and harmonious with each other, which are called the Legislative, the Executive, and the Judiciary.

In the pursuit of political and administrative activities, the federal authorities need tools to reach the satisfaction of the needs of the population and, in a broad sense, the public administration, in addition to the administrative functions, following the understanding of Alexandrino and Paulo (2018) the public administration prepares public policies through government agencies, establishing government action guidelines and programs, government action plans and public policy setting.

From the point of view of the strict sense, regardless of the power it exercises, Public Administration means the set of state bodies and agents in the exercise of administrative function (MAZZA, 2020).

In this context, Federal Higher Education Institutions appear, as Public Foundations of Indirect Public Administration, which operate in competition with the private sector, linked to the Ministry of Education - MEC. The main characteristics of Public Foundations, for Mazza (2020), are the creation and extinction by a specific law, to hold public services, to have administrative autonomy, own assets, operation funded by Union resources and other sources.

For ANDIFES (2004), the links between the defense of its academic nature and the constant concern with the role of knowledge in the construction of a more just and inclusive society are indissoluble to public institutions, including for the quality of the system and the development of the parents. IFES are opinion makers and knowledge generators, which require their managers to have a reflective, proactive, knowledge, vision, ability to plan, coordinate, control, and evaluate management processes (MIZAEL; VILAS BOAS; PEREIRA; SANTOS, 2013).

2.2 - The Public Budget and Cost Management

The management of costs in the public service is not related to making a profit, as in a private company, however, it is linked to the effectiveness of service to the population, since the public budget is annually marked out and controlled by budget laws: federal law nº. 4,320 / 64, complementary law 101, of May 4, 2000 (tax liability law), bidding law 8,666, of June 21, 1993, in addition to the Federal Constitution itself (1987).

For public expenditure to take effect, according to Law No. 4,320 (1964), it must follow three stages, which are: commitment, settlement, and payment: the first corresponds to an act issued by the competent authority that creates an outstanding payment obligation for the State whether or not to implement the condition; the second is the verification of the right acquired by the creditor and aims to ascertain the regular condition of the good or service provided to the Administration; and the third, consists of the outflow of funds from the entity in favor of the creditor in order to extinguish the obligation, usually by payment orders or credit in the account.

For Nogueira (2017), the cost management must be known by the manager in order to analyze the most accurate scenario to identify the deficit points with the objective of reducing operating expenses.

Directing the search to the operational costs of a fleet, the classification is used in which the administrative costs are incorporated in the fixed costs, without detailing all the components of the costs, however, those adopted in fleet management may be the following:

• Variable Costs: fuels, oils, and lubricants, washing, running, parts and accessories (BULGARI FILHO, 2019; VALENTE, NOVAES, PASSAGLIA, VIEIRA, 2015);

• Fixed Costs: Capital cost, depreciation, driver remuneration, personal expenses, administrative expenses, licensing, and compulsory insurance (BULGARI FILHO, 2019; VALENTE, NOVAES, PASSAGLIA, VIEIRA, 2015).

For Valente, Novaes, Passaglia, and Vieira (2015), several factors can substantially determine costs and their composition, such as the mileage developed by the vehicle, since the cost decreases as the vehicle is used.

Also in accordance with the authors, the type of traffic, the type of road, the region, and the size of the vehicle, as well as the imbalance inflows do system, can be factors of increase or decrease in operating expenses.

2.2 The Public Budget and Cost Management

The management of costs in the public service is not related to making a profit, as in a private company, however, it is linked to the effectiveness of service to the population, since the public budget is annually marked out and controlled by budget laws: federal law nº. 4,320 / 64, complementary law 101, of May 4, 2000 (tax liability law), bidding law 8,666, of June 21, 1993, in addition to the Federal Constitution itself (1987).

For public expenditure to take effect, according to Law No. 4,320 (1964), it must follow three stages, which are: commitment, settlement, and payment: the first corresponds to an act issued by the competent authority that creates an outstanding payment obligation for the State whether or not to implement the condition; the second is the verification of the right acquired by the creditor and aims to ascertain the regular condition of the good or service provided to the Administration; and the third, consists of the outflow of funds from the entity in favor of the creditor in order to extinguish the obligation, usually by payment orders or credit in the account.

For Nogueira (2017), the cost management must be known by the manager in order to analyze the most accurate scenario to identify the deficit points with the objective of reducing operating expenses.

Directing the search to the operational costs of a fleet, the classification is used in which the administrative costs are incorporated in the fixed costs, without detailing all the components of the costs, however, those adopted in fleet management may be the following:

• Variable Costs: fuels, oils, and lubricants, washing, running, parts and accessories (BULGARI FILHO, 2019; VALENTE, NOVAES, PASSAGLIA, VIEIRA, 2015);

• Fixed Costs: Capital cost, depreciation, driver remuneration, personal expenses, administrative expenses, licensing, and compulsory insurance (BULGARI FILHO, 2019; VALENTE, NOVAES, PASSAGLIA, VIEIRA, 2015).

For Valente, Novaes, Passaglia, and Vieira (2015), several factors can substantially determine costs and their composition, such as the mileage developed by the vehicle, since the cost decreases as the vehicle is

used.

Also in accordance with the authors, the type of traffic, the type of road, the region, and the size of the vehicle, as well as the imbalance inflows, can be factors of increase or decrease in operating expenses.

2.3 Costing Systems

The Federal Accounting Council-CFC (2012) understands that a costing system understands how the entity measures different costs, which are appropriated to products or services through costing methods, and can use different units of measurement. The main costing methods are: direct or variable; absorption; by activity; and full.

The method adopted for the elaboration of the system was the absorption costing, which was shown to be the most adequate in the decision-making by the fleet manager, providing reliable information for analysis and optimization of the company's resources.

According to Pereira Filho and Amaral (1998), Absorption Costing can be used for legal and tax requirements, while variable costing can be used to assist the company's management decision process.

2.4 Fleet Management

Considering a key point in the elaboration of this research, there is the concept of Fleet Management, which is not limited to specific software or activity, but also to a set of procedures aligned in order to bring about better vehicle management organization. For Valente et al. (2016), fleet management consists of managing in a more balanced way a set of vehicles belonging to the same division or agency.

For Nogueira (2017), fleet management encompasses several strategic areas of administration with regard to vehicle management, such as an organization's economic, accounting, contractual, and administrative areas. In agreement with Rodrigues et al. (2015), vehicle management through grouped tasks can serve to assess and support decision making by senior management.

