

Fiscalização a serviço da sociedade

# REVISTA do TCU

Federal Court of Accounts Journal • Brazil • year 46 • Issue n° 131 • September/December 2014 • English version





Federative Republic of Brazil

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*Fiscalização a serviço da sociedade*

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# Letter to the Reader

**D**ear reader,

We are pleased to present Issue 131 of the TCU Journal. This issue covers one topic only: technological innovation and different approaches, experiences, and concepts in public management. Given the importance and relevance of the topic today, we believe the topic deserves a special edition in this periodical. The reader will have access to texts that took into consideration the current scenario where there is a large amount of information in a moment in which society calls for transparency and asks governments to open their data

This moment shows that citizens want to participate even more in the formulation of public policies and that information technology (IT) may be the key to this social transformation. This is reinforced in an interview by substitute minister Augusto Sherman Cavalcanti for this special issue when he states that respect and appreciation of citizenship are the values that the Brazilian government should seek when promoting technological innovation policies.

In the Highlight section, technological innovation comes side-by-side with the issue of open data and warehousing and processing of big data. Together, these issues signal a new moment for exercising social control. In this section, you will find out a little more about the audit carried out by TCU in the area of IT and, especially, about the recent work that aimed at gaining knowledge of initiatives to publish open data in the federal public administration.

The Articles section offers different experiences and approaches in IT, from TCU's background – between 1995 and 2014 – covering collection and treatment of oversight data - to the experience of the TCU Department of Social Security, Labor and Social Assistance Audit (SecexPrevidência) and its audit strategies in the big data context. It is also possible to get to know more about the use of open data as a strategy to increase transparency and modernization in public management and, when dealing with open government, see how technology could contribute to a greater proximity between the Government and society.

The Exchange of experiences and diversity of approaches regarding the topic “technological innovation” does not end here. Also in the Articles section, we will read more about the methodological structure adopted to implement the security controls applied to information assets; about an analysis of overpricing in the Maracanã renovation works; financial audit in the big data era; and about Management of Physical and Technological Resources in Health. Finally, we hope you enjoy Reading this issue and that the different articles add to your knowledge on this challenging topic of innovating in the field of IT.

It is always worth mentioning that the TCU Journal's main objective is to promote knowledge and reflection on important topics in the area of government audit and that contribute to improving public management.

Enjoy this issue!

Bruno Spada



**Aroldo Cedraz de Oliveira**

is Minister of the Federal Court  
of Accounts and Editorial  
Council Supervisor.

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## Technological innovation and promotion of citizenship

**Augusto Sherman Cavalcanti**  
*Substitute Minister of the Federal Court of Accounts*

Born in Natal (RN- Brazil), Augusto Sherman Cavalcanti has been a Substitute Minister of the Federal Court of Accounts (TCU) since 2001. He has a Bachelor in Law and in Electronic Engineering and a Graduate Degree in Process Control by the Federal University of Brasília (UnB). He was a Federal Government Auditor of TCU where he also held the position of Advisor and Chief of Staff of the Office of the Public Prosecutor. He was a graduate course professor at the Public Law Institute of Brasília (IDP) and at *Centro Universitário de Brasília (UniCeub)* in the fields of Financial Law, Constitutional Tax Law and Administrative Law. He is very active in matters regarding Information Technology Governance at the Court.

1. What kind of value must the Brazilian State aspire for the promotion of technological innovation policies?

Respect and value of citizenship. Other values would be economy, efficiency, efficacy and effectiveness, but, in my opinion, the greatest value to be sought is the promotion of citizenship. The State must use the existing technology in an intensive and responsible way and the technological innovation to expand and improve the services provided to citizens, offering services of different types in the broad spectrum of its operation, such as education, health, social security, transportation, security, social assistance and so forth in a fast and simplified way. Good quality services and with no need to stand in line.

2. How should social technological innovation - understood as new practices aiming at changing a social situation of exclusion and risk - be approached or inserted into public policies?

In an urgent and responsible way, prioritizing social sectors of greater risk. It is urgent because we know, especially this Court due to the audits it performs, the conditions of risk and social exclusion of great part of the Brazilian population. In a responsible way since technology and innovation must be used appropriately to produce adequate results, according to the technique and good practices that support them. The identification of priorities based on risk criteria is fundamental, once there is not enough human, technological and financial resources to face all matters simultaneously.

3. There is a common understanding that a country that does not have its own technology or does not have sound relations in this area with other

countries may become dependent in several aspects in a permanent manner. How is the State responsible for encouraging technological innovation and what guarantees must be sought in processes and partnerships of technology transfer?

Technology advances in an exponential speed. The country that does not invest in research, development and technological innovation and does not ally with other countries for that purpose is fated to being a backwards nation and permanently dependent. It is definitely the State's responsibility, as one of the development promoters and as an institution that communicates in an international environment with other national States, to provide the necessary encouragement to the sector, including the search for strategic partnerships. Nevertheless, this does not exclude nor suppress the participation of the private sector in the same search, which is many times necessary. On technology transfers, partnerships must prioritize full transfer of knowledge and internalization of products, materials and techniques of which they are composed.

4. Technology development has a considerable cost, which usually only great enterprises and the State can afford. How can one balance the need for technological development by the State and the apparent shortage of resources? Is it possible?

Balance is the result of priorities – if they are well defined. There is indeed the tradeoff between meeting current and urgent needs of the State and society and the necessary structuring for meeting future needs, which are usually greater. Creating this structure for the future necessarily involves development, acquisition and use of technology

*“ By generating new technologies or improving those that already exist, technological innovation significantly contributes to the performance of management activities. In my opinion, the main change which is currently visible in the administration is high dependency, which tends to grow in relation to the use of IT solutions in the accomplishment of the institutional mission. Almost all relevant management activities are supported by IT solutions nowadays.”*

and innovation, which currently present high costs. Because of the shortage of resources, choices need to be made and priorities must be defined also considering the future, for this is what we are heading for. I believe that mechanisms of international funds may be useful for the solution of this dilemma. Moreover, several incentive public policies have been introduced in the last ten years to promote participation of the private sector, including in partnerships with institutions of education, research and development by granting fiscal incentives.

