

# The importance of data analysis for the improvement of the selection process of audit areas and objects: a systemic and risks view on the PAC public works



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## ABSTRACT

According to the Strategic Plan of the Federal Court of Accounts, the complexity, scope, diversity and extent of jurisdiction and of the control objects require that the Court act in a selective and systemic manner in relevant areas, aiming to reach greater efficiency and effectiveness in its oversight performance. This article shows the potential of data analysis for the improvement of the selection process of audit areas and objects, using the statistical analysis of public data of about 37 thousand projects of the Federal Government Growth Acceleration Program (PAC).

**Keywords:** Data analysis. Data Warehouse. Public works audit. Systemic selection of audit objects. Growth Acceleration Program (PAC).

## 1. INTRODUCTION

The activity of auditing the infrastructure projects is an attribution ultimately assigned to the Federal Court of Accounts (TCU) by the Federal Constitution. In more detail, the Budget Guidelines Law (LDO) states several criteria that must be observed in the selection of audit objects.

This noble mission assigned to TCU brings great challenges that result mainly from the complexity, scope, diversity and extension of jurisdiction and of the



audit objects that need to be analyzed and interpreted to support the selection of infrastructure works to be audited.

Considering only the infrastructure works under the Growth Acceleration Program (PAC), the universe of possible audit objects comprises about 37 thousand projects.

In this manner, it becomes extremely important for the Court of Accounts to use techniques and tools that enable an assertive and economic selection of the public works that deserve to be audited, considering materiality, relevance and risk criteria.

Aware of these challenges, the Federal Court of Accounts presented in its Strategic Plan (2015-2021) some initiatives regarding the need to improve the selection process of areas and objects of action, through the application of methodologies of data treatment and analysis that make it possible to evaluate, in a systemic manner, governmental performance by topics.

Thus, the objective of this paper is to cooperate with the dissemination of the use of information technology in the activities under the responsibility of the Court of Accounts, as an essential tool to treat and analyze great quantities of data. In addition, it aims to foster the improvement of the selection process of audit objects, by obtaining a systemic view of governmental programs that have a high budget impact and their associated risks.

## 2. GROWTH ACCELERATION PROGRAM - PAC

In 2007, the Federal Government resumed planning and execution of great social, urban, logistics and energy infrastructure projects in the country, with the creation of the Growth Acceleration Program (PAC).

According to official data, during its first four years, the PAC fomented Brazilian public investments, which went from 1.6% of the GDP in 2006 to 3.27% in 2010.

According to public data available on the Federal Government open data portal, in its second phase, initiated in 2011, more resources were reserved for the program and more partnerships with states and municipalities were established, aiming to improve the quality of life in Brazilian cities and increase trade competitiveness in the country.

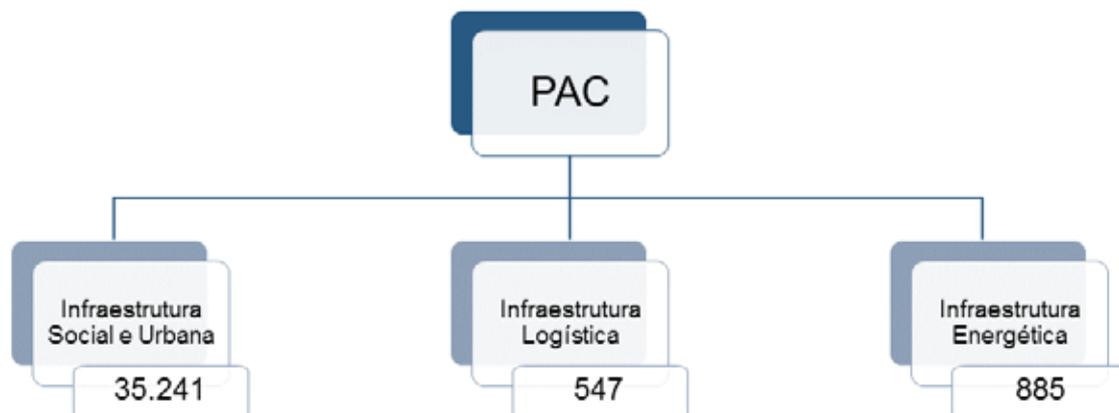
In 2015, the program presented a portfolio of about 37 thousand projects with an expressive volume of resources, which, based on the data of the second balance sheet of 2015, totalized more than R\$ 1.5 trillion reais.