According to Valente et al. (2016), the challenges presented in vehicle management are complex and empirical knowledge is often adopted in decision making. According to the authors, there is some resistance and insecurity in changes, since the process has been going on for some time, without significant interruptions. However, there is a lack of tools and computer systems capable of improving management, at affordable costs, in addition to the execution of operations with planning.

2.5 Maintenance

According to the Brazilian Association of Technical Standards - ABNT (1994), maintenance is the combination of all technical and administrative actions aimed at maintaining or replacing the equipment in order to perform a required function, which may even be with the modification equipment.

Corroborating the concept of ABNT (1994), Mirshawka and Olmedo (1993) define maintenance as a set of activities and resources used in systems or equipment to ensure the productivity and safety of operations in order to avoid failures within availability parameters.

It is peaceful, however, the understanding that the maintenance activity improves the performance of the equipment, reduces costs, and increases the useful life of the equipment. Slack, Chambers, and Johnston (2002) list six benefits resulting from it, which are: improved safety, increased reliability, higher quality,

lower operating costs, longer life, higher final value (for resale).

As explained, vehicle maintenance encompasses all types of intervention that can prolong the life of the vehicle/equipment. According to Slack et al. (2002), the main types of maintenance are preventive, corrective, and predictive.

According to Valente et al. (2016), preventive vehicle maintenance is intended to conserve the vehicle by previously preventing it from returning due to breakages. This type of maintenance includes the services of Revision of the electrical system; Mechanical system; Checking of paint, chassis and body shop; Changing and checking the oil level; Review of other essential equipment for the vehicle (NOGUEIRA, 2017).

It is known that the correct preventive maintenance can minimize costs with fleet management, in order to increase the efficiency of the equipment and avoid unnecessary downtime, as well as complex and expensive problems for the organization.

Valente et al. (2016) state that corrective maintenance has the ability to reestablish the functions of the vehicle or the system for which it was designed through the correction, recovery, and restoration of the equipment's productive capacity. Bearing in mind that, according to the author, stopping the machinery can compromise the entire production system.

Reinforcing this idea, Alvarez (2016) states that corrective maintenance occurs, in most cases, at more inopportune moments, such as distant trips or without a cell phone signal for distress calls. This is because the vehicle is used until its failure, resulting in high repair costs, long periods of maintenance time in the workshop, in addition, to directly impacting the organization's logistical efficiency.

Another type of maintenance is predictive, which according to Takahashi and Osada (2015), once implemented, anticipates failures to avoid over-maintenance. It takes place through the control and evaluation analysis of the facilities, making it possible to determine effective remedial measures.

Within the scope of maintenance management, there are numerous indicators for monitoring equipment. However, they need to be well used to obtain effective results. According to Kardec and Nascif (2001), it is unnecessary to use so many non-specific indicators. The authors argue that it is necessary to choose the essential indicators for each specific case, in order to obtain the high performance of the machines.

According to Medeiros, Mendes, and Ferraz (2005) and Souza (2007), performance indicators assist in determining goals and monitoring the results achieved in certain areas. The authors list some important indicators to support the monitoring and maintenance management such as Average Time to Failure - TMPF, Average Time to Repair - TMPR, Average Time between Failures - TMEF, and Operational Availability, which will be addressed in Table 1:

Table 1. Maintenance Indexes.

INDICATOR	INITIALS	DESCRIPTION
Mean Time To Failure	MTTF	According to Medeiros et al. (2005), this metric shows the average time of operation of the system without failures or interruption if the measurement time is taken for each operation until the first defect or failure.
Mean Time To Repair	MTTR	Determines the maintainability of equipment and systems, in addition

		to allowing viewing the time spent for repair actions, it can assist in the control of operational and safety goals: the smaller the number of repairs carried out on equipment, the higher the TMRP, that is, the sustainability of the service (MIRANDA, 2007).
Mean Time Between Failures	MTBF	According to Braniva (2018), it is a metric that reports the reliability of the system. TMEF is the average time that a system/equipment can perform its function without interruption. It is measured from the moment the item starts to work, until its next failure. For Villanueva (2015), the TMEF is the inverse of the failure rate, which determines the reliability of the system/equipment.
Operational Availability	-	Operational Availability can be understood as the fraction of the time that the equipment or system is performing the function, or that is in operating conditions during the determined time interval (ABNT, 1994; MONCHY, 1989; NAGAO, 1998; SOUZA; 2007, VILLANUEVA, 2015).

Source: Prepared by the authors (2020).

Given what is shown in Table 1, it is noted that maintenance indicators are important for equipment control and ensure that the machines are available for use, in safe and operational conditions. However, it is known that in fleet management it is possible to adopt other criteria so that the manager may be able to bring responses to changes and have a clear view of the system's sustainability and effectiveness.

3. Methodology

The methodology adopted in this work is action research. For Silva (2017), action research works on issues of shared interests and involves specific problems of a certain group, in addition to encouraging a process of changes to solve problems of the company or organization.

Regarding the nature of the research, applied research is adopted through a Case Study procedure. To solve the problems found through descriptive and exploratory research, techniques, tools, data, and action plans collected from the Institution's Transport Coordination are used.

To meet the objectives, initially all the supply and maintenance data per vehicle contained in the spreadsheets, requisitions, maintenance system, documents, records and interpretations of the Agency's 2018-2019 Management Report, letters, contracts, notes of commitment available. Then, articles, dissertations, publications at congresses on topics such as fleet management, costing systems, vehicle maintenance costs applied to fleet management were selected.

Consequently, the impacts of the lack of information on the previous rendering of accounts were verified, as well as the inefficiency in decision making by the fleet managers.

4. Elaboration of the Fleet Costing System (Step by step) and Data Capture

After the data collection and analysis stage, it was noted that they were disorganized, therefore, unable to

assist the manager, which would directly impact the detailed cost analysis. Therefore, it was implemented practically and technically, with the aid of the Excel software of the Office package, in addition to the Astah software used for modeling and diagrams, a costing system for fleet management using the absorption method divided into the modules described in Figure 1.