As examples, there is the law Lei do Bem (Law 11196/2005), which grants fiscal incentives to businesses investing in research, development and technological innovation, the Lei Rouanet da Pesquisa (Rouanet Research Law, 11487/2007), Innovation Law (Law 10973/2204) and the Information Technology Law (Law 8048/1991, which was amended by Law 11077/2004). These norms enable the reduction of taxes in exchange for investment in research and development, promoting partnerships among businesses and institutions of education, research and scientific and technological development. Under these conditions, I believe it is possible to solve the dilemma.

5. What changes may be identified in public administration because of the use of information technology (IT)? How can technological innovation contribute to a greater management efficacy and efficiency?

By generating new technologies or improving those that already exist, technological innovation significantly contributes to the performance of management activities. In my opinion, the main change which is currently visible in the administration is high dependency, which tends to grow in relation to the use of IT solutions in the accomplishment of the institutional mission. Almost all relevant management activities are supported by IT solutions nowadays. For instance, let's look at the social security, the fiscal, security, labor and employment and the social assistance systems, etc. They strongly depend on the good functioning of the IT solution that supports them. Why? Because when IT is properly used, it offers efficiency, agility, low costs, broader coverage of services, better control of activi-

ties and so forth. Therefore, there is a direct relationship between the adequate use of technology and the positive performance of the management activity with greater efficiency and efficacy.

6. Information Technology governance is a part of corporative governance, which seeks to ensure that the use of IT adds value to business at an acceptable risk level. It tends to avoid or reduce management weaknesses, which result in a loss of quality and efficiency of public services provided to society. How do you evaluate the current stage of IT governance of the Federal Public Administration?

Good public services to citizens, as previously mentioned, depends on the good performance of administrative institutions. Nowadays, good performance can be translated into good Corporative Governance, which involves good IT Governance due to the dependence mentioned before. Since 2007, the Federal Court of Accounts performs biannual audit surveys aiming at verifying IT Governance in the Federal Public Administration. The last survey was performed in 2014 and it presented an evolution in several aspects, as for example, in the planning, in the oversight of IT contracts and in the structuring of decision support boards. The number of federal public bodies that achieved an intermediate and advanced stage of the index measuring IT Governance (iGovTI) increased. In short, there was an evolution, which means that the public administration is concerned with the matter and has adopted measures to reduce weaknesses. There is still much to be done regarding IT personnel policy and the adoption of internal controls based on risks analysis. However, I believe that an impor-

*“ I must highlight the influence of the Court’s precedents in the issuance of the specific legal norm published by the Ministry of Planning to regulate the IT contracts in the federal administration. I would also like to highlight that the TCU offered an individual diagnosis to each body that took part in the biannual audit survey on IT Governance. ”*



tant step was taken in the sense of raising awareness of the federal administration regarding the need to work to improve its Internal IT Governance.

7. How does the Court contribute to the promotion of improvements in governance and of information technology in the Federal Public Administration?

With audits and decisions – many of them are already consolidated by case law. For the audits and deliberations, the Court strongly lies in the systemic analysis and in the use of good international practices that rule the good IT Governance, in addition to legal parameters. Thus, these good practices become part of the everyday life of those under the jurisdiction of the Court, changing the reality of the federal public administration regarding the adequate use of IT. I must highlight the influence of the Court’s precedents in the issuance of the specific legal norm published by the Ministry of Planning to regulate the IT contracts in the federal administration. I would also like to highlight that the TCU offered an individual diagnosis to each body that took part in the biannual audit survey on IT Governance. The diagnosis shows the strengths and weaknesses in several parameters that rule Governance. Based on the diagnosis, the bodies had the opportunity to make the necessary corrections and amendments and, from there, improve their maturity in IT Governance. Therefore, the Court’s contribution derives from the joint performance of its Ministers and its technical staff, especially those who compose the Department of IT Audit (Sefti), Department of IT Infrastructure (Setic) and the Department of IT Solutions (STI).

# Technological innovation, open data and big data: a new moment to carry out social control



**W**ith the advances in information technology, activities such as going to the bank, watching movies, shopping, monitoring legal procedures, distance learning

and requesting services are being carried out using a simple smartphone. Technology has changed our notion of time, distance and space and produced great impacts that affect the way people relate

to each other, the way we work, produce, communicate and have fun. It is no wonder that, parallel to the real world, there is a world that is represented virtually – the so-called “cyberspace” – with codes

and a language of its own but that is greatly interrelated with the real world.

Today, this interdependence between the real and virtual worlds is so strong that it is hard to imagine that one can exist without the other. Public administration also is more and more immersed in this world. So much so that the use of technology has enabled the expansion and improvement of services offered to society and changed the way the government works and relates to the public.

In the 60s, the Federal Data Processing Service was created (Serpro). It is a company linked to the Ministry of Finance with the objective of modernizing strategic sectors of Brazilian public administration and making them more agile. Together with Serpro, the National Treasury Secretariat created the Integrated Financial Administration System of the Federal Government (Siafi), which was implemented in 1987 with the purpose of integrating the systems of financial programming, budget

execution, and internal control of the Executive Branch.

After Siafi, other programs and actions were made possible by using ICT, such as the Control System for Agreements and Transfer Contracts (Siconv) and the Sole Registry. These programs improved the operation of programs in several areas, including the social area. These measures were reflected both on the daily life of the population, in such areas as procurement, logistic, storage and control of data related to government actions.