The program is structured in three axes: social and urban infrastructure; logistics infrastructure; and energy infrastructure. Figure 1 shows the quantity of projects associated with each one of the PAC axis.

As can be inferred by Figure 1, the Social and Urban Infrastructure axis comprises about 96% of all

**Figure 1:**

Quantity of projects per PAC axis

Source: [www.pac.gov.br](http://www.pac.gov.br).

PAC projects. The goal of the activities of this axis is to face the main challenges of small, medium and large Brazilian municipalities, and includes programs such as Minha Casa Minha Vida (My house, My Life).

The Logistics Infrastructure axis has as its goal the optimization of the national production outflow through investment in railways, roads, ports, airports and waterways. Strategic Armed Forces and Communications projects, which aim to expand access to the internet in isolated regions and increase security in data communication, are also included in this axis.

Finally, the Energy Infrastructure axis comprises investments with the goal of assuring the supply of electric energy in the country and promote oil and natural gas exploration and production activities, among others.

### 3. DATA ANALYSIS APPLIED TO THE AUDIT OF PAC PUBLIC WORKS

A holistic view of a determined set of data can offer an important direction for the selection of possible audit objects. However, in a universe of almost 37 thousand projects in portfolio, having a systemic view of the program and, consequently, being able to identify potential risks that deserve attention or monitoring, become great challenges.

Aiming to allow a systemic view of the PAC public works, a data warehouse was created to store the

information of the PAC projects in the TCU Microsoft SQL Server database. It was supplied with the public data made available in the open data site of the Federal Public Administration ([dados.gov.br](http://dados.gov.br)).

Ballard (1998) conceptualizes data warehouse as a database created to offer easy access to a high quality data repository, commonly used to support decision-making.

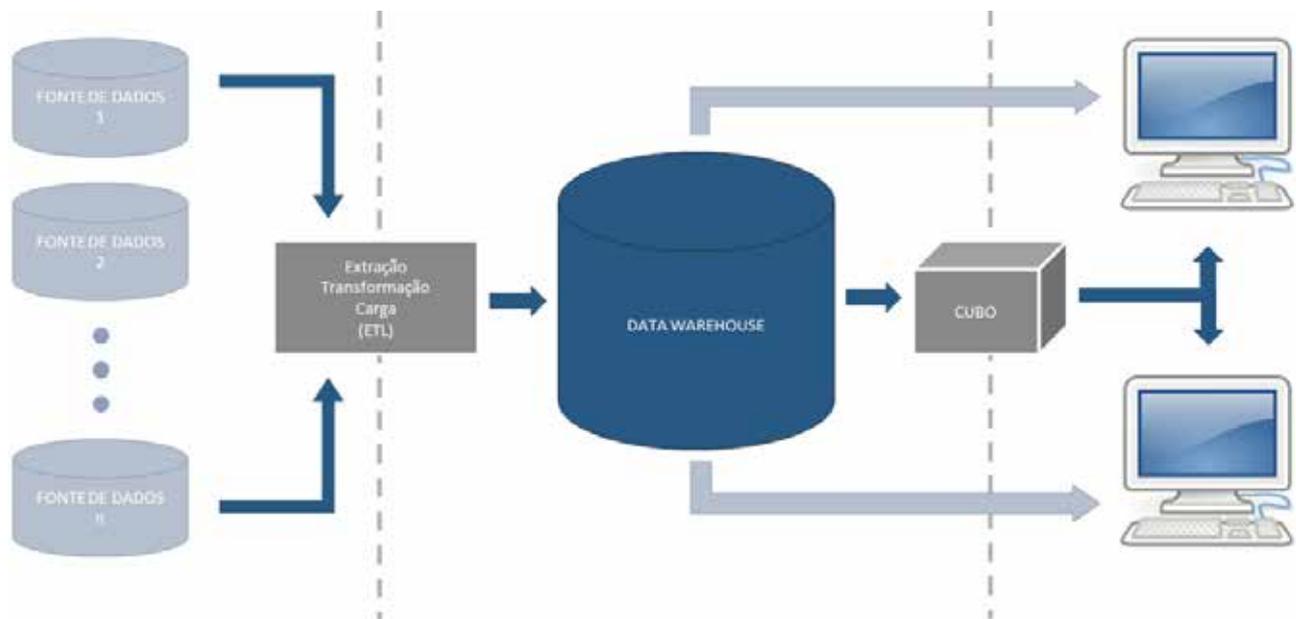
According to this same author, the main benefits associated with the implementation of data warehouse solutions are related to: i) the creation of a central data repository that is reliable, secure and accessible to the whole organization; and ii) the possibility of application of data mining and data cross-checking techniques, among others that are more traditional for data query and analytical reports.