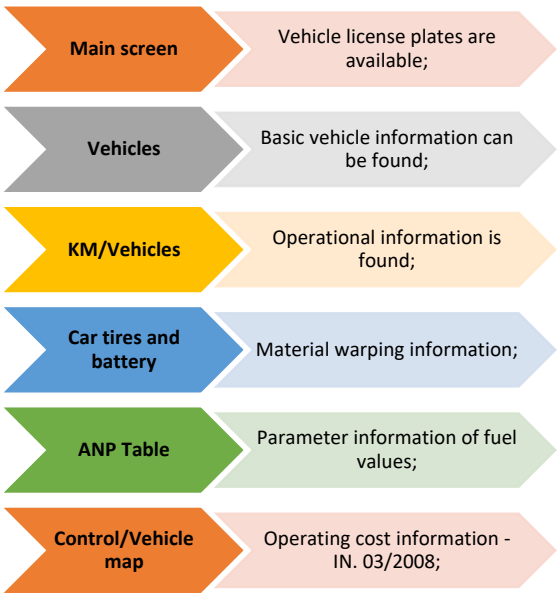

Figure 1 - Modules - Fleet Costing System.

Source: Prepared by the authors (2020).

Main Screen: The main worksheet of the system was called “Menu”, comprising the ranges of A1: K33. In cell "A1", the system header was inserted: "TRANSPORT COORDINATION - UF / MAP OF PERFORMANCE CONTROL AND MAINTENANCE OF OFFICIAL VEHICLES - YEAR". In the remaining cells (A2: K33), all license plates of the fleet vehicles were inserted using the SmartArt tool, as well as the following items at the bottom of the spreadsheet: Vehicles, KM / Vehicles, Unavailable, Tires and Batteries, and ANP Table also using the SmartArt feature of the Office. Thus, we have the initial screen of the system as shown in Figure 2.

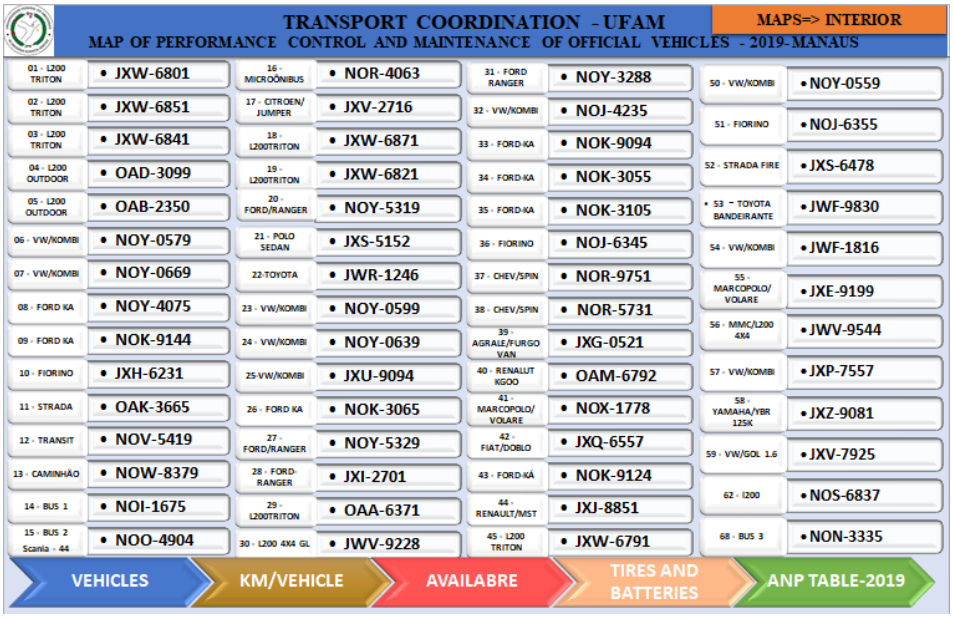

Figure 2 - Home Screen - Fleet Costing System.

Source: Prepared by the authors (2020).

In this initial screen, shown in Figure 2, red sunk vehicles are identified. These vehicles, according to Federal Decree 9.373 / 2018, can no longer be used for the purposes for which they are intended or their recovery is not justified by the market value. Therefore, it is considered that they are within the category unserviceable to the Administration, according to the Arts. 3rd, 6th, and 7th of the said regulation.

"Vehicles" module: In this module, fleet information is distributed in the respective columns (A: S) with the following denominations: Item (Identification Code, Vehicle / Brand, License Plate, Year of Manufacture / Acquisition, Municipality, Fuel (type), Chassis, Renavam, Tipping, Status (Activated or Inactive, Power, Market Value, Tachograph, Issue Date, Tachograph, Date / Expiration; Number of maintenance interventions, Available days and Unavailable days. After setting the information for the module was inserted with the data available in the institution's internal control system.

"KM / Vehicles" module: In this module, all information about the institution's fleet is located. They are the main instrument for decision-making which is most evidently used by absorption costing methods through formulas and applications. By linking the different modules, the power will be provided automatically. As well as the "Vehicle" module, the distribution of information comprises columns (A: X), with the following denominations: Item (Identification Code), Vehicle / Brand, License Plate, Year of Manufacture, KM KM, Fuel Consumption (in liters), KM Rotated (per liter), Total Annual Fuel (R $), Total Annual Maintenance (R $), Total Annual (R $), Average Per KM Annual Rotated, Fuel Tank (liters), Municipality, Age, Group (Category), Lubricating Oil, Lubricating Oil Type, Lubricant Qty / Annual, Tire Dimensions, Annual Tire Qty, Battery Amperage, Annual Battery Qty, Status (Active or Inactive) and, finally, the Observations column. After inserting the aforementioned denominations, they were fed with the data available in the reports of the institution's internal control system, except for the consumption columns that depended on the direct cost values, because, at this stage, there is still no link with the

modules of the plates of vehicles (Control / Vehicle Map).

"Unavailable" Module: This module contains information on vehicles and energy generators not managed by the Transportation Coordination, which is only for control and monitoring purposes since there are expenditures to the institution not linked to the object of the research. They were distributed by the following denominations, each with its module: External Vehicles (agreements), Indoor Units, Energy Generators, UF, PAAV (Annual Vehicle Acquisition Plan), Control Sheets, Generator Sheets. All using Excel's SmartArt feature.

"Car tires and battery" module: In this module, there is a history of the lubricating oil consumption of official UF vehicles, based on legally authorized commitments. To obtain greater control, it was distributed as follows between columns (A: H): Order, Requisition No., License Plate, Vehicle, KM (current), Date (effective exchange), Specification (the same described in the module " KM / Vehicles "), Lubricant, Qty (requested), Responsible Driver.