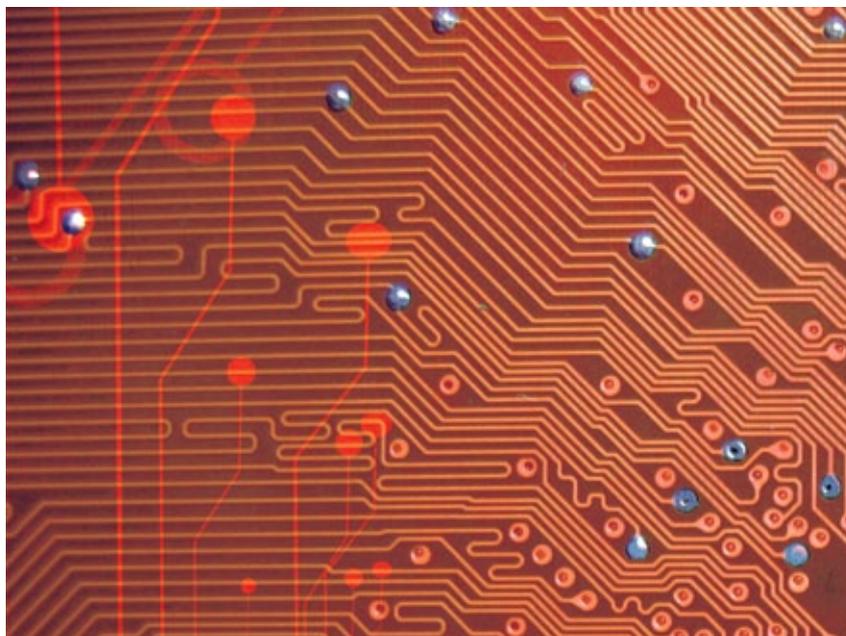
The innovations have also required that the public administration take measures in the area of IT resources, which involves data collection and storage processes, equipment, computer programs, investments and training of personnel. Therefore, one notices that technology applied to information influences the bureaucratic organization of the Government from planning, to control, to the execution of public policies, the manner and possibilities of ser-

vice delivery, and dialogue with society. In addition, it proposes new directions for government action, aimed at promoting and disseminating the social impact of technological development.

As an oversight body, the Federal Court of Accounts of Brazil (TCU) monitors the technological advances of the federal public administration and carries out audits aiming to, above all, contribute to the sound use of public resources and to the improvement of the use of technology to favor the delivery of quality public services to the population.

Among the numerous oversight actions performed by the Court in this area we can mention TCU's monitoring of the development of the new Siafi, the audit of the Sole Registry of the Social Programs of the Federal Government, the audits of the Contract Monitoring Systems of the National Transportation Infrastructure Department (Dnit) and of the Siconv data base. Other examples are the monitoring of the Fingerprint Identification Automated System (Afis), used by the Federal Police Department. Another activity carried out by TCU was a diagnosis of 448 federal public organizations, from the three branches of the Republic, and one of the Federal Public Ministry. This diagnosis had the objective of understanding the quantitative and qualitative aspects of the human resources structure in the area of information technology.

Minister Raimundo Carreiro was the rapporteur of the diagnosis and Substitute Minister Augusto Sherman was the reviewer. The diagnosis pointed out gaps and opportunities for improvement and disseminated the good practices



found, capable of making IT good governance feasible, aiming at improving the IT human resources structure as well as the effectiveness of government performance. Based on this work, TCU issued alerts to the National Justice Council, to the Public Ministry Council, Planning Ministry and Department of Coordination and Governance of the State Enterprises, stating the need to reformulate the policy related to the IT personnel policy. Among the recommendations are the creation of specific IT positions, distributed in careers; appointing exclusively tenured IT employees to perform managerial functions; establishment of a remuneration that is coherent with the relevance of the activities performed; and permanent capacity building activities for employees.

According to TCU President, Minister Aroldo Cedraz, information technology covers all areas of public management and can contribute to the oversight activities of TCU as well as of the agencies that execute public policies. “TCU is committed to giving this contribution to the Brazilian State so that citizens can truly feel that the public resources are being spent in a more efficient and effective way”, he stated.

This transformation in society makes it possible even to use information technology to increase citizen participation in building and executing new public policies. This shows that social control has advanced. The initiatives that illustrate this new reality are related to open data, which is a global movement that states that government data, because they are public, should be available to everyone.

In view of this new context, TCU carried out a survey to find initiatives of publication of open data in federal public administration, taking into consideration how the government and society used the solutions of collection, storage and processing of big data as strategies to achieve transparency and modernization in public management. The rapporteur of this survey case was Minister Benjamin Zymler. The survey found that in order for a government to be considered open, it should be committed to increasing the availability of information on government activities; to supporting social participation; to implementing the highest professional standards of integrity possible in the Administration; and to increase access to new technologies that promote transparency and accountability. For Aroldo Cedraz, “Before, the work in the area of information technology was linked to structured data. Now, through non-structured data and new Technologies, such as big data and data mining, it will be possible to render services more transparent, more agile and, above all, the State will be able to have more effective control over its public policies”.

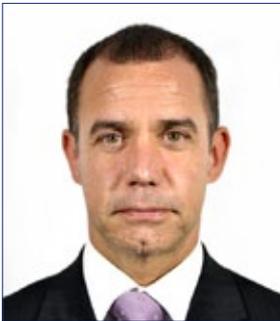
TCU found that there are already actions in place in Brazil that make government information available through open data thus promoting transparency, accountability and popular participation in public administration. Some examples are the creation of the Transparency Portal; the Access to Information Law (12.527/2012); participation in an International initiative that disseminates and promotes globally government practices related to transparency; and the creation of the Open Data

National Infrastructure (Inda) and of the Brazilian Open Data Portal ([dados.gov.br](http://dados.gov.br)). Despite the initiatives, according to the court, the actions adopted are still not sufficient to implement and popularize open government in the federal scope.