In general, the data warehouses are fed by data coming from different sources of information. Nonetheless, before being loaded in the data warehouse environment, the data go through a process of extraction and cleaning or transformation, known as ETL (Extraction, Transformation and Loading).

In this analysis, the source of information used was the open data site of the Federal Administration. Before being permanently stored in the data warehouse, such data went through an intermediate process of cleaning and transformation to, only then, be loaded in the data repository, remaining available for queries and analyses by the authorized users.

**Figure 2:**

shows a simplified view of the typical architecture of a data warehouse



Source: The Data Warehouse Toolkit (adapted)

Once we have the information on the PAC projects (project status, volume of resources allocated, agency responsible for the execution, state of the federation where the project will be executed, program axis to which the investment is applicable, ministry, among others), it becomes possible to answer a series of questions that help in the creation of a systemic view of the program and in the selection of audit objects in an objective manner.

In order to exemplify how the data analysis can be applied to the process of selecting areas and objects of action, we attempted to answer the following questions about the PAC projects:

- Which PAC axis has the largest budget representation the?
- In the axis of greater representation, which is the area that has greater participation?
- In the area of greater participation, which is the main agency responsible for the budget execution?
- What is the status of the projects?

These questions will be answered in the following sessions, based on a descriptive statistical analysis of the information inserted in the data warehouse.

### 3.1 A MORE IN-DEPTH ANALYSIS OF THE PAC AXES

As described previously, the PAC projects are divided among the Social and Urban Infrastructure axis, the Logistic Infrastructure axis and the Energy Infrastructure axis.

Analyzing only the information presented in Figure 1, where we verify that 96% of the PAC projects are part of the Social and Urban Infrastructure axis, it can be concluded that this axis would be responsible for the greater part of the program budget.

However, when we analyze the PAC data inserted in the data warehouse, it is possible to identify that the social and urban infrastructure axis is responsible for the execution of only 22% of the program budget as a whole, even though it contemplates almost the totality of the number of projects of the program, according to Figure 3.

We note in Figure 3 that the largest portion of the resources planned is connected to the energy infrastructure axis, that represents about 66% of the who-

le budget amount, totaling over one trillion reais >R\$ 1.044.087.709.827,00).

It is important to emphasize that the Energy Infrastructure axis only has 885 projects. Thus, analyzing the budget of this portfolio's projects, it is possible to disclose what, in a superficial analysis, could indicate a paradox: 2.4% of the PAC projects represent more than two thirds of the global budget of the program.

Considering only the Energy Infrastructure axis projects, which effectively have allocated resources (value greater than zero), one can conclude that only 444 out of the 885 projects of the axis are responsible for about 66% of the entire budget of the program. This reinforces the materiality of the axis, according to what is described in Table 1.

Therefore, once the Energy Infrastructure axis is identified as the one with greater representation (66% of the PAC resources), it is possible to answer the second question through a deeper analysis of this axis, studying the characteristics of each one of its areas.

### 3.2 A MORE IN-DEPTH ANALYSIS OF THE ENERGY INFRASTRUCTURE AXIS AREAS

AS SEEN, Energetic Infrastructure is the PAC axis of greater budget relevance. Internally, this axis is divided into the following areas: renewable fuels, electric energy generation, merchant marine, oil and natural gas and electric energy transmission.