"ANP Table" module: In this module, the average spent values are available in the table of the National Agency of Petroleum, Natural Gas and Biofuels (ANP). Such amounts were used as a reference by the institution to pay fuel suppliers in 2019 for the campus in Manaus. The following information was collected: Month (NF reference), Gasoline, Diesel, Diesel S10. The values shown in Figure 3 were obtained.

TRANSPORT COORDINATION
ANP TABLE - 2019

ANP TABLE (AVERAGE PRICE) - 2019

MONTH	Gasoline	Common Diesel	Diesel S10
January	R$3,79	R$3,61	R$3,71
February	R$3,88	R$3,53	R$3,65
March	R$4,07	R$3,64	R$3,74
April	R$4,27	R$3,65	R$3,75
May	R$4,12	R$3,71	R$3,83
June	R$4,59	R$3,65	R$3,70
July	R$4,57	R$3,69	R$3,80
August	R$4,08	R$3,68	R$3,78
September	R$4,27	R$3,69	R$3,79
October	R$4,36	R$3,79	R$3,89
November	R$4,55	R$3,78	R$3,88
December	R$4,12	R$3,78	R$3,78

Figure 3 - ANP Table Values in 2019.

Source: Research data (2020).

Module "Control / Vehicle Map": In this module, the individualized structure for each vehicle/license plate was developed based on the data needs requested by Normative Instruction No. 3, of May 15, 2008, and annexes. All bases collected in the Annex to the standard were stratified in this module.

Continuing the elaboration of this module, after renaming the spreadsheet with the individual code plus the license plate, such as, for example, 01_UFS-0001, the part of the graphical analysis of supplies was created in cells A52: N62 (see Figure 4), using Excel's own graphical tool with KM as the parameter per liter consumed (column N). Then, the spreadsheet was fed with the supply data authorized in the requisitions and registered in the columns (A63: N63). In this step, the following nomenclatures

presented in this order were used: Supply Qty (Numeral Order of Supply); Date, Time, Driver, Coupon Code (unique request-id), Liters Qty, KM-Current, KM-Previous, KM Difference, Fuel Type; Value per Liter, KM / Liters, Total Fuel in $, Annual depreciation. After elaborating and inserting the data, we have Figure 4.

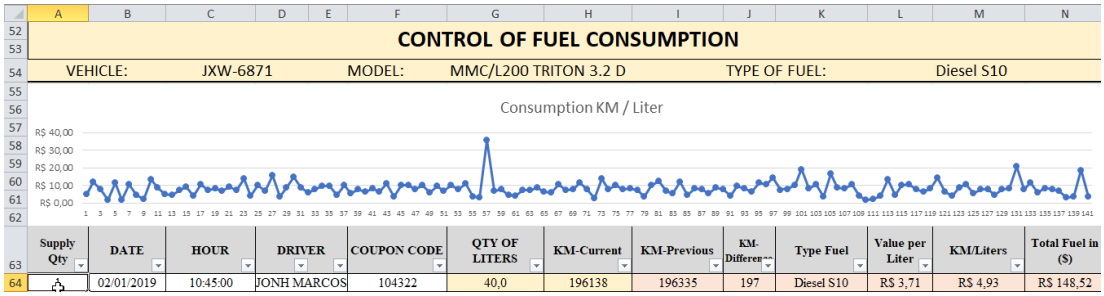

Figure 4 - Graph - Control of Fuel Consumption.

Source: Prepared by the authors (2020).

Given the above until the elaboration of this stage, it is necessary to prepare the formulas, obeying the financial techniques of apportioning the method by absorbing costs, which automatically link the various information between the modules. Table 2 shows the schedule, line “64”, as an example for registering the first supply record.

Table 2 - Formulas - Control / Vehicle Map Module.

DESCRIPTION	LOCATION LINE 64 (COLUMN)	FORMULA / EXPLANATION	USER ACCESS LEVEL
"Supply Qty (order of supply)	A	Number format	Free
Date	B	Short date format	Free
Hour	C	Text format	Free
Driver	D-E	Formato em texto	Free
Coupon code (Unique supply identification)	F	Number format	Free
Qty of Liters	G	Number format	Free
KM-Current	H	Number format	Free
KM-Previous	I	= supply_posterior_line Example: = H65 (1st supply)	Restrict with password, as

			the update is automatic.
KM difference	J	= IF (AND(H64 <> 0; I64 = 0); 0; I64-H64) Description: If the values of cell H are different from zero and the value of I is equal to zero, the value shown will be null. Otherwise, the value displayed in J will be the mileage traveled by the vehicle with the last refueling.	Restrict with password, as the update is automatic.
Type Fuel	K	= IF(F64 <> 0; $ M $ 54,0) Description: If the values of cell F are different from zero, it means that a fuel request was released; therefore, the system will recognize the type of fuel located in cell M54 (the same located in cell G8).	Restrict with password, as the update is automatic.
Value per Liter	L	= IF (K64 <> 0; INDEX (TABLE_ANP; MONTH (B64) +1; IF (K64 = "Gasoline"; 2; IF (K64 = "Diesel"; 3; 4))); "") Description: If the values of cell K are different from zero, it means that fuel has been released; therefore, the system filters by the month entered in “B” and searches for the respective fuel value registered in the “ANP Table Module”,.	Restrict with password, as the update is automatic.
KM / Liters	M	= IF(J64 <> 0; J64 / G64; "") Description: If the values of cell “J” are different from zero, it means that there was mileage covered; therefore, the system calculates the amount traveled in KM (J) per liter supplied (G).	Restrict with password, as the update is automatic.
Total Fuel in ($)	N	= IF(J64 <> 0; L64 * G64; "") Description: If the values of cell “J” are different from zero, it means that there was mileage covered; therefore, the fuel value (L) is multiplied by the quantity of liters supplied (G).	Restrict with password, as the update is automatic.

Source: Prepared by the authors (2020).

From this stage, after replicating the formulas elaborated in Table 2 for the subsequent lines (of Line 65), as well as filling in the information contained in the supply requisitions (columns A: H), it is already possible to view the information graphic shown in Figure 4. In this way, it was possible to connect this information from Table 2 to the "Control / Vehicle Map" module and also as it allowed to elaborate table 3.

Table 3 - Formulas - Control / Vehicle Map Module.