The work performed by the court also brought to light an International panorama of making government data available in open formats and presented a set of technological solutions implemented in other countries to solve different problems in society. These solutions were built based on private or governmental initiatives. As an example, Minister Benjamin Zymler mentioned the solution adopted by the English government called FindTheBestHospitals. This solution “makes it possible for the citizens in London that need medical assistance to better identify the best and nearest hospital by comparing indicators based on evaluation made by patients, medical staff, surgery statistics, mortality rates and average treatment time, among others”, he stated.

President Aroldo Cedraz believes that, when public administration is opened, the possibilities of creating solutions to improve public service delivery by the government and by society itself will increase. Cedraz reasserted that that, in this new framework, TCU is enhancing its knowledge in the area of new technologies in order to apply them when carrying out oversight. “In order to have a permanent exchange of information with society and to inhibit corruption, we need to use immediately these new technological tools, especially the ones related to open platforms. All this to increase transparency and strengthen social control”, Cedraz highlighted.

# History of data collection and processing for Oversight at TCU - 1995-2014.



**Claudio Souza  
Castello Branco**

is a civil servant of the Federal Court of Accounts - Brazil. He performs as General Coordinator of External Oversight of Essential Services for the State and the Southern and Midwestern Regions (Coestado).

## SUMMARY

Information Technology (IT) can promote and leverage the most diverse areas of human knowledge, including government audit.

Aware of this reality, the Brazilian Federal Court of Accounts (TCU) has sought, since 1995, to use various means to include IT in its work processes and thereby garner better results for society.

Several examples of this inclusion have occurred in the last two decades at TCU. From the introduction of the Integrated Personnel Acts Examination System (SISAC) in 1995 to the implementation of the Strategy for the Audit of Social Security Benefits Control in 2014, the Court has used data collection and processing with the aim of generating better information and knowledge for the fulfillment of its constitutional mission.

Currently, with the varied and increasing options for IT use in audits and the growing quantity and quality of public services available to citizens electronically, the Court is increasingly seeking to optimize its activity through information technology, in a permanent and inevitable way that will ultimately lead to a more efficient and effective government audit for the benefit of citizens.

**Key words:** Data processing; SIAFI; Transparency; Public Management; Technological evolu-



tion; Optimization; SISAC; SINTESE; Data extraction; SIAPE; SIGI; DGI; ADP; Automatic analysis; SAUDI.

## 1. INTRODUCTION

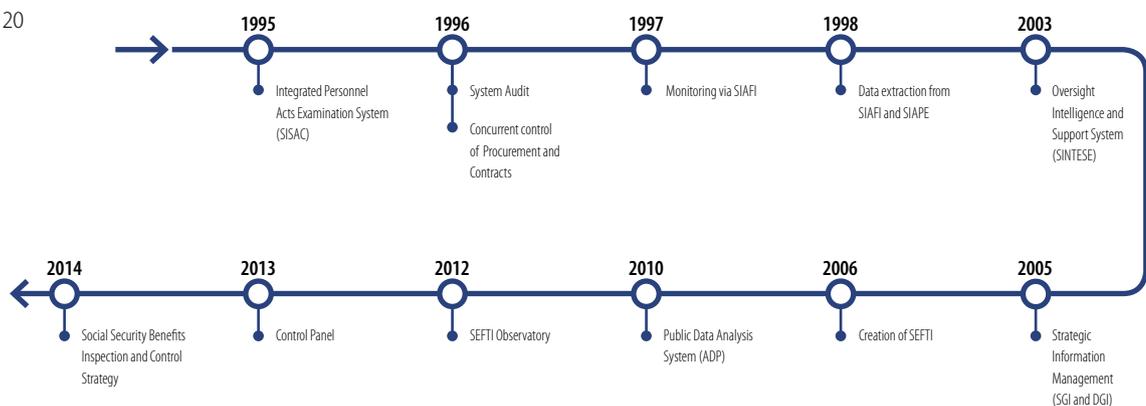
As a result of the implementation of the Integrated Financial Administration System (SIAFI) in 1987, federal public managers now have only one accounting records system, including for the implementation and monitoring of budgets and finances. This scenario has enabled SIAFI to become the main tool

for the federal government’s processing and control of financial resources, as it has brought greater agility and transparency to public spending, representing undoubtedly a breakthrough in public management.

Soon after, the Brazilian Federal Constitution of 1988 extended the jurisdiction of Brazil’s Federal Court of Accounts (TCU) with respect to audits, leading to a significant improvement in oversight. At that time, data and information were obtained in the form of paper documents, and the evidence collected came from copies of documents attached to court records.

**Figure 1:**

Data processing: 20 years of history



Back then, the culture of using electronic database to obtain or confront information used in TCU audits had not yet been established.

To further contextualize the technological situation available to TCU auditors during that period, it is worth mentioning that audit reports were handwritten and then typed; each office had only one microcomputer, which was shared by a group of 5 to 10 auditors.

Despite this reality, in the mid-1990s TCU optimized the examination of concession and admission acts subject to registration, by electronically collecting and processing data. This advance led the Court to see SIAFI and other federal administration systems as powerful instruments of aid to audits, since they enabled direct and real time access to budget and financial transfers, allocation bills and money orders, among several other management acts, which before required auditors to commute or documents to be physically sent to them.

The first data collection and processing initiatives at TCU were implemented against this backdrop, sometimes by creating an internal system, others by using existing federal administration systems, and others yet by auditing them.

## 2. INTEGRATED PERSONNEL ACTS EXAMINATION SYSTEM (SISAC) - 1995

The duties of the Secretariat of Personnel Audit (SEFIP) include examining concession and admission acts subject to registration and auditing payments in the area of personnel. The mission entrusted to this Secretariat highlighted the need for the strong use of information technology in fulfilling its duties, with the definition, maintenance and use of databases and information systems related to the unit's business. Basically, two activities carried out by SEFIP are founded on the massive use of databases: the examination of personnel acts (concession and admission) and the audit of federal civil servants payroll.

As for the examination of personnel acts, the following evolutionary steps are worth mentioning:

- a. Until 1995, the examination of personnel acts was based on information contained in personnel proceedings organized at the origin (personnel body). This means that TCU acted on administrative proceedings (conventional acts) referred to the Court by government

agencies containing personnel acts for registration purposes.