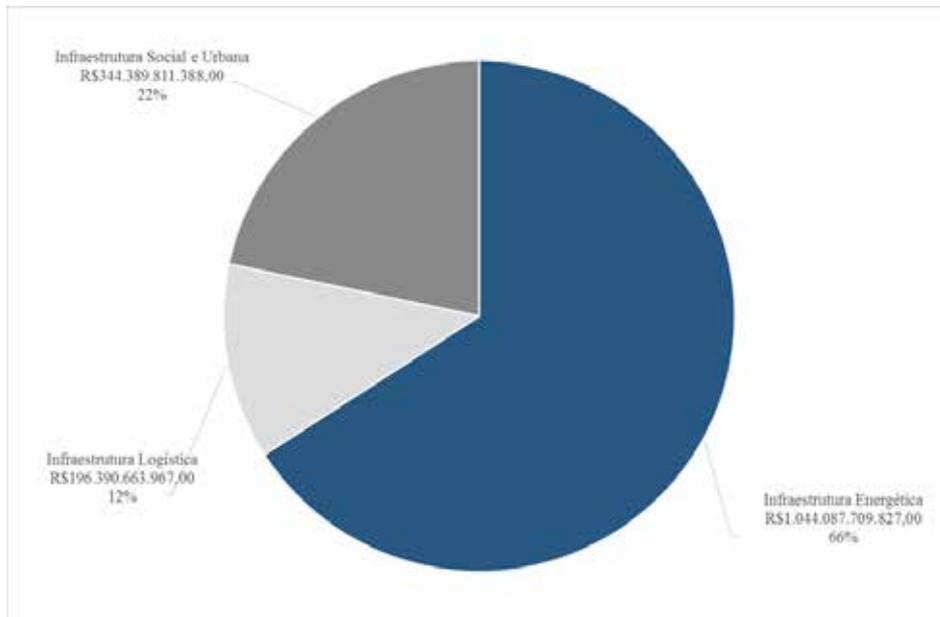
The division of financial resources in the areas that are part of this axis is rather unbalanced. The oil and natural gas area answers for more than 85% of the total budget of the axis, totaling more than R\$ 890 billion reais in investments.

Figure 4 illustrates the relation between the number of projects of the Energy Infrastructure axis areas and the budgetary impact of these areas in relation to the axis.

At this point, it is important to highlight that the oil and natural gas area has 96 projects in its portfolio. This means that 11% of the projects of the Energy Infrastructure axis is responsible for the execution of more than 85% of the total budget of the axis, characterizing the materiality of this area in relation to the axis analyzed.

Through the analysis of the information of Table 2, we find that the area with the greater amount of projects of the axis is the electric energy generation, which also presents the greater number of entities responsible for the execution of its projects.

**Figure 3:**  
PAC budget per program axis



Source: dados.gov.br (own creation)

