RESEARCH ARTICLE OPEN ACCESS

Appropriation of Logistics Costs in Pipelines and Terminals: A case study in the Brazilian oil industry

Andrey Pimentel Aleluia Freitas[1], João Alberto Neves dos Santos[2], Joaquim Teixeira Netto[3], Luciana Silva Fonseca[4], Nylvandir Liberato Fernandes de Oliveira[5]

1 - PhD Researcher at Department of Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil.
2 - PhD Teacher at Department of Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil. Email: joaoalbertoneves@gmail.com
3 - PhD Researcher at Department of Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil.
4 – Master´s Degree at Department of Postgraduate in Production Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil
5 - PhD Researcher at Department Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil.
Corresponding Author: Andrey Pimentel Aleluia Freitas

ABSTRACT
In Brazil, the accounting of transportation costs and the movement of oil and its derivatives is carried out between Petrobras and its subsidiaries under two contract forms: tariffs and operation-maintenance. In the tariff agreement, the subsidiary uses its facilities and operation-maintenance, it is responsible for the operation-maintenance of the contractor's facilities. The costs of these operations are accounted for apportioned and allocated to only two cost centers: oil and oil products. This paper aims to present a methodology for an accounting of logistics costs that contemplate the operations in each unit, identifying the efficiency of each process. Through the analysis of data in the budget and logistics areas, it was verified the possibility of accounting by specific cost centers, defined for each type of product moved (oil or derivatives) in each terminal, involved in tariff contracts, besides to change the measurement of fare contracts, prepare the cost center structure, adjust the allocation cycles to the new method, and update the internal order master data according to their new structures. As a result, the managers of each production unit are expected to contribute by providing a clearer and more objective view of costs.
Keywords – Cost Accounting, Logistics Costs, Oil Transportation and Handling.

Date Of Submission: 07-08-2019 Date Of Acceptance: 23-08-2019

I. INTRODUCTION

With increasing competitiveness in domestic and international markets, the accuracy of cost control makes it highly relevant for decision making. In this context, Cost Accounting has changed, in recent decades, from merely assisting in the assessment of global inventories and profits to important management control and decision tool. [1].

Petrobras is a publicly held corporation whose majority shareholder is the Brazilian government. The company operates in the exploration and production, refining, marketing and transportation of oil and natural gas, petrochemical, derivatives distribution, electricity, biofuels and, recently, renewable energy sources.

The handling and transportation activities are carried out by about 300 subsidiaries, affiliated and controlled companies that make up the company's distribution system, with Petrobras S.A as the controller of the entire logistics network of this system.

Transpetro is the logistics operator of the Petrobras System. It has over 14,000 kilometers of oil and gas pipelines, 49 terminals and 53 oil tankers with the challenge of bringing the fuel that drives the economy to different parts of Brazil. For this reason, logistics costs are of great relevance to the logistics operations of the Petrobras system.

Costs for the movement of oil and oil products through pipelines are governed by two contract models: tariff contracts (leased terminals) and operation-maintenance contracts. In tariff

agreements, Transpetro owns the facilities and provides services to Petrobras and interested third parties. In operation-maintenance (O&M) contracts, which include its facilities, Transpetro operates as a service provider contracted to operate and maintain the facilities, but, except for labor, all expenses are the responsibility of Petrobras itself.

Currently, the appropriation of costs for accounting for tariff contracts does not meet the purpose of the supply area, as costs are not allocated at the terminals where the operations are performed but are presented by apportionment to two generic cost centers characterized by general operations associated with oil and derivatives.

Given the context presented, the purpose of this paper is to analyze the current form of accounting for tariff contracts and to propose a methodology that accounts for costs clearly and specifically, helping the managers of each unit to identify their actual levels of efficiency in their respective — operating processes.

Expenses on tariff agreements between Petrobras and Transpetro represent about 25% of total manageable operating expenses in the supply area, accounting for more than a third of the organization's total logistics expenses.

Cost accounting helps to detail cost-related data so that management can have greater control over its operations and future projections and contribute information that allows management to allocate resources to the most efficient and profitable areas of the operation. Thus, the difficulty of accurately assessing the cost and therefore, the profitability of delivery points can hide pricing deformities and profit margin improvement opportunities [2].

The method used considers only two cost centers for the movement of oil and oil products, not considering the volume of operations in each terminal. Through an applied approach, we sought to answer the following questions:

Q1: Does this method of cost appropriation make management efficiency analyzes possible by comparing the costs calculated and the volume of movements made in the different terminals?

Q2: Does this method allow you to identify the cost of delivering products to a terminal, contributing to profitability analysis of other delivery points?

The method proposed by this research aims to replace the current form, proposing the creation and use of specific cost centers for each type of product moved (oil or derivatives) in each terminal, encompassing all tariff contracts. Thus, this new structure will value the accurate measurement of tariff contracts and the update of the register of internal service orders.

II. LITERATURE REVIEW

2.1 Cost Systems

Cost management in large organizations requires an information base that enables them to control, analyze and make decisions quickly and properly. However, for the process to proceed, the information provided by the deployed cost system must be reliable and appropriate to the proposed objectives.

It is essential that the cost system is supported by a consistent and robust conceptual method, scaled for its purpose and endowed with criteria that enable data processing to ensure the production of information to effectively assist in decision-making processes. and control.

Nowadays, cost information is becoming important for companies in various sectors due to various factors such as economic globalization, increased competition, advancement of information technology, economic stability and falling inflation, open markets between countries and blocs. economic differences and increasing the distance between owners and managers [3].