- b. The Integrated Personnel Acts Examination System (SISAC), which consisted of the electronic collection of data relating to concessions and admissions subject to registration by TCU, was developed and implemented in 1995. With this system, TCU began to issue opinions on the legality of the information contained in the summary sheet of each personnel act in the SISAC system.
- c. From 1995 to 1999, two systems for the examination of personnel acts coexisted: the conventional system and the system based on the analysis of the summary sheets of personnel acts (SISAC).
- d. Since the year 2000 TCU has accepted only summary sheets contained in the SISAC system. At that time, there were more than 400,000 personnel acts in stock, with an annual output of 25,000 acts on average and an annual average entry of more than 90,000 acts. That meant an excessive stock associated with the strong tendency towards stock formation.
- e. Also in 2000 an automatic system for the examination of admission acts was developed as a way to face this scenario, with the development of a series of electronic reviews that allowed TCU to declare the legality or illegality of such acts. As a result, the annual output jumped from 25,000 to more than 70,000 acts. In addition to this gain, the new system also led to a significant reduction in the stock of these acts.
- f. In 2005 the work process was improved, further increasing the output of acts. The system began to prosecute, investigate, and examine acts with similar characteristics, a fact that increased the annual output to over 90,000.
- g. Since 2009 new electronic reviews, now also for concession acts, which began to access fields of various computerized systems of the Federal Public Administration (Integrated Human Resources System - SIAPE; Computerized Deaths Control System - SISOBI; Annual List of Social Information - RAIS; Registration of Individuals - CPF, etc.), have increased the annual number of acts examined from 90,000 to more than 120,000, with the consequent improvement in the quality of decisions in the area of personnel acts.

- h. Today, the SISAC system has more than 4 million personnel acts in its databases, each act with more than 100 fields each, totaling more than 400 million data/registration fields. In addition, in 2013 TCU reached the milestone of 1 million acts examined automatically, with no human intervention whatsoever.

The activity related to the audit of the aforementioned federal civil servants payroll is discussed in the chapter on Systems Audit - 1996.

### **3. CONCURRENT CONTROL OF GOVERNMENT PROCUREMENT AND ADMINISTRATIVE CONTRACTS - 1996**

In June 1996 TCU enacted Ordinance No. 347, regulating the Concurrent Control of Government Procurement and Administrative Contracts.

This control entailed monitoring bidding processes as well as cases of exemption from and non-requirement of bidding by the agencies and entities of the federal direct and indirect administration, through the selection of samples of the procedures to be analyzed based on the information available in the computerized systems of the Federal Public Administration, including SIAFI, and on other available sources. The sample selection criteria took into account the materiality of events, inconsistencies between the available data, and the signs of irregularities among others. The information collected fed a database organized by agencies and areas. The Audit and Inspection Secretariat (SAUDI) was responsible for conducting a preliminary analysis of the selected procedures with respect to legal, economic and administrative aspects; request additional information to procurement agencies and entities; and in the case of identification of possible irregularities, pursue or refer the relevant evidence to the competent technical unit for further verification and examination.

### **4. SYSTEMS AUDIT - 1996**

At that same time, SAUDI began to conduct systems audits and data analysis, with an emphasis on: audit of the Employee's Dismissal Fund (FGTS) to verify the safety and reliability of the data processing systems used, held in 1998 (Decision 445/1998, TCU-Plenary); audit of SIAFI, also held in 1998 to verify the safety of the system as to the veracity and

reliability of the information it produced and the possibility of fraud against the public administration through the system (Decision 1380/2002-TCU-Plenary); and audit of the Secretariat of Government Property Management (SPU) to assess the situation of government property and the payment of rent and laudemium owed on Navy land, held in 2000 (Decision 295/2002-TCU/Plenary).

Later, with the creation of the Under Secretariat of Inspection (ADFIS) and its Information Technology Audit Division (DATI), the scope of the audit of data systems and databases was expanded, with the special aim of verifying the safety and reliability of these bases against frauds, with an emphasis on: Social Security Benefits (Decision 1921/2003-TCU-Plenary); Admission and Concession of Retirement and Pension of SIAPE (Decision 2167/2004-TCU-1st Chamber); Collection of Social Security (Decision 231/2005-TCU-Plenary); Student Funding System (Decision 914/2006-TCU-Plenary); National System of Integration of Information on Justice and Public Safety (INFOSEG) (Decision 71/2007-TCU-Plenary); and Collection System of the Internal Revenue Secretariat (Decision 2697/2007-TCU-1st Chamber).

In 2006, with the creation of the Information Technology Audit Secretariat (SEFIT), the systems audit was intensified, with the same focus as that of ADFIS, i.e., verification of the safety and reliability of databases with regard especially to fraud, with an emphasis on: Consignment in SIAPE (Decision 1505/2007-TCU-Plenary); Document of Forest Origin System (DOF) (Decision 309/2009-TCU-Plenary); Unified Registry (CadÚnico) (Decision 906/2009-TCU-Plenary); Computerized Death Control System (SISOB) (Decision 2812/2009-TCU-Plenary); Integrated Registry of Delinquent Taxpayers (CIDA) (Decisions 3382/2010 and 2994/2011, TCU-Plenary); General Services Administration System (SIASG) and Comprasnet System (Decision 1793/2011-TCU-Plenary); Contract Monitoring System (SIAC-DNIT) (Decision 2832/2011-TCU-Plenary); Transfer Agreements and Contracts Management System (SICONV) (Decision 2550/2013-TCU-Plenary); and National Transplant System (SNT) (Decision 1691/2013-TCU-Plenary).

These audits, which were initially performed using the Microsoft Access software and later the Audit Command Language (ACL), relied on experts in the business of the entity being audited, from the technical unit to which the clients belonged. In all, 18 system audits were conducted by SAUDI, ADFIS and SEFIT.