**Table 1:**

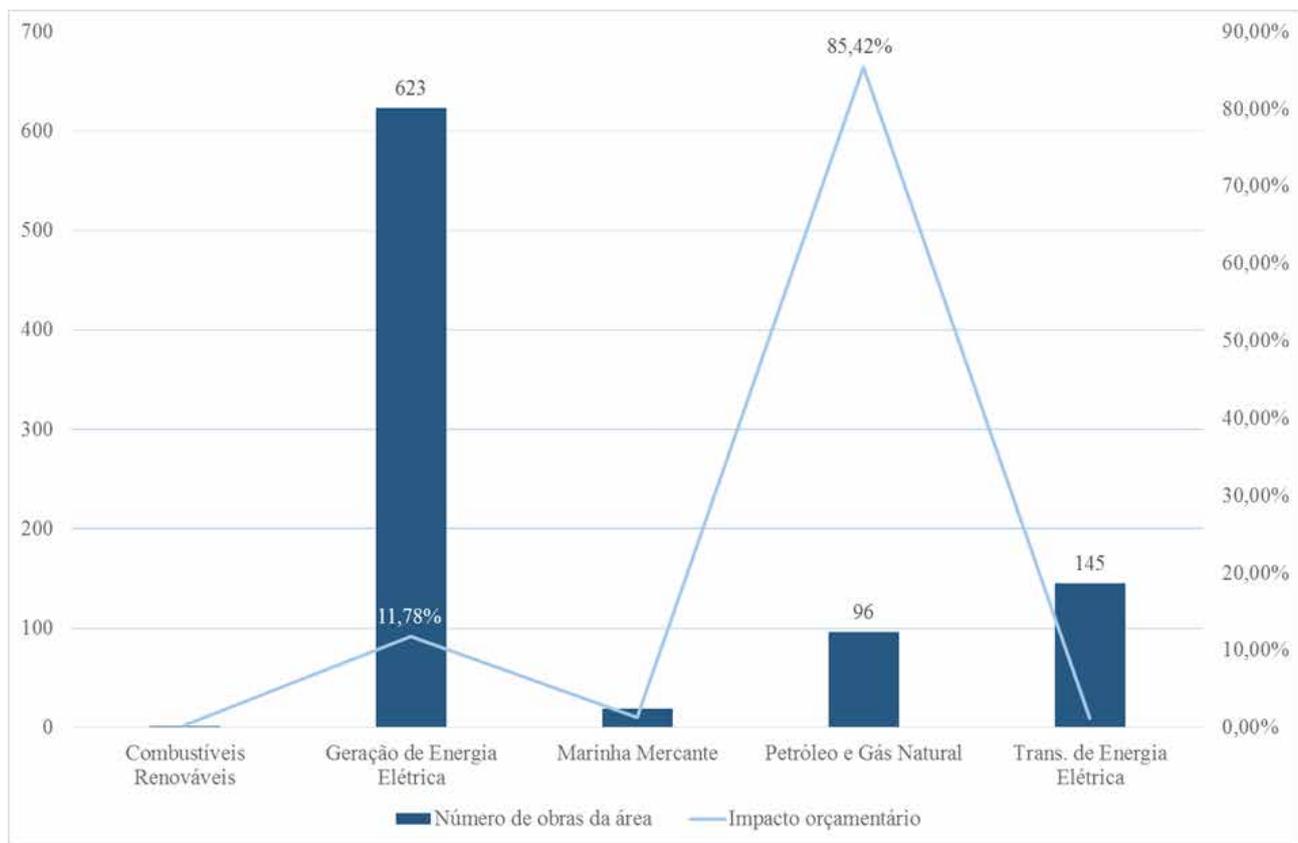
Stage of the projects of the Energy Infrastructure axis

Stage of the projects	Number of works	Investments (R\$ billion)
Preparatory action	24	0,00
Concluded	133	13,931
Being contracted	11	0,00
Under execution	17	0,499
In bid stage	406	0,00
In progress	265	341,320
Operating	29	688,336

Source: dados.gov.br (consolidated data at the data warehouse)

**Figure 4:**

Relation between the number of public works of the Energy Infrastructure axis areas and their budget impact on the axis



Source: dados.gov.br (own creation)

Strategically connected to energy generation, the electric energy transmission area is the second axis area with the greater number of projects and executive bodies.

Moreover, the execution of 85% of the Energy Infrastructure axis budget is limited to only four executive agencies, showing a high concentration on the execution of the projects of this axis.

**Table 2:**

Energy Infrastructure axis areas

Axis areas	Projects	Executive agencies	Investments (R\$ billion)	Representation
Renewable fuels	2	1	2,789	0,27%
Electric energy generation	623	399	123,033	11,78%
Merchant marine	19	10	13,885	1,33%
Oil and natural gas	96	4	891,833	85,42%
Electric Energy Trans.	145	65	12,547	1,20%
			<b>1.044,087</b>	<b>100%</b>

Source: dados.gov.br (consolidated data at the data warehouse)

Because of the representation on the PAC budget execution and the risks associated with its achievement and considering the concentration of resources in a few executive bodies, it becomes necessary to carry out an analytical assessment of the oil and natural gas area. The purpose of this is to answer the third question suggested in this study regarding which is the main body responsible for the budget execution.

### 3.3 A MORE IN-DEPTH ANALYSIS ABOUT THE OIL AND NATURAL GAS AREA

When we add the dimension related to the agency responsible for the execution of the projects in the area of oil and natural gas to the analysis, we observe that Petrobras is the one responsible for the execution of 85 out of 96 projects planned in this area of the program, as listed in Table 3.

Below, Table 4 shows the PAC investments per axis, with special emphasis on the Energy Infrastructure

axis and its material importance in relation to the total PAC budget.