Departmentalization aims at the distortion caused by apportionment, dividing the company into different areas according to the activities developed in each of these areas. Decree-Law No. 200/1967 determines the need for cost information, which should be explained by accounting to highlight the costs of services, how they appear in management results, ascertain their importance for decision making and improvement. public management assessment [3].

Anything that you want to measure the cost or that needs a separate cost measure is a cost object. Thus, a cost object can be vendor, product line, department, project, business process, or set of activities that are performed [4].

The Federal Accounting Council - CFC uses the definition of costs relating to them as expenses with goods or services applied in the production of other goods or services. These expenses are like the expenditure of an asset, or the creation of a liability to generate a product or service, with the disbursement as payment resulting from the acquisition of that good or service and the investment as the expenses taken to the assets due to their useful life, with all assets and acquired rights recorded therein [3].

Some costs can be directly related to the products, just having a consumption measure as a reference. However, others do not offer such measurement conditions, requiring allocations made on an estimated basis. Therefore, the classification of costs by object is related to the product made and not to the production or departments of a company.

Costs are object-driven and can be classified as direct or indirect. Direct costs are all

values for resources that can be allocated clearly and specifically for a product segment. By establishing a direct link to the process, this type of cost allows you to measure your participation in the product. Indirect costs, where it is not possible to identify and objectively allocate the amounts and resources used to the products or operating activities. Thus, they need distribution criteria, proportionally based on numeric or percentage. Regarding the product, they are indirectly linked because they are generic and not specific.

Also, regarding absorption costing, all direct and indirect costs are allocated to products. Absorption costing assumes that the cause of costs is a function of the volume of operations generated. In this logic, direct costs are appropriated directly to individualized processes, while indirect costs are apportioned according to certain bases. The regular behavior of costs over a period may indicate a lack of gain and knowledge in the execution of the cost control routine [6, 7].

One of the fundamental elements for costing is the existence of a costing and control system. The costing of activities or processes is necessary for the existence of accounting control, through the organization and systematization of costs, with the recording of expenses by sector or service [4].

2.1.1 Absorption costing

It consists of settling all costs (fixed or variable) in the production results in each period. All non-production related expenses, also known as non-manufacturing expenses (expenses) will be excluded. From then on, the distinction in absorption costing will be under the focus of costs and expenses.

Absorption costing is characterized by the appropriation of variable and fixed costs. Thus, it is said as absorption because in addition to variable costs, the product also absorbs fixed costs [3].

In the case of full absorption costing, in addition to all production costs that are considered, administration and sales costs are also associated with the products. From the perspective of full absorption costing, the cost of a given product should include all efforts directed by the company, not only production efforts, but also those of administration, logistics and marketing of these products [3].

2.1.2 Cost Centers

A cost center is an accounting unit that is no longer as interesting as an element. Communication centers are classified by type of organization, by location, by responsibilities. Moreover, it can be defined as an operating unit represented by men and machines of characteristics develop similar activities within the same area [3, 8]. As for their purpose, the transport centers are classified as support and production. Cost centers are related to product manufacturing or execution of activities. Support is a support that supports production cost centers, which occur through the provision of a service flow [9].

In the absorption costing process, five stages must be followed: the separation of costs into items; the division of the organization into cost center; the allocation of costs element to element to centers; the placement of costs from support centers to the centers in which the services are provided; and, finally, allocation of production centers to products. They stand out as the latest recent stages and guide the entire process of absorption costing, in a didactic and easy to understand.

2.1.3 Assessment Criteria

The use of apportionment criteria is indispensable for overhead costs as well as to settle costs to centers and later to products. Such criteria will always carry subjective concepts of costing, but in some cases may be questioned as well as quite acceptable and in other situations may be established because there are no better alternatives [3].

2.2 Logistic Cost Management

Logistics is currently a crucial area of companies' competitive competitiveness, an important tool to ensure the success of their processes and good results of operations and finance. It is essentially a guidance and planning framework that seeks to create a unique plan for the flow of information and products throughout a business [10].

Logistics operations are the same as costs related to its activities. In a long-term environment, the maintenance of customers, lost profits and the permanence of the company in the market are subject to higher costs [11].

Costs in Brasil is a difference in variables that impact products in comparison to other countries, making them less competitive as well as abroad. These variables include infrastructure, logistics, tax burden and high-interest rate [12]. Thus, the concept of Cost in Brasil may agree with national companies, when compared with companies from other countries. The main problems are tax burden, bureaucracy, informal economy, monetary policy, legislative slowness, judicial slowness, lack of a quality education system, absence of sectoral policies, inefficiency and poor infrastructure [13].

The weakening of the economy generates negative situations for companies, in their new actions directed at logistics, innovation in the management processes of new technologies [14].

In a straightforward and narrow way, logistic variables are associated with the main problems in Brazil. These variables include poor transport infrastructure; high operating cost; absence of a network of distribution centers; absence of frequent routes of major modes; and especially misaligned state legislation [15, 16].

Fig 1 shows the composition of the logistics costs percentages about the GDP result in the 2004-2012 period.

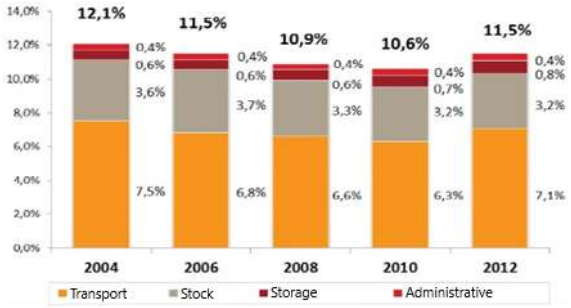

Fig. 1: – Percentage of logistics costs in relation to GDP result (2004-2012) [14].