Some Oversight secretariats also conducted system audits, developed and applied data collecting and processing methods, with a special emphasis on the work of the Oversight Secretariat in Ceará (SECEX-EC), SEFIP and the 5th SECEX, which was succeeded by the Social Security SECEX.

Pursuant to Decision No. 2416/2008-TCU-Plenary, SECEX-CE conducted an audit at Bank of Northeast Brazil (Banco do Nordeste do Brasil - BNB) covering the credit recovery area and the management of resources of the Northeast Development Constitutional Fund - FNE.

The objective of the audit was to verify the efficiency and effectiveness of the Credit Recovery area of BNB by identifying, after the loan was granted and the default on obligations undertaken by the client assessed, which administrative and legal measures the bank was taking to ensure the return of the money lent/financed and whether such measures were achieving adequate results.

At the time of the audit, the assets of both the bank and the fund exceeded R\$41 billion. The option chosen was to conduct a system audit: the tables comprising the six audited systems were requested, and through reverse engineering the auditors developed an integrated tool consisting of the union of all systems.

The option for system audit allowed auditors to get to know the databases of the six systems databases and generated as a byproduct the development of a new system that enabled analyzing thousands of operations in fourteen of nearly 211 branches in operation at the time. Hardware and software limitations prevented this analysis from being extended to all branches. The following figures show the extent of the work done:

1. Systems audited: 6;
2. Fields mapped out: 7,000 fields in 582 tables;
3. Records obtained: approximately 150 million;
4. Analytical data of branches: 14 branches with 234,154 operations, representing 33% of the financial amount of the BNB Asset Base;
5. Databases generated to store the information obtained: about 60.

The audits provided a broad view of how BNB was managing its credit operations, and led to the identification of numerous weaknesses that can be found in TC-002 793/2009-0.

The conclusions led to the proposal of measures to improve BNB controls in the audited area, in order to enable the legal recovery of debts.

SEFIP, in turn, also used databases in several activities, among which the most recent are the Audit on Accumulation of Offices in each of the armed forces (Navy: Decision 11.52/2014 Plenary; Air Force: Decision 11.53/2015 Plenary; Army 11.54/2014 Plenary). In general, payroll audits:

- a. Are carried out through monthly data collection (Audit Command Language Software - ACL) of SIAPE.
- b. Data from the databases of the following systems are collected on a periodic basis: SISOBI (every two months), RAIS (annually).
- c. Every six months SEFIP receives all databases containing the payrolls of all entities of the Legislative and Judiciary branches, Public Prosecution Service and the Armed Forces.
- d. In each payroll audit SEFIP inspects thousands of records. For example, in the audit of constitutional ceiling throughout the federal public sector more than 600 million records were analyzed.
- e. Today, the payrolls that are copied to the SEFIP databases alone take 6TB (terabytes) of storage space, due to the huge amount of data.

Another unit that has also conducted system audits and data processing is the Social Security SECEX, which operates in the areas of Social Security, Social Assistance and Labor, which concentrate more than 90% of all benefit resources, such as retirement and pensions, sick pay, unemployment insurance, salary bonus, bolsa família (family grant), and continuous cash benefit. As a result, the use of control measures involving data collection and analysis has been one of the main strategies of the secretariat.

Among the experiences of the secretariat is the Strategy for the Audit of Social Security Benefits Control, which included the analysis of internal controls and the implementation of three audits in the databases of the benefits of greater materiality (rural and pension for death, age limit and time of contribution). Data audits in Unemployment Insurance for Formal Workers and Small-Scale Fishermen have also been conducted since 2012.

Although the data matching methodology used in the above mentioned audits have had sig-

nificant control benefits, the Social Security SECEX understood that advances in methodology would be required for a more effective identification of irregularities and fraud. In this regard, these technologies are under development at the technical data analysis secretariats that integrate analysis models. That is, models that assess the business rule, abnormal patterns and social networks among others which are ultimately integrated and start to produce a ranking of the benefits in which irregularities are more likely to occur. This methodology currently in the implementation phase will translate into and advance towards audit efforts and the identification of problems that usually are not detected by conventional audits.

## 6. MONITORING VIA SIAFI - 1997

The use of SIAFI as an inspection support tool began in the 1990s and had its main milestone in Ordinance No. 31-SEGECEX of 12.01.1997, which provided for Monitoring via SIAFI within TCU.

This monitoring aimed to inspect accounting, financial, budgetary, operational, and property management – from the standpoints of legality and cost-effectiveness, as it was being implemented by agencies and entities of the System and was based on a script of routines divided into three different phases, namely:

1. Preliminary survey, in which basic data and specific legislation of the unit to be monitored was obtained;
2. Initial analysis and periodic review, which aimed to disclose the transactions carried out by the management unit prior to monitoring, as well as the monthly examination of its summary records through the analysis of accounting and financial statements; and
3. Monitoring of the management unit's initiatives, which entailed the concurrent examination of management actions carried out based on sample selection.

Monitoring was carried out based on the information contained in system, which was obtained through terminals or the use of data extractor. With regard to projects and activities of the monitored management unit, auditors verified whether the acts resulting in revenue and expenditure were in compliance with legal provisions; the accuracy of accounting and administrative records; the correct completion of

documents with clear information about the recorded event; whether the use of resources was consistent with the objectives of the agency/entity and the cost-effectiveness principle.

During the monitoring process, the information necessary for the audit was requested by message via SIAFI, signed by the immediate superior and setting the deadline for response. Should failures or irregularities persist the head of the Technical Unit proposed to the rapporteur that an inspection be carried out so that the facts could be examined to the necessary extent. At the end of the accounting period a report was prepared containing the outcome of the inspection, the inadequacies identified and the corrections made. The report was submitted to the rapporteur, proposing that it be attached to the accounts of the respective financial year to inform his/her examination.