In Table 4 we can observe that the 85 projects under Petrobras execution responsibility in the oil and natural gas area, in a universe of about 37 thousand projects in the PAC portfolio, represent more than 56% of the total of resources estimated by the program. This makes this government-controlled company the main executive company of the PAC projects.

It is important to remember that among the PAC projects under the responsibility of Petrobras, there are emblematic projects, such as Rio de Janeiro Petrochemical Complex (Comperj) and Abreu e Lima Refinery (Rnest), in Pernambuco state, whose total amount of resources represent R\$ 76.6 billion, according to the data published by the site of the program.

According to the information extracted from the data warehouse, the program also estimates substantial investments in platforms for the production and processing of oil and natural gas in ultra-deep

**Table 3:**

Agencies responsible for the budget execution of the oil and natural gas area

Area	Executive agencies	Projects	Investments (R\$ billion)	Representation
Oil and natural gas	ANP (National Agency of Petroleum, Natural Gas and Biofuels)	6	0,349	0,04%
	ANP (National Agency of Petroleum, Natural Gas and Biofuels) and Others	1	0,00	0,00%
	ANP (National Agency of Petroleum, Natural Gas and Biofuels) and Petrobras	4	0,428	0,05%
	Petrobras	85	891,056	99,91%
			<b>891,833</b>	<b>100,00%</b>

Fonte: dados.gov.br (dados consolidados no data warehouse)

**Table 4:**

The PAC Investments per activity axis

Axis	Area	Executive Area	Investments (R\$ billion)	Representation
Energy infrastructure	Oil and natural gas	Petrobras	891,056	56,22%
		Others	0,777	0,05%
	Generation of electric energy	Others	123,033	7,76%
	Merchant Marine	Others	13,885	0,88%
	Electric energy transmission	Others	12,547	0,79%
	Renewable fuels	Others	2,789	0,18%
Logistics infrastructure	All	Others	196,391	12,39%
Social and urban infrastructure	All	Others	344,390	21,73%
			<b>1.584,868</b>	<b>100%</b>

Source: dados.gov.br (consolidated data at the data warehouse)

waters, with amounts of about R\$ 225 billion that total more than 25% of the investments under the responsibility of Petrobras in the PAC.

It must be emphasized that several projects of the PAC portfolio under the responsibility of Petrobras were object of leniency agreements in the *Lava Jato* Operation. This was widely discussed in the media that reports payments of bribes to government employees and political agents, besides the creation of a cartel among the construction companies, corroborating the criticality of the risks of the Company's projects, as well as the relevance of the topic.

From this point on, we can use several variables to generate other views about the data, offering means for a greater understanding of the projects under Petrobras execution responsibility.

### 3.4 A MORE IN-DEPTH ANALYSIS OF PETROBRAS PUBLIC WORKS IN THE PAC

If we analyze the Petrobras public works inserted in the oil and natural gas area under the PAC Energy Infrastructure axis, we can verify that about 25% of them are operating, 62% are in progress and 13% are in the bid stage, according to what is described in Table 5.

It is important to remember that 13% of the projects under Petrobras execution responsibility are still going through the bid process and, therefore, they have investment values equal to zero.

Crossing the data, it can be noticed that after the year of 2007, when the PAC was created, the total debt of Petrobras presented an average annual growth of 38%, going from R\$ 40 billion in 2007 to R\$ 493 billion in December 2015, according to Figure 5.

This scenario, in which we see that large investments were planned for Petrobras, associated with the current low oil price, the high exchange rates and the great debt level of the company, creates challenges to be overcome by the Company. The challenges regard operating efficiency and its internal processes, eviden-