The tax cost in Brazil is an extremely impacting factor in the economic development of the country. It represented 35.42% of Gross Domestic Product - GDP of 2014. This value represents the tax burden related to goods handling operations, which include ISS for service providers, as well as ICMS, PIS, COFINS, IRPJ and which add costs to transport of cargo and transported goods [18].

Infrastructure is the fundamental point for logistics efficiency and the heating of the national economy. Transportation costs are the most impacted, among the logistics costs, due to the low level of infrastructure presented for all modes. This is due to the mistaken political strategies adopted decades ago that weakened cabotage and rail modalities, prioritizing the road modal, to meet growing demand from the installation of the automobile industry [19, 20, 21].

2.3Logistic Structure of Oil Derivative Distribution in Brazil

Existing distribution network planning problems arise in defining and specifying the structure of the products following their destination. This definition involves identifying and determining the facilities that should be properly appropriated [22].

The Oil Industry encompasses all activities related to exploration, development, production, refining, processing, transportation, importation, the exportation of oil, natural gas, other hydrocarbons and their derivatives. Its transportation structure encompasses this set of processes and has a subdivision into three major groups: Upstream, Midstream and Downstream [23].

Upstream are all processes related to oil and natural gas, from exploration to production. The midstream covers the refining, transportation (import and export) processes of oil, natural gas and their derivatives. Downstream is the logistics phase of all processes. It includes the acquisition, transportation, storage, distribution and marketing.

The oil transportation network accounts for all the displacement of products from productive areas to their refineries. It also covers the distribution of refining of derived products to consumer markets. The most widely used means of transport by the oil industry are oil tankers, pipelines and maritime terminals.

Pipelines are classified into oil pipelines (liquid transport) and gas pipelines (gas transportation) which in turn are divided into terrestrial (built on land) or submarine (built on the seabed). Oil pipelines carry petroleum and alcohol derivatives. Oil tankers carry gases, oil and its derivatives, as well as chemicals. Shipment of cargo from ships to shore or vice versa is done through maritime terminals [23].

A refinery is an industrial facility that manufactures finished products from petroleum, unfinished oils, natural gas liquids, other hydrocarbons and alcohol. The purpose of the storage terminals is to enable the movement of oil and its derivatives and comprises the set of facilities used for the receipt, dispatch and storage of petroleum industry products that can be classified into maritime, lake, river or land [23].

The terminals are extremely important especially in the internalization of products for the Midwest, North and Northeast regions. As these regions have very low or nonexistent production of petroleum products, the arrival of products can only be made possible through the terminals. In the case of product imports, maritime terminals represent the entry point for derivatives in Brazil.

The distribution base is an installation that aims to facilitate the receipt of fuels for storage, mixing, packaging and distribution to the market. The distribution bases are the fuel distribution centers, which store the distributors' products. There are two types of bases and their distinction is defined from the point of origin of the product. If the source of service is a Refinery or terminal, the base will be primary, if this supply is from a Distributor Primary Base, the base will be secondary.

Primary Bases are located near direct supply sources (refineries or terminals). The Secondary Bases have the function to serve the markets farthest from the offer points, aiming at reducing costs.

Oil from land or maritime production fields is transported to refineries mainly by pipelines. In the case of imports, they are unloaded at sea terminals and then transferred to refineries through pipelines.

For long distances, transport is primarily done by ships, as they have lower costs. While for small and medium distances, priority is given to the use of oil and gas pipelines, as they present greater safety and economy of large volumes of oil, derivatives and natural gas.

The use of oil tankers increases economies of scale in the transportation process because they can transport large volumes over long distances. This view has caused the size of oil tankers to increase over time, precisely in order to achieve this economy of scale and lower costs.

In addition to the economy of scale, opting for this system means removing hundreds of trucks from circulation, reducing fuel consumption and relieving heavy vehicle traffic on the highways, not to mention the environmental benefits of reducing toxic gas emissions.

For short-haul transportation, the best costs are in using pipeline modal. However, setting up a pipeline structure is quite costly. The diameter of the pipeline is directly related to the cost-efficiency of the network, because of the larger the pipe diameter, the lower the transportation costs. It is important to note that spending on the construction of large-capacity pipelines requires labor resources and facilities like the construction of mesh with small transport capacity [23].

In the processes of distribution and resale of derivatives, as they are activities that present lower investment risks throughout the oil production chain, they still present high values.

III. RESEARCH METHOD

The research strategy used was the case study, which comprises a comprehensive method, with the logic of data planning, collection and analysis. It may include a single case, or multiple case studies, as well as quantitative and qualitative research approaches. It is usually organized by a small number of questions concerning the conduct and motivation of the research [24].

In this work, empirical research was made with the analysis of a single case, restricted to the Logistics area of Petrobras Refining and Natural Gas Directorate. The data were obtained from the documentary analysis of internal reports prepared by the workgroups constituted by the Budget, Performance Evaluation, Logistics and Refining of Supply areas, besides the Information Technology area, which cooperated with the project operationalization through the changes made to the corporate ERP (SAP R3). Also, corporate intranet reports and information analyzes were performed, unstructured interviews were conducted, and SAP / ERP reports were withdrawn with cost center and internal order descriptions and information.

The results were structured in three parts. It began with the presentation of the Logistics area and its most relevant characteristics related to the object of study. In the second part, the method used for accounting for logistics costs by tariff contract and its limitations were discussed. Moreover, in the third part, we presented the new method implemented to account for these costs with their impacts.