CELL ADDRESS	FORMULA	EXPLANATION
Line 5 – F5	-	Vehicle code described in the "Vehicle module".
Line 6 – (A6-E6)	=VLOOKUP($F$5;VEHICLES!A2:Q78;2;1)	The system searches, using the unique vehicle code in F5, for the information "BRAND / TYPE MODEL" in the "Vehicles" module.
Line 6 – (G6)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;7;0)	The system searches, using the unique vehicle code in F5, for the "COLOR" information in the "Vehicles" module.
Line 6 – (J6)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;4;0)	The system searches, through the unique vehicle code in F5, for the information "YEAR OF MANUFACTURING" in the module "Vehicles".
Line 12 – (A12-C12)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;3;0)	The system searches, using the unique vehicle code in F5, for the information "CURRENT PLATE" in the "Vehicles" module.
Line 12 – (D12-E12) Line 12 – (J12)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;9;0)	The system searches, using the unique vehicle code in F5, for the "UF" information on the "Vehicles" module plate.
Line 12 – (F12-I12)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;8;0)	The system searches, through the unique vehicle code in F5, for the information "LOCATION-MUNICIPALITY" in the module "Vehicles".

Line (14-15) (A14:D15)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;12;0)	The system searches, through the unique vehicle code in F5, for the information "CHASSIS" in the "Vehicles" module.
Line (14-15) (E14:F15)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;16;0)	The system searches, using the unique vehicle code in F5, for the information "CV" in the "Vehicles" module.
Line (14-15) (G14:I15)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;17;0)	The system searches, using the unique vehicle code in F5, for the information “MARKET VALUE” in the “Vehicles” module.
Line (14-15) (J14:K15)	=VLOOKUP($F$5;VEHICLES!$A$2:$Q$78;13;0)	The system searches, using the unique vehicle code in F5, for the information “CODE. RENAVAN ”in the“ Vehicles ”module.

Source: Prepared by the authors (2020).

From the formulas elaborated in Table 3, it is possible to establish the header pattern of the Control Map and the linking of the “Vehicles” modules with the “Control Map” module. And considering that the formulas in Tables 2 and 3 have the correct applicability, a connection is created with the consumption information per vehicle, which occurred in the manner obtained in Table 4.

Table 4 - Formulas - Control / Vehicle Map Module.

CELL ADDRESS	FORMULA	EXPLANATION
Month (A21)	-	Standard date format.
Km traveled per month (B21)	=SUMIFS($J$63:$J$214;$B$63:$B$214;">="&A21;$B$63:$B$214;"<="&EOMONTH(A21;0))	This formula - applied to the absorption costing concepts - causes the sum of the effective mileage to be automatically rotated, taking as a parameter the month in which the supply was made.
Fuel consumption (C21)	=SUMIFS($G$63:$G$214;$B$63:$B$214;">="&A21;$B$63:$B$214;"<="&EOMONTH(A21;0))	This formula - applied to the absorption costing concepts - makes the sum of the quantity in a liter of the fuel supplied automatically, taking as a parameter the month in which the supply was made.

KM rotated per liter (D21: E21)	=IF(B21<>0;B21/C21;0)	This formula - applied to the absorption cost concepts - calculates the mileage per liter of fuel per month. If there is no information registered, the cell phone is reset.
Fuel ($) (F21)	=SUMIFS($N$63:$N$214;$B$63:$B$214;">="&A21;$B$63:$B$214;"<="&EOMONTH(A21;0))	This formula - applied to the absorption costing concepts - makes the sum of the amounts spent on fuel automatically, taking as a parameter the month in which the supply was made.
Maintenance/ Conservation (G21)	-	Feed via the Link Card Maintenance system manually.
Mechanical repair (H21)	-	Feed via the Link Card Maintenance system manually.
Total Sum (R $) (I21)	=SUM(F21:H21)	This formula sums total monthly operating expenses per vehicle.
Average per km traveled (R $) (J21: K21)	=IF(B21>0;I21/B21;I21)	This formula calculates the average per kilometer traveled per month if there is mileage traveled during the month; otherwise, the amount will be the total monthly operating cost.

Source: Prepared by the authors (2020).

Table 4 is taken as an applied example for recording the first month of the year (January). However, the respective formulas must be replicated in the following cells (other months) until completing the information on the official vehicle performance and maintenance Control Map shown in Figure 3.

After the elaboration of the costing system modules is completed, the connection between the modules is made through the References and Hyperlinks resources of the Office package.

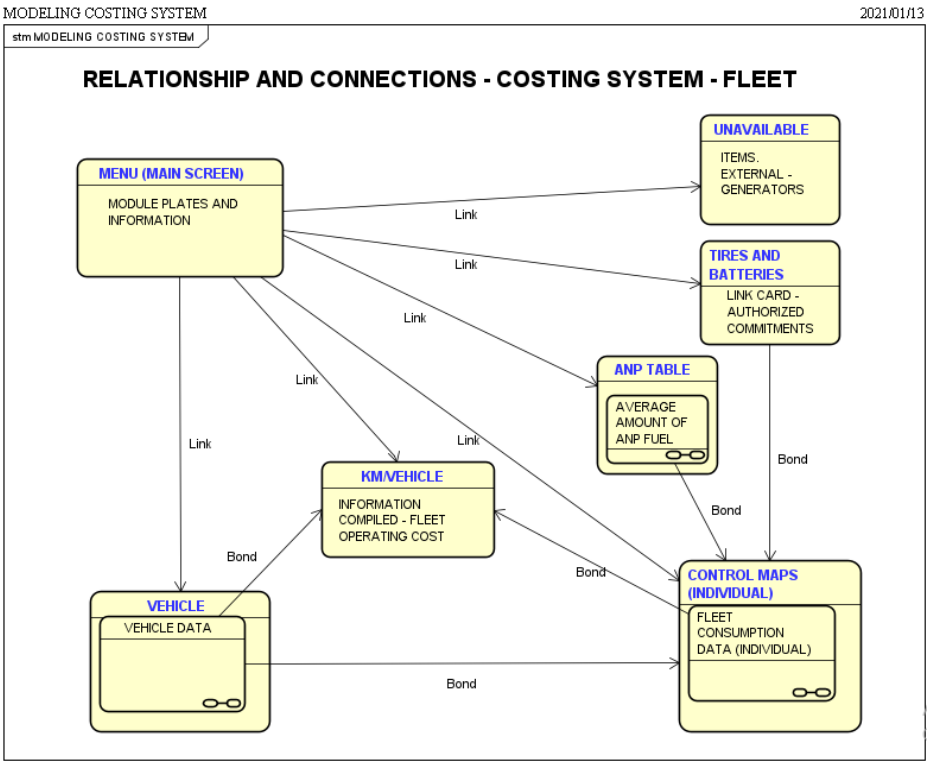

Figure 5 - Basic Modeling of the Costing System.