**Table 5:**

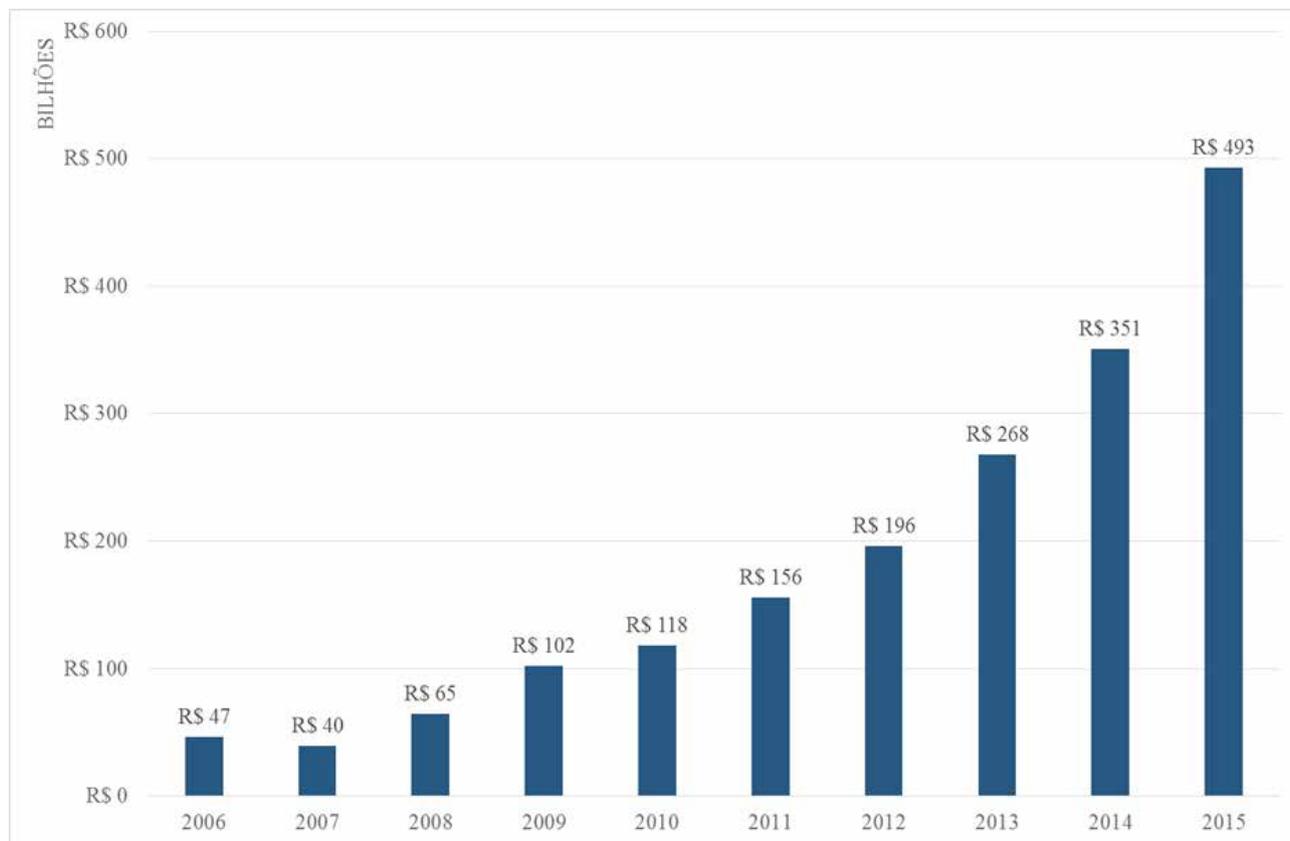
Stages of Petrobras public works in the oil and natural gas area

Area	Percentage of projects	Number of projects	Investments (R\$ billion)
Operating	25%	21	644,804
In progress	62%	53	246,252
In bid stage	13%	11	0,00

Source: dados.gov.br (consolidated data at the data warehouse)

**Figure 5:**

Evolution of total debt of Petrobras



Source: Petrobras – Relacionamento com Investidores (own elaboration)

cing, besides the materiality and relevance of the topic, the risks associated with the execution of its projects.

#### 4. CONCLUSION

Without any intention of exhausting the topic under discussion, this study illustrated how data analysis is an important tool to improve the selection process of areas and objects for public works audit that has the ability to offer a systemic and risk view on a certain set of data.

Based on the analysis of the Growth Acceleration Program (PAC) data, we built a systemic view of the program projects based on its budget representation, allowing the identification of the axis and of the area of the program with greater budgetary relevance, its main executive company and the stage of the respective public works under its responsibility.

Based on the materiality, risk and relevance criteria, we identified that 56% of the budget estimated

for the PAC is concentrated in a single executive body, making these projects potential audit objects.

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