IV. RESEARCH RESULTS

4.1 Logistics Segment Characteristics

The Refining and Natural Gas Directorate - RGN emerged in 2017 from the merger of the Supply and Natural Gas and Energy areas. With the unification of the two boards, RGN now has the functions of managing the energy business in an integrated manner, including the operation of the thermoelectric units and the commercialization of energy, optimizing profitability and reducing costs and losses, as well as ensuring the management. Downstream operation between industrial processes and consumer markets, maximizing product mix profitability and minimizing costs and losses, except for Natural Gas logistics. This business area is structured into six organizational units called Executive Management: Integrated Asset Management, Industrial, Natural Gas, Energy, Marketing and Marketing and Logistics.

The Integrated Asset Management Executive Management is responsible for conducting integrated actions for tactical and technical-operational planning and for controlling and evaluating the performance of operating units, managing holdings, for evaluating, structuring and developing programs and projects. or in partnerships, aiming at the realization of the Business Plan and Management of the Refining and Natural Gas Business Area.

The Industrial Executive Management is responsible for the planning, management, organization and implementation of policies, strategies and guidelines in an integrated manner in the Industrial area, including management of Operations Units (refineries, fertilizer factories and shale processing units), with the objective of optimizing the production process in order to guarantee the highest added value to the products and the best profitability for Petrobras. Process management of subsidiaries that own refining, petrochemical or gas-chemical assets (overseas refineries, petrochemical complexes, fertilizer plants) is also part of this segment.

The Natural Gas Executive Management is responsible for the processing, logistics and

commercialization of Petrobras' liquefied natural gas (LNG) and natural gas, ensuring optimal supply and profitability to the Company.

The Energy Executive Management is responsible for managing the energy business in an integrated manner, including the operation of thermoelectric units and the trading of energy, optimizing profitability and reducing costs and losses.

The Marketing and Marketing Executive Management is responsible for planning, executing and evaluating the marketing and marketing activities of oil and its derivatives, biofuels and petrochemicals. It comprises the trading of light products, petroleum and industrial products, specialty products, bunker products, petrochemicals and chemical gas, traded by Petrobras SA and Petrobras companies abroad, including the management of trading interests and distribution and marketing businesses in the country. Abroad, setting prices and developing products and services based on customer needs to ensure that production is placed on the market, either in-house or through imports.

The Logistics Executive Management is responsible for ensuring integrated management of the Downstream operation between industrial processes and consumer markets, maximizing product mix profitability and minimizing costs and losses, except for Natural Gas logistics.

The scope of this study is related to the logistics costs involving pipelines and terminals for the movement of oil and oil products. Thus, among the areas mentioned above, two were directly involved with the development of the work: Logistics and Integrated Asset Management, through the performance of the Performance Evaluation and Budget management.

Logistics Executive Management is divided into six general managements: RTC Operational Planning, RTC Scheduling, Transportation and Storage, Operational Management Support, Logistics Operations Efficiency and Reliability, and Pipelines and Terminals. In turn, the general manager is subdivided into two other managements: Land Terminals and Oil Pipelines and Waterway Terminals.

The logistics segment operates in the transportation and storage of oil, derivatives, biofuel and natural gas through the subsidiary Petrobras Transporte S.A. - Transpetro. It operates a network of more than 30,000 km of oil and gas pipelines, own or chartered oil tankers and onshore and waterway terminals where products are stored before going to refineries or being exported. Terminals and pipelines are used for storage and distribution of petroleum and derivatives. In the way that the oil goes from the well to the station, a network of pipelines and terminals is used that make the oil reach the refineries and help in the flow of production.

In 2010, the Supply value chain was prepared and approved, an area that after the restructuring of 2016 was renamed RTC (Refining, Transport and Marketing). Its goal was to translate strategic aspirations into processes to be performed daily, enabling the improvement of process-oriented management, developing the foundations for increased internal integration and with the rest of the company. It complements the vision of functional management by aligning objectives and addressing interfaces to optimize overall results. [25].

This view is called level zero and presents the most consolidated level of Supply processes. The work in the value chain continued in 2011 with the detailing of the level 1 processes, where the supply chain business macro processes were established. Thus, the detailing of level 1 processes attributed six macro processes to the Logistics segment, as follows:

• Receiving, Transporting and Storing Oil: execution of movements and storage of oil to relieve the production of the platforms, receiving third parties with a focus on service to industrial plants or taking advantage of complimentary opportunity, seeking compliance with the agreed ranges and quality, maximizing the operational efficiency by optimizing assets and meeting HSE guidelines;

• Delivering Oil to the Foreign Market: operationalization of the delivery of oil to customers in compliance with the commercial contract;

• Delivering Oil to the Domestic Market: operationalization of product delivery to customers in compliance with the commercial contract;

• Receiving, Transporting and Storing Derivatives, Biofuels and Others: execution of movements and storage to receive E&P (Exploration and Production) derivatives, from suppliers focused on customer service, internal transfers or taking advantage of offshore opportunities, seeking compliance with agreed ranges and quality, maximizing operational efficiency by optimizing assets and meeting SMS guidelines. Derivatives are first-generation fuels, lubricants, solvents, petrochemical and petrochemical inputs.

• Delivering Derivatives, Biofuels and Others to the Foreign Market: operationalization of the delivery of derivatives to clients in the foreign market in compliance with the commercial agreement. Derivatives are first-generation fuels, lubricants, solvents, petrochemical and petrochemical inputs.

• Delivering Derivatives, Biofuels and Others in the Domestic Market: operationalization of the delivery of derivatives to clients in the domestic market in compliance with the commercial agreement.

Derivatives are first-generation fuels, lubricants, solvents, petrochemical and petrochemical inputs.
Given this, there is a concern with maximizing the operational efficiency in the transportation and storage of oil and derivatives, which includes the appropriation of the costs of these activities that contributes to profitability analysis of the terminals involved in this movement.