## 4. DATA EXTRACTION FROM SIAFI AND SIAPE - 1998

In parallel to Monitoring via SIAFI, to facilitate implementation the Service for the Evaluation of Public Administration Systems - an arm of SAUDI – developed the Script for Data Extraction from SIAFI (Ordinance No. 4-SEGECEX of 01/29/1998), which at the time aimed to meet the expectations of many users at TCU seeking information that was essential for exercising Government Audit. These data were scattered across SIAFI, thus hindering access to information.

Along the lines of the Script for Data Extraction from SIAFI, another script was developed focused on the extraction of data from SIAPE, to support the work of auditors responsible for carrying out personnel audits in agencies and entities that used the system (Ordinance No. 05 - SEGECEX of 01/29/1998).

## 5. GOVERNMENT AUDIT INTELLIGENCE AND SUPPORT SYSTEM (SINTESE) – 2003

In 2003 TCU began to plan the specifications for a Data Warehouse (DW) that contained essential information for control, especially information from SIAFI and SIASG (OS No. 05/2003 - Presidency). The first attempt to develop this tool included hiring services through the Inter-American Development Bank (IDB). As this initiative failed, TCU decided to hire the Federal Data Processing Service (SERPRO), the company that owns the SIAFI and SIASG databases,

to develop software capable of extracting data from these systems by converting them into an appropriate format for use by TCU. The tool also had the ability to structure information in a multidimensional model, allowing its use through OLAP (online analytical processing). In November 2004 SERPRO delivered to TCU the first prototype for testing and in 2007 the Data Warehouse was put into operation with data from these two systems plus data from the Clientele system belonging to TCU.

The Data Warehouse, also called SINTESE, had a high level of complexity as it was the only DW that dealt with six SIAFI exercises within the same data model. This system had 172 tables, 995 indices and more than 1,500 attributes, in addition to a large amount of information, since there were already 1.5 billion SIAFI entries.

The aim of SINTESE was to improve the planning of control actions by identifying areas requiring more action by the Court, considering risk, materiality and relevance requirements, besides performing electronic Government Audit based on information from various systems and the crossing of said information, and detecting signs of fraud through information processing.

From the user’s point of view, another advantage of the DW was the fact that it offered a user-friendly interface, with the possibility of search structured by code or text; cross-sectional analysis that enabled, for example, comparing the purchase

of the same object by different agencies and entities; temporal analysis by comparing information from various years; multidimensional analysis such as the analysis of contracts by vendor, company owners, contracting entities, etc; variation in the depth of the analysis through drill up operations (by accessing more aggregate data) or drill down (by accessing less aggregate data); and integration of information from multiple systems.

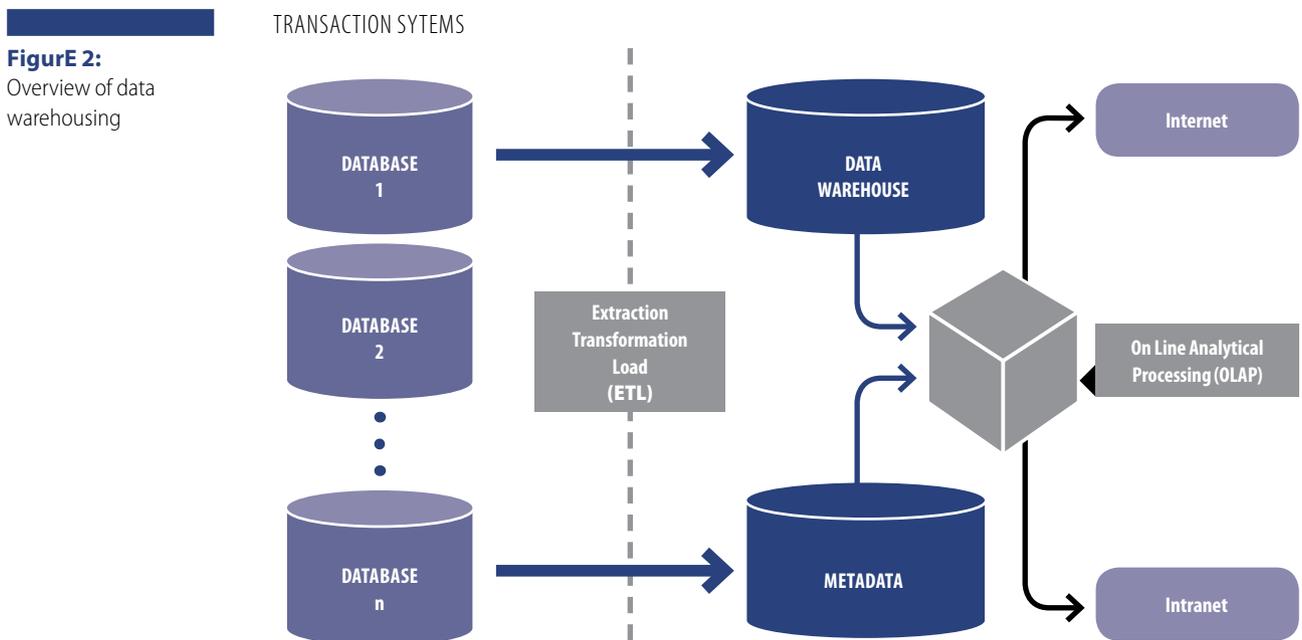
In March 2011 SINTESE received the final batch of updates and was discontinued in 2012 due especially to its high cost for TCU; little use by end users due to lack of culture in the use of data; and lack of knowledge about the needs of the end user’s work process.

The development of SINTESE enabled SERPRO to offer various solutions based on DW technology to multiple clients (DW Debt, DW Payment and Managerial Treasury).