Source: Elaborated by the authors (2020).

In Figure 5, with the aid of the Astah modeling tool, the relationship diagram of the costing system modules was created, showing the links and links between the screens. Note that the MENU module (Main Screen) has connections to all screens in the system and that the other screens communicate by sharing information.

Continuing with the implementation of the system, the linking and sharing of information from each of the "CONTROL MAP" modules with "KM / VEHICLE" is done using the formulas presented in Table 5 in "KM / VEHICLE.

Table 5 - Formulas and Links between the Control Map Modules with "KM / Vehicle".

DESCRIPTION - LOCATION	FORMULA	EXPLANATION
A3: Item	-	-
B3: Vehicle / Brand	-	-
C3: Plate	-	-
D3: Year of Manufacture	-	-
E3: KM rotated	='1_JXW-6801'!B34	Links the information in cell B34 of the "CONTROL MAP" of the vehicle code "1" in this cell.

F3: Fuel consumption per liter	='1_JXW-6801'!C34	Links the information in cell C34 of the "CONTROL MAP" of the vehicle code "1" in this cell.
G3: KM rotated per liter	=IF(E3<>0;'1_JXW-6801'!D34;0)	Links the information in cell D34 of the "CONTROL MAP" of the vehicle code "1" in this cell, if the value of cell E3 is not null.
H3: Total - annual fuel (R $)	=IF(F3<>0;'1_JXW-6801'!F34;0)	Links the information in cell F34 of the "CONTROL MAP" of the vehicle code "1" in this cell, if the value of cell F3 is not null.
I3: Total - annual with maintenance (R $)	=IF(D3<>0;'1_JXW-6801'!G34;0)	Links the information in cell G34 of the "CONTROL MAP" of the vehicle code "1" in this cell, if the value of cell D3 is not null.
J3: Total - annual (R $)	='1_JXW-6801'!I34	Links the information in cell I34 of the "CONTROL MAP" of the vehicle code "1" in this cell.
K3: Average per km driven	=IF(E3<>0;'1_JXW-6801'!J34;0)	Links the information in cell J34 of the "CONTROL MAP" of the vehicle code "1" in this cell, if the value of cell E3 is not null.

Source: Prepared by the authors (2020).

Table 5 and Figure 6 show the registration of formulas for the first vehicle registered in the "KM / VEHICLE" module. However, the procedure carried out as other posterior cells was replicated following the same parameters in Table 5, changing only the license plate corresponding to the vehicle in the "CONTROL MAP" module.

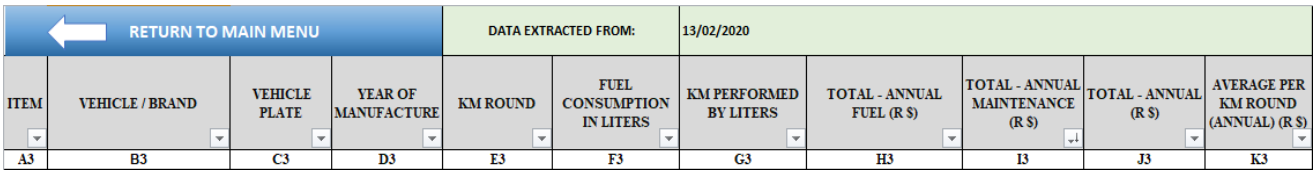

Figure 6 - "KM / VEHICLE" module.

Source: Elaborated by the authors (2020).

Finally, all the vehicle data of the institution's fleet in its last modules were elaborated and registered, as well as all the fueled and maintenance purchased were recorded, the cost accounting concepts were

evaluated in the formulas and there is a Costing System using the method by absorption, prorating the direct costs individually by vehicle and fully operational to the Transport Coordination of this Public University.

5. Analysis and Results.

This research proposed the implementation of a Costing System to comply with Normative Instruction No. 3, of May 15, 2008, annex II, relating to the Performance Control and Maintenance of the Official Vehicle License of the Brazilian Public University efficiently, as well as how to make up for the lack of information on fleet operating costs. Applied to the universe of 73.68% of vehicles located at the campus headquarters in the city of Manaus / AM, it generated the following results described in Table 6:

With the implementation of the application developed in Excel, it was possible to generate strategic information about the fleet (see Table 7), in addition to the operational information seen in Tables 2 and 4;

Table 6 - Strategic results of the application of the costing system.

GENERATED INFORMATION	DESCRIPTION	LOCATION – MODULE
TOTAL - ANNUAL FUEL	The annual sum of amounts spent on debts; stratified by vehicle;	Column “H” - Module “KM per vehicle”.
TOTAL - ANNUAL MAINTENANCE	The annual sum of amounts spent on maintenance; stratified by vehicle;	Column “I” - Module “KM per vehicle”.
DEPRECIATION - FIXED COST	Based on the depreciation rate applied to the value of the vehicle, excluding the Residual Value; the criterion adopted was 10 years for heavy vehicles (buses, micro, truck, and tractors) and 5 years for light vehicles.	Column "L" - Module "Vehicle".
LICENSING - FEES AND INSURANCE - FIXED COST	Value registered according to the network by the Traffic Agency;	Column "M" - Module "Vehicle".
TOTAL - ANNUAL (R $) - VARIABLE COST	The annual sum of amounts with expenses and maintenance;	Column “H” - Module “KM per vehicle”.

Source: Elaborated by the authors (2020).

To analyze the biggest consumers of the maintenance budget (more than 50%), and after inserting the data available in the IFE Transport sector in the "Vehicles" module, maintenance indexes were obtained for each of the vehicles that were in this cost category, using the concepts applied in Table 1 to calculate the indices.

Table 7- Application of Maintenance Indexes.