4.2 Cost Appropriation at Petrobras

In October 2004, SAP Brazil's SAP R/3 software went live throughout Petrobras in one of the largest deployments of an integrated management system in the world. SAP ERP is an Integrated Management System whose characteristic is the integration of different performance modules into a single database. The system is divided into 12 integrated modules. Corporate accounting is represented by the FI module, while management accounting is dealt with in the CO module. Because it deals with cost accounting, the Controlling (CO) module is the basis used for the analyzes proposed in this paper. The CO module uses cost elements and costs objects to settle costs.

Cost elements are existing codes in the CO module through which the nature of expenditures is recognized. Cost objects are the instruments in the various system modules for receiving journal entries and accruing expenses. The CO cost objects contained in the system are cost centers, internal order, production order, maintenance order, and WBS element. Cost centers and orders have characteristics that make them central to this work.

4.3 Cost Centers

Cost centers are objects that accumulate expenses of an operation unit or administrative area, identifying where they were incurred and enabling the planning, realization and control of expenses. Cost centers represent the organizational structure of the company. Its training structure identifies the responsible (who), the activity (where) and the unit (where) of the expenditure, through a hierarchy that relates them to the existing managers in the organization chart. The code structure has ten positions, categorized according to the compositions presented in Fig. 2.

A	**L**	**4**	**7**	**A**	**D**	**M**	**B**	**0**	**0**
1		**2**		**3**			**4**		

Fig. 2: Cost center code.

1) the 1st and 2nd positions of cost centers identify the Business Unit (Operations, Services or Corporate Unit) related to an area of the Company.
2) the 3rd and 4th positions are sequential codes that identify the hierarchy in the system. They may represent management or lower levels, such as coordination or other detailing within management.
3) the 5th, 6th and 7th positions are the Activity codes. Its purpose is to identify the set of tasks or production processes where resources are consumed. In this work we highlight the use of three activity codes: EAC, DMD and DMP. The EAC code covers a series of pipelines and terminals, without specifying to which processes they belong and represent 109 cost centers. The code DMD is related to the activity of movement of derivatives in pipelines and terminals. The DMP code is related to the oil movement activity in pipelines and terminals.
4) The 8th, 9th and 10th positions are unit codes that aim to identify the set of physical facilities where resources are consumed.

4.4 Orders

Orders are cost collectors that are used to further detail spending when only using cost centers is not efficient. It is often used as an intermediate cost collector and as an aid in the necessary planning, supervision and control processes. At the end of the process, the costs collected are settled to one or more receivers through the settlement process.

Orders can be classified by their category as Internal Order, CO Production Order, Product Cost Collector, PP Production Order, Network Diagram, and Service and Maintenance Order. They can also be classified according to the type of order, whose coding consists of 4 alphanumeric digits, serving to identify the process and operation in which the order is to be used and how expenses will be passed on and settled. Table 4 exemplifies this classification.

For the sake of simplicity only the Internal Order type Z031 and the CO Production Order Type ZLOG used in this work will be addressed.

Internal Order (OI) is a cost collector, usually temporary, used to detail certain events. Being subdivided into OI Statistics and Real OI. In statistical internal orders the expense is recorded simultaneously in the order (statistically) and the cost center responsible for the expense. Thus, there is no settlement of statistical internal orders because the actual posting takes place on another cost object. Actual Internal Orders are used to temporarily collect expenses and distribute them to cost objects (Cost Center, Order, WBS and Profitability Report) or G / L accounts in the monthly closing process through apportionment or settlement. Figures 5 and 6 further exemplify this process.

Thus, as explained above, we used the actual internal order type Z031 which is responsible for tracking budgeted and realized expenses in shipping logistics which after the settlement is

settled to a cost adjustment account (G / L account).).

CO Production Orders are cost objects that collect production-related expenditures, with the purpose of totaling the cost of products and entering and leaving materials in inventory through the movement record. It works as follows: After creation, if applicable, you enter manually the planned costs as you have no production planning. Then the order must be released to receive the actual costs. They receive the costs related to production, whether direct (raw material and input) and indirect (by pointing activities or apportionments: all costs that pass through the production cost centers and production support).

The residual costs for orders are settled at the end of the production process to a material account or a cost adjustment account (G/L account). Fig. 3 shows the processes.

Category	**Type**	**NAME**
Internal order (controlling)	Z003	PB Statistical training
	Z019	PB Computer services
Production order co	ZCOM	Energy co-buy production
	ZENE	Energy and steam production
Product cost collector	RMFF	Fagen repetitive production
	RPFF	Unexpected stop production
Pp production order	PP04	Assembly order
	PRAS	Asphalt production
Network diagram	ZPS1	PS - Network diagram (investments)
	ZPS4	PS - Eva jva network diagram
Service and maintenanc e order	ZM01	Maintenance order
	ZM04	Restoration order

Fig. 3: Order classification examples.

Thus, CO Production Order type ZLOG is used to collect costs related to logistics for pipeline and ship transportation.

4.5 Contract Models

In its commercial relationship with Transpetro, Petrobras establishes three contracting modalities for pipelines and terminals: leasing, payment of fees and rendering of services (O&M).

The lease agreements include facilities related to Petrobras' transportation pipelines, transfer pipelines and waterway terminals.

Tariff agreements are entered into for the transportation and movement of products in pipelines and terminals leased by Petrobras to Transpetro, where fees are charged for the movement and transportation of these products, as shown.

The service agreement consists of the contracting of operation and maintenance services at the pipeline, pipeline and terminal facilities and natural gas processing that covers assets that are operated by Transpetro and which are not included in the lease agreements.