## 6. GOVERNMENT AUDIT INTELLIGENCE AND SUPPORT SYSTEM

### 6.1 STRATEGIC INFORMATION MANAGEMENT (SGI AND DGI) - 2005

In the wake of data processing and aiming at the management and design of control strategies, in 2005 TCU created the Strategic Information Management Service for Government Audit Actions (SGI) (Ordinance - TCU No. 142, 08/08/2005), within the Gov-



ernment Audit Secretariat (SEGECEX). This service aimed to manage strategic information for government audit actions; assist in the internal coordination of a network for the production of strategic information; and interact with other government agencies in the establishment of a network for the exchange and sharing of information and strategic knowledge to support control actions.

At the time, some of the main duties of SGI included assisting in the design of risk analysis methodology and in the development, implementation, monitoring and evaluation of the audit plan.

In 2011 the service was transformed into a division of the Under Secretariat of Planning and Procedures (ADPLAN), a unit belonging to SEGECEX (Ordinance SEGECEX-1, 01/06/2011). The following year, the division became part of the structure of the Under Secretariat-General of Government Audit (ADGEXCEX) (TCU Ordinance No. 67 of 02/27/2013) which had among other duties obtaining, organizing and managing strategic information for inspection actions; promoting coordination with other agencies and entities related to public management control; managing and ensuring the updating of information bases relating to their area of operation; and coordinating initiatives relating to Government Audit intelligence.

More recently, in 2013, the Court enacted Resolution No. 256/2013, which changed the organizational structure of SEGECEX. At that time, the Secretariat of Support for Government Audit Management (SEGEST) was created with the aim, *inter alia*, to carry out intelligence activities and obtain, organize and manage strategic information for Government Audit actions. As a result of said Resolution, DGI became part of the structure of SEGEST, which in 2014 defined the responsibilities of that division, which included, especially, defining, organizing and disseminating strategic information to inform the planning and implementation of Government Audit actions and support the Court's technical units in the exercise of Government Audit, particularly with regard to the processing and analysis of information bases.

## 6.2 PUBLIC DATA ANALYSIS SYSTEM (ADP) - 2010

In 2010 the Information Technology Audit Secretariat (SEFTI) developed a work process to track publications in the Federal Official Gazette (DOU) on procurement notices or excerpts of IT service contracts. This activity was carried out through searches

aimed at locating on the national press website, matters published in the Official Gazette containing any words from a list of IT-related keywords. In the initial analysis the auditors selected matters that suggested any sign of irregularity, which were then subjected to further study based on additional information from the notice or the contract or from contact with the procurement or IT areas in the contracting agency.

However, the search based on keywords proved little effective with regard to variations in the descriptive text of the matter published in the Official Gazette. These variations in wording resulted, on the one hand, in the selection of a large number of irrelevant matters and, on the other, in the loss of several others that contained, in fact, something of interest.

The inconsistencies, which were constant and interfered with the quality of the results, led SEFTI to work in partnership with the Information Technology Secretariat (SETEC) to improve the work process, so as to ensure greater sensitivity to the search for the selected terms and enlarge the scope of the search. The effort of both secretariats resulted in a system able to obtain the full version of the Gazette, logically decompose each publication and identify metadata by inference regarding text organization, format or font.

The result produced by the new tool was a structured database, since the searches began to identify various material attributes such as: date, agency/entity, type of matter (such as "procurement notices", "contract excerpts", "eligibility results" or "addenda", among many others); identification of the act and specific fields such as "description of the object", Individual Taxpayer ID Number or National Register of Legal Entities contained in the matter; monetary values mentioned; and even a classification of subjects based on a rich list of keywords with variations thereof (plural, presence or absence of accents, including the most common spelling errors).

Since this remodeling, database searches have become much more significant and reliable, enabling the quick identification of relevant matters published in the Official Gazette. In addition to this improvement, an interface was designed for searching and visualizing these data, known as ADP or "Official Public Data" and available at: <https://contas.tcu.gov.br/adp/procura>.

This website, however, contains only matters published until 2013. More recent data can be accessed through the standard search interface of the corporate TCU portal at: <http://portal2.tcu.gov.br/>

portal/page/portal/TCU/corporate. Further details on recent uses of the tool are available in Decision 813/2014-TCU-Plenary.

### 6.3 SEFTI OBSERVATORY AND CONTROL PANEL - 2012

When it was created in 2006, SEFTI planned to conduct five surveys to structure its activities. One of these surveys sought a permanent way to obtain information that was relevant and essential to the business of the secretariat. This search resulted in the creation of the SEFTI Observatory (Decision 1496/2012-Plenary-TCU), a tool that was presented in a plenary session by Justice Augusto Sherman on September 27, 2012.

This Observatory – which was born out of a collaborative effort between ADPLAN and SEFTI and relied on data from the Government Audit Knowledge Repository, a data warehouse developed by DGI - consisted of a set of information providing quantitative and temporal views of federal public actions in information technology regarding the evolution of the amounts spent on IT goods and services by the Federal Public Administration (APF). This information, combined with data analysis, allowed TCU to have a broader view of public IT actions, follow the evolution of the amounts spent in goods and services and obtain other information that is relevant to the business of SEFTI.

The main purpose of the Observatory was to assist in the planning of control actions carried out by TCU in general and by SEFTI in particular. It was implemented in the form of a dashboard using the QlikView Business Discovery, and presented, in a dynamic format, expenditures on IT grouped by agency/entity, management unit, programs, and actions among others. The technology enabled viewing and interpreting large databases through the construction, by users themselves, of views and cutouts built from graphs.

The data presented here were taken from official databases, particularly from SIAFI and SIASG. The central metric used in the SEFTI Observatory was expenditures on IT. This metric was built according to a set of criteria that took into account, among other factors, sub-elements of expenditure specific for IT goods and services, to which the outlay is associated.

In December 2013 the SEFTI Observatory was selected by the People Management Committee of

TCU as one of the innovative initiatives implemented by the Court.

### 6.4 CONTROL PANEL - 2013

The experience of SEFTI led to the creation of the Control Panel, a tool developed to support the management of audit activities and decision-making based on the use of information produced within the scope of the internal actions of the Court, as well as information arising from the