VEHICLES	QTY OF INTERVENTIONS	AVAILABLE DAYS	DAYS - IN MAINTENANCE	MTTR	MTBF	OPERATIONAL AVAILABILITY
BUS 1	16	246	119	7	15	67,4%
BUS 2	12	260	106	9	22	71,1%
MICRO-BUS 1	13	324	42	3	25	88,6%
MICRO-BUS 2	15	335	30	2	22	91,8%
BUS 3	3	350	15	5	117	95,9%
VAN-JUMPER	11	330	36	3	30	90,3%
PICAPE 1	10	301	64	6	30	82,5%
PICAPE 2	16	336	29	2	21	92,1%
PICAPE 3	21	295	70	3	14	80,8%
VAN	6	284	81	14	47	77,8%

Source: Elaborated by the authors (2020).

According to Table 7, it is noted that the heavy vehicles of the bus models 1 and 2 were the least available, with high rates of MTTR and low MTBF, indicating that the vehicle ran for a few days and was returning to the workshop with mechanical problems. Besides, it has an availability index below 70%, resulting in system idleness and excessive maintenance expenses. The maxim that every fleet manager needs to know has been ratified: the more the vehicle is in use, the lower its cost per kilometer, which directly impacts logistical activities and the effectiveness of service to the University's academic community.

6. Final Considerations

The concern with effectiveness in Public Administration should be the focus of every manager in conducting the budget. Therefore, one of the necessary tools to guide them in the best decisions, according to legality, is to know the control data of the managed business; after all, what is not controlled cannot be improved. In this work, it was concluded, efficiently, and free of cost, how to implement a costing system for fleet management of a Public University using tools and software that are easy to handle.

This research, which had as the main objective the implementation of a Costing System for fleet management of a public university, followed the guidelines of Normative Instruction No. 3, of May 15, 2008. It was found, at the end of the system, the full compliance with the requirements of the regulations regarding the Performance Control and Maintenance Maps for the Official Vehicle in an individualized manner, among other information on costing the fleet.

In addition, this costing system showed the actual situation in which the fleet was in the period under analysis, as it provided reliable information to managers, to be used in the institution's strategic planning, as well as in the formulation of fleet management policies. It was also possible to plan and establish studies for the implementation of fuel management and maintenance software more suitable for

management.

As noted, the System provided support to accountability to the Control Bodies, to decision making by fleet managers and to Senior Management, identified the individualized costs per vehicle, in addition to showing the situation of the fleet, including evidencing the advantages of the indexes of the system's operability. It is important to highlight that this research was applied to fleet management of a public University, however, the system proposed here can be adapted according to the reality of a specific fleet (up to 100 vehicles), just making the necessary adjustments, once that the information requested by IN 03/2008 applies to any fleet management, whether public or private.

This work was limited to the elaboration of a technical and comprehensive way of a costing system for the fleet that any manager, or user with basic knowledge in the tools proposed here, can reproduce and use in daily operations without major investments in robust software. or database, since the elaboration of this research practically did not demand financial costs. It can even be developed using free software, such as LibreOffice Calc. Furthermore, as a point of improvement, a real-time web application could be created to collect this information, using the parameters adopted in this system.

As a suggestion for future studies, this application based on this fleet system may be shared with the other campuses of the Educational Institution, in order to identify vehicles that are not usable to the University or those that need to be relocated among the campuses due to idleness based on maintenance indexes. Another point to study would be the stratification of the main fleet maintenance problems on all campuses.

Given the above, it is believed that the research objectives have been achieved and, in addition to the benefits already listed, one can note the concern with the Accountability of the public service through transparency in the use of public resources and more accountability clear and efficient way to society.

7. References

ABNT (1994). Associação Brasileira de Normas Técnicas, NBR 5462: Confiabilidade e mantenabilidade. Rio de Janeiro.

ALEXANDRINO, Marcelo; PAULO, Vicente. **Resumo de Direito Constitucional Descomplicado**.12. ed. São Paulo: Método, 2018

ALVAREZ, E. R. **Estudo utilizando o portal da transparência como meio de consubstanciar as informações para modelo de implantação do pilar Manutenção planejada em uma frota de veículos militares**. Dissertação (Mestrado em Engenharia de Produção) – Universidade Federal do Amazonas, Manaus, 2016.

ANDIFES. **Reforma Universitária**: proposta da ANDIFES para a reestruturação da educação superior no Brasil. Disponível em: http://www.andifes.org.br/categoria/documentos/reforma-universitaria/documentos-sobre-reforma-universitaria. Acessado em 15 de março de 2020,

BRANCO, L. **Gestão de Frotas**. Curso Militar em Administração. Amadora, Lisboa: 2008.

BRANIVA, Indústria Mecânica. **Tempo Médio Entre Falhas** – MTBF - 2018. Disponível em: https://www.manutencaoesuprimentos.com.br/tempo-medio-entre-falhas-mtbf/. Acesso em: 12 fev. 2020.

BRESSER-PEREIRA, Luiz Carlos. Da administração pública burocrática à gerencial. **Revista do Serviço Público**, v. 47 n.1, jan./abr. 1996.

BULGARI FILHO, Armando. **Gestão de Frota de veículos**. Material de ensino do Instituto Esafi. Foz do Iguaçu-PR, 2019.

CANAN, Ivan. Escolhas na construção de sistemas de custeio: estudos de caso. Revista **Ambiente Contábil** - Universidade Federal do Rio Grande do Norte; ISSN 2176-9036; v. 9. n. 2, jul./dez. 2017. Disponível em: http://www.periodicos.ufrn.br/ambiente. Acesso em: 22 jan. de 2020.

CONSTITUIÇÃO FEDERAL - CF. SEÇÃO II- DOS ORÇAMENTOS. Disponível em: http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm. Acesso em fev. 2020.

DECRETO Nº 9.373, DE 11 DE MAIO DE 2018. Dispõe sobre a alienação, a cessão, a transferência, a destinação e a disposição final ambientalmente adequadas de bens móveis no âmbito da administração pública federal direta, autárquica e fundacional. Disponível em: http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2018/Decreto/D9373.htm. Acesso em mar. 2020.

INSTRUÇÃO NORMATIVA Nº 3, DE 15 DE MAIO DE 2008. Dispõe sobre a classificação, utilização, especificação, identificação, aquisição e alienação de veículos oficiais e dá outras providências. Disponível em: https://www.comprasgovernamentais.gov.br/index.php/legislacao/instrucoes-normativas/413-instrucao-normativa-n-3-de-15-de-maio-de-2008. Acessado em jan. 2020.