4.6 Current Logistic Accounting Method

The land and waterway pipeline and terminal tariff agreement between Petrobras and Transpetro represent approximately 1/3 of Logistics' total manageable operating expenses, thus making it relevant to the segment.

In general terms, the tariff that Transpetro charges from Petrobras consider the type of service provided (transportation or movement), the type of product (oil, light, dark and LPG), the means of movement or transportation (long pipeline, short pipeline or terminal) plus taxes (ISS and ICMS). For the calculation of the transportation fare, the origin and destination of the cargo are considered. For the calculation of the terminal handling fee, only the destination of the cargo is considered. Thus, the value of the tariff per volume moved or transported (R$/$m^3$) is reached. The tables with these rates are available on the company's website [26].

The current accounting model groups all fee contract expenditures into only two totalizing cost centers: one for pipeline and terminal oil movement - AL00DMPB00; and another for handling derivatives in pipelines and terminals - AL00DMDB00.

At the beginning of each month, Transpetro forwards the billing reports to the Petrobras Logistics area, so that the appropriate conferences and measurements for the previous month can be made. The charges are grouped by tax type (ISS and ICMS) and types of services provided, based on the movements of BDEMQ - Stock, Movement and Quality Database. BDEMQ is a corporate system that provides inventory, movement and product quality information.

The services charged by Transpetro can be grouped into two types:

• Warehousing and Ports: In this case, the ISS is charged and opened per Petrobras delivery point at SAP (SAP PB Branch) and merchandise category.

• Transportation: In this case, ISS and ICMS are charged, and ICMS is opened by Petrobras origin

and destination point in SAP (SAP PB Branch) and merchandise category.

The responsible Logistics department checks the billing report with the volumes moved in BDEMQ. Subsequently, the launches are made one by one, according to the opening sent by Transpetro in the two totalizing cost centers of oil and derivatives.

For each of the cost centers, there is an associated apportionment cycle which aims to pass their costs to expense through internal orders Z031 (in the case of derivatives) or stock through production orders ZLOG (in the case of oil).

BDEMQ makes a periodic selection of material documents of type Z01 (system code for pipeline movement) and Z02 (system code for reversal of Z01), thereby obtaining the quantity that is to be distributed by the program. The duct information is obtained from these material documents.

The product generated by the program is the updating of the receivers' quotas (internal or production orders) and the execution of the mentioned apportionment cycles, that is, only based on the volume moved, settling in the EAC type cost centers of the pipelines and terminals.

Resuming the question whether the current settlement model in only two totalizing cost centers and later the execution of the allocation cycles based only on volume moved enables management analyzes of cost productivity, to compare the cost of moving derivatives between terminals. Moreover, allowing the cost of the product to be identified at a point of delivery, the answer is No.

The current model does not consider the differentiation of tariffs charged by Transpetro, wherelow-turnover terminals have more representative storage tariffs, for example, and that in the volume-only apportionment cycle this detail is not considered. This factor often takes to a division by cost center, after apportionment, inconsistent with what is charged by Transpetro.

Another relevant issue is that EAC cost centers are not suitable for controlling operating expenses because they are settled as a "lease cost" and the activity is classified as non-operating. Therefore, for expenditures to be correctly allocated to inventory or selling expenses, and not to be mixed with these "lease costs," cost centers must have activity code DMD and DMP.

4.7 New Logistic Accounting Method

The new logistic accounting method proposes to replace current cost centers with cost centers for each type of product moved (Oil or Derivatives) in the terminals included in the tariff agreement. Thus, within each terminal, there may be up to two cost centers in addition to the EAC, which will direct to ZLOG if Oil, and Z031 to the other products, with no need to change cost elements.

The proposed solution to enable the method involves creating at least one additional cost center for each terminal, with activity code DMD / DMP, according to the product moved in the terminal. Thus, expenses related to the property (depreciation) and related to lease revenue are separated from operating expenses related to the rendering of services.

In the development of this new method some work fronts were carried out in order to create these new cost centers for each terminal and to redefine the posting and costing rules. Below is a breakdown of the activities performed by these work fronts:

• Change tariff contract measurement by automating purchase order creation, entry sheet and tariff contract measurement with Transpetro.

• Prepare cost center structure, linking current EAC cost centers to new profit centers; creating the new DMP and DMD activity cost centers, linked to the new profit centers; preparing the assignment of cost centers to internal refinery orders and from there to the unit output.

• Implement the apportionment rule for product movements. The movement is recorded by BDEMQ through codes that determine the type of movement.

Regarding the apportionment cycle, some points of attention should be observed and treated in different ways. In some terminals there is no billing point (cost pushed), in other cases, the logistics center is a terminal and in other cases the logistics center is an Operating Unit (OU), in the refinery.

For terminals where there is no billing point (pushed cost), the outgoing movements considered are those of type Z01 (only where this terminal originates). In this case, the system must identify the movements configured for this type, coming from the terminal, ascertaining the quantities, products and destinations.

From this, it will be possible to apply the apportionment percentages based on the corresponding volumes and values to allocate them to the respective target oil and derivatives cost centers, according to what each received. This way, the cost of the origin terminal will be zeroed by having its costs apportioned to the destinations, that is, the costs determined in this terminal will be allocated in the CO (Z031 and ZLOG) production orders of the destination terminals. Fig. 4 shows an example of a terminal where cost is pushed.

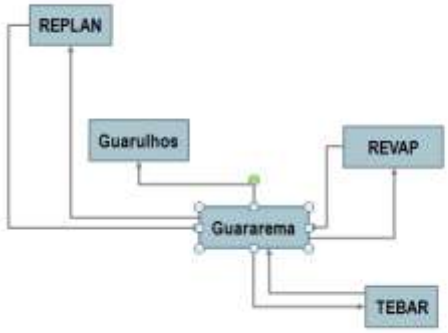

Fig. 4: Terminal without billing.

When the logistics center is a terminal, the output movements considered are those of type 601, Z21, 962, ZF1, 942, 952, Z67 (only where the origin is this terminal) and Z01 (only where the origin is this terminal). In this case, the solution should identify the movements configured for this type, coming from the terminal, ascertaining the quantities and products. This will allow you to apply the volume-based apportionment percentages to the amounts allocated in the oil and by-products cost centers, allowing you to obtain costs per product and terminal. That is, the costs determined will be allocated to the CO production orders (Z031 and ZLOG) of the terminal itself, except for outbound movements of type Z67 where the destination logistics center and product are associated with a business area outside of RTC. In this case, the costs should be pushed to the CO production order of the destination. Fig. 5 outlines the movements of a terminal.

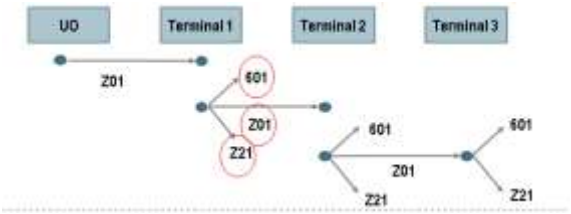

Fig. 5: Example of terminal movements as a logistics center.

When the logistics center is the Operational Unit (OU), inbound movements Z01 (only where the destination is that OU), Z67 (only where the destination is a non-RTC business center) are considered. The solution should identify the movements configured for this type, where the destination is this OU, regardless of the logistics center of origin, ascertaining the quantities and products. This will allow you to apply the volume-based apportionment percentages to the amounts allocated in the oil and derivatives cost centers, allowing you to obtain costs per product and OU. That is, the costs determined will be allocated to the CO's production orders CO (Z031 and ZLOG), except for outbound movements of type Z67 where the destination logistics center and the product are associated with a business area outside the RTC. Fig. 6 shows the flow of an OU.

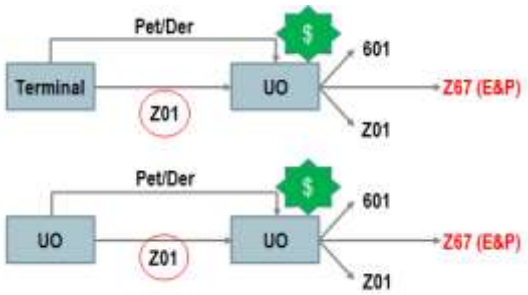

Fig. 6: Example of OU movements as a logistics center.

• Adjust the allocation of internal and production orders to update the register of orders type Z031 and ZLOG, so that oil and oil cost center postings are allocated to their respective orders since this is already the best value. when the actual tariffs of the sections handled are considered.

To synthesize the new method of appropriation of logistics costs, a flowchart was assembled with the information described above. Fig. 7 presents the flow developed and the main activities performed in each step.

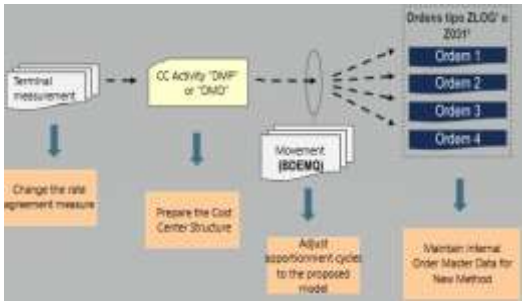

Fig. 7: Overview of the new method of settlement of the tariff contract logistic costs.

V. CONCLUSIONS

The land and waterway pipeline and terminal tariff agreement between Petrobras and Transpetro are of considerable relevance, given that 1/3 of the manageable operating expenses of Petrobras' RTC - Refining, Transport and Marketing segment is related to this model of contract.

Therefore, it is important that these costs are appropriated to provide a better analysis of profitability and productivity, so that it is possible to identify, for example, the cost of moving derivatives between terminals or the cost of delivering products in a terminal.

As has been seen, the proposed method links the current EAC cost centers, as well as the DMP and DMD activity cost centers, to the new profit centers; preparing the assignment of cost centers to the internal refinery and terminal orders and from there to unit output. When entering Transpetro's measurement report data, directly at the destination cost center, linking tariff and volume moved, to the specificities of each delivery point, answers the question raised, which aimed to present a new method that would allow the identification the cost of delivering products to a particular terminal, enabling management analyzes of productivity and profitability.

Linked to this objective, the segregation of property-related (depreciation) and lease-related expenses from operating expenses related to the provision of services provides better management of the costs and demands of each terminal.

Another point to consider is the case of terminals where there is no billing. With the new method, there is no apportionment for this terminal, because if it does not invoice, it cannot be burdened with movement costs. The cost is pushed (pushed) to the terminal where there is billing. In this case, the model adopts apportionment percentages based on the corresponding volumes and values to allocate them to the respective oil and destination cost centers, according to what each received.

Some limitations were found in this paper. It is not the scope of this study at this time to create order subtypes for product groups (diesel, gasoline). Allied to this factor, however, there is no way to separate light and dark or each derivative, as the information is not included in Transpetro's measurement reports.

Another improvement opportunity is related to the operationalization of the system launches. With a total of 112 pipelines and terminals, launching at each cost center, while derivatives and oil measurements can still be on the same terminal, which was simplified before launching at only two totalizing centers, can increase the likelihood of misstatements. by the operator.