LEI FEDERAL N.º 4.320, DE 17 DE MARÇO DE 1964. Estatui Normas Gerais de Direito Financeiro para elaboração e controle dos orçamentos e balanços da União, dos Estados, dos Municípios e do Distrito Federal. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/l4320.htm. Acesso em fev. 2020.

LEI N.º 8.666, DE 21 DE JUNHO DE 1993. Normas para licitações e contratos da Administração Pública e dá outras providências. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/l8666cons.htm. Acesso em fev. 2020.

LEI COMPLEMENTAR Nº 101, DE 4 DE MAIO DE 2000. Estabelece normas de finanças públicas voltadas para a responsabilidade na gestão fiscal e dá outras providências. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/lcp/lcp101.htm. Acesso em fev. 2020.

LINK CARD, Sistema Link Benefícios. Disponível em: https://www.linkbeneficios.com.br/Link/Index#about. Acesso em: 27 abril de 2020.

KARDEC, Alan; XAVIER, Júlio Nascif. **Manutenção** – Função Estratégica. Rio de Janeiro: Qualitymark, 2001.

MASCARELO, Kauane; PFÜLLER, Ernane E.; FEDERIZZI, Roberta B. Gestão de custos: o método ABC em uma indústria de fibras. Revista **Gesto,** v.5, n.2, jul./dez.2017.

MAZZA, Alexandre. **Manual do Direito Administrativo**.10. ed. São Paulo: Saraiva Educação, 2020.

MEDEIROS, F. W. A.; MENDES, M.; FERRAZ, S. Contratação por Performance para Serviços de Manutenção Industrial. In: CONGRESSO BRASILEIRO DE MANUTENÇÃO, 20, 2005, Belo Horizonte. **Anais**.

Ministério da Educação – MEC. MEC lança programa para aumentar a autonomia financeira de universidades e institutos. Disponível em: http://portal.mec.gov.br/component/content/index.php?option=com_content&view=article&id=78211:mec-lanca-programa-para-aumentar-a-autonomia-financeira-de-universidades-e-institutos&catid=212&Itemid=86. Acesso em: 25 jan. 2020.

MIRANDA, Marco M. **Indicadores de desempenho da manutenção**. Pós-Graduação Lato Sensu, Engenharia de Manutenção, ICAP, 2007.

MIRSHAWKA, Victor; OLMEDO, Napoleão Lupes. **Manutenção** – Combate aos custos da não eficácia – A vez do Brasil. São Paulo: Makron Books do Brasil, 1993.

MIZAEL, G. A.; VILAS BOAS, A.A.; PEREIRA, J. R.; SANTOS, T. S. Análise do Plano de Desenvolvimento Institucional das universidades federais do Consórcio Sul-Sudeste de Minas Gerais. **Revista de Administração Pública**, v.47, n. 5, p. 1145-1164, 2013.

NOGUEIRA, D. P. B. **Análise da viabilidade econômica para a terceirização de frotas**: Estudo de caso na Universidade Federal do Amazonas (UFAM). Dissertação (Mestrado em Engenharia de Produção) – Universidade Federal do Amazonas, Manaus, 2017.

MONCHY, F. **A Função Manutenção**: Formação para a Gerência Manutenção Industrial. São Paulo: Editora Ebras/Durban, 1989.

NAGAO, Sérgio Kimimassa. **Manutenção industrial**: análise, diagnóstico e propostas de melhoria de performance em indústrias de processo. Dissertação de Mestrado, EPUSP, São Paulo, 1998.

CONSELHO FEDERAL DE CONTABILIDADE (CFC). **Normas brasileiras de contabilidade**: contabilidade aplicada ao setor público: NBCs T 16.1 a 16.11. Brasília: Conselho Federal de Contabilidade, 2012.

PALUDO, Augustinho. **Administração Pública**. 3. ed – Rio de Janeiro: Elsevier, 2013.

PEREIRA FILHO, A. D.; AMARAL, H. F. A Contabilidade de Custos como Instrumento de Informação Gerencial: um enfoque no sistema de custeio ABC. **Contabilidade Vista e Revista**, Belo Horizonte, 1998.

PORTARIA Nº 179, DE 22 DE ABRIL DE 2019. Dispõe sobre medidas de racionalização do gasto público nas contratações para aquisição de bens e prestação de serviços. Disponível em: http://www.in.gov.br/en/web/dou/-/portaria-n%C2%BA-179-de-22-de-abril-de-2019-*--84797395. Acessado em jan. 2020.

PORTARIA Nº 424, DE 21 DE AGOSTO DE 2019. Dispõe sobre medidas de racionalização de gastos e redução de despesas para o exercício de 2019 no âmbito do Ministério da Economia, autarquias e fundações vinculadas. Disponível em: http://www.in.gov.br/en/web/dou/-/portaria-n-424-de-21-de-agosto-de-2019-211914320. Acessado em jan. 2020.

RODRIGUES, E. C. C.; BRANDÃO, M. G. S.; SILVA, R. B. Análise da gestão de frotas da Câmara Legislativa do Distrito Federal. In: 20º CONGRESSO BRASILEIRO DE TRANSPORTE, 2015, Santos-SP: ANTP, 2015. Disponível em: <http://www.antp.org.br/biblioteca>. Acessado em 27 de jan. de 2020;

SILVA, Jean Machado Maciel da. **Máquina de prensar cerdas para jovens e adultos com síndrome de down**: um estudo de caso. 2017. 119 f. Dissertação (Mestrado em Engenharia de Produção) - Universidade Federal do Amazonas, Manaus, 2017.

SOUZA, Valdir Cardoso de. **Organização e gerência da manutenção**: planejamento, programação e controle da manutenção. 2.ed. São Paulo: All Print Editora, 2007.

SLACK, N.; CHAMBERS, S.; JOHNSTON, R. **Administração da Produção** [Book]. 2. ed. São Paulo: Atlas, 2002.

TAKAHASHI, Yoshikazu; OSADA, Takahashi. **TPM / MPT - Manutenção Produtiva Total**. Tradução: Outras Palavras. São Paulo: IMAN, 2015.

VALENTE, A. M.; PASSAGLIA, E.; NOVAES, A. G.; VIEIRA, H. **Gerenciamento de Transportes e Frotas**. 3. ed. rev. São Paulo: Cengage Learning, 2016;

VILLANUEVA, Marina Miranda. **A importância da manutenção preventiva para o bom desempenho da edificação**. Rio de Janeiro: UFRJ / Escola Politécnica, 2015.