REFERENCES

[1]. Martins, A. C. B.; Chaves, J. G.; Alemão M. M. Implantação do sistema de custos na FHEMIG. Revista de Administração Hospitalar e Inovação em Saúde, n.4, p.50-61, 2010.

[2]. Derbeck, Edward J. Van; Nagy, Charles F. Contabilidade de custos. 11. ed. São Paulo: Thomson, 2001.

[3]. Martins, E.; Rocha, W. Métodos de custeio comparados: custos e margens analisados sob diferentes perspectivas. São Paulo: Atlas, 2015.

[4]. Souza, P. C.; Scatena, J. H. Apuração do custo da diária de internação hospitalar: um estudo de caso. Revista de Administração Hospitalar e Inovação em Saúde, v.11, n.2, p. 123-135, 2014.

[5]. Padoveze, C L. Curso básico gerencial de custos. São Paulo: Pioneira Thomson Learning, 2003.

[6]. Ching, H. Y. Manual de custos de instituições de saúde: sistemas tradicionais de custos e sistema de custeio baseado em atividades (ABC). 3ª ed. São Paulo: Atlas, 2010.

[7]. Gonçalves, M. A.; Amorim, C. A.; ZAC, J. I.; Alemão. M. M.; Costa, M. R. T. Gestão Hospitalar: a aplicabilidade do sistema ABC em um bloco cirúrgico. Revista de Administração Hospitalar e Inovação em Saúde, v.11 n.2, p. 73-86, 2010.

[8]. Perez Junior, J H; Oliveira, L M; Costa, R G. Gestão Estratégica de Custos. 6. ed. São Paulo: Atlas, 2009.

[9]. Souza, M. A.; Diehl, C. A. Gestão de custos: uma abordagem entre contabilidade, engenharia e administração. São Paulo: Atlas, 2009.

[10]. Martin Christopher, Matthias Holweg. Supply Chain 2.0: managing supply chains in the era of turbulence. International Journal of Physical Distribution & Logistics Management, Vol. 41 Iss:1, pp.63-82, 2011.

[11]. Rodrigues, P. R. A. Introdução aos Sistemas de Transporte no Brasil e à Logística Internacional. São Paulo: Aduaneiras, 2002.

[12]. Guereschi, J. S. Logística de transporte: a importância dos custos logísticos AJM Transporte LTDA. 2012. Monografia - Centro Universitário Católico Salesiano, Lins, São Paulo

[13]. Barbieri, A C; Silveira, M H F; Silva, A S B da. Custo-Brasil e Investimento Direto Estrangeiro: uma análise de suas relações. Disponível em: < http://www.inovarse.org/ sites/ default/files/T14_0156_3.pdf > em 02 de março de 2019.

[14]. Radaelli, V; Galett, J R. Além da Crise Global: desafios de uma política industrial para a "reindustrialização". s.a. Disponível em: < http://ipea.gov.br/agencia/images/stories/PDFs/radar/140226_radar31_cap4 > Acesso em 14 mar. 2019.

[15]. Gimenez, F. A. P.; Pelisson, C.; Hayashi Junior, P.; Kruger, E. G. S. The benefits of a coherent strategy for innovation and corporate change: a study applying Miles and Snow's model in the context of small firms. Creativity and Innovation Management , v. 9, n. 4, 2000.

[16]. Lima, M. Pesquisa de custos logísticos no Brasil. XIX Fórum Nacional de Logística. Rio de Janeiro, 2014.
[17]. Martins, Eliseu. Contabilidade de Custos. São Paulo: Atlas, 2003.
[18]. Amaral, G L. Evolução da carga tributária brasileira. 2015. Disponível em:<http://www.ibpt.com.br/img/uploads/novelty/estudo/2142/05EvolucaoDaCargaTributariaBrasileira.pdf.> Acesso em: 04 abr. 2019.
[19]. Radaelli, V; Galett, J R. Além da Crise Global: desafios de uma política industrial para a "reindustrialização". s.a. Disponível em: < http://ipea.gov.br/agencia/images/stories/PDFs/radar/140226_radar31_cap4 > Acesso em 14 abr. 2019.
[20]. Wanke, P. F.; Hijjar, M. F. Exportadores Brasileiros: Estudo Exploratório das Percepções sobre a Qualidade da Infraestrutura Logística. Produção, v. 19, n. 1, p. 143-162, 2009.
[21]. Agência Nacional de Transportes Terrestres - ANTT – Relatório anual 2009. Disponível em: < http://www.antt.gov.br/ > Acesso em 06 mar. 2019.
[22]. Ballou, R H. Gerenciamento da Cadeia de Suprimentos. Planejamento, Organização e Logística Empresarial. 4. ed. Porto Alegre: Bookman, 2004.
[23]. Agência Nacional Do Petróleo, Gás Natural E Biocombustíveis - ANP. Disponível em: < http://www.anp.gov.br/ > Acesso em 04 mar. 2019.
[24]. Yin R. Estudo de caso: planejamento e métodos. 2a ed. Porto Alegre: Bookman; 2001.
[25]. Moreira, J C S; Carvalho, J L F. Investigando o roubo de carga nas rodovias brasileiras a partir da percepção dos atores envolvidos com o problema. 2011.
[26]. Companhia Ambiental do Estado De São Paulo (CETESB). Disponível em: http://www.cetesb.sp.gov.br/Emergencia/acidentes/dutos/introducao. Acesso em 30 jan. 2019.

Andrey Pimentel Aleluia Freitas" Appropriation of Logistics Costs in Pipelines and Terminals: A case study in the Brazilian oil industry" International Journal of Engineering Research and Applications (IJERA), Vol. 09, No.08, 2019, pp. 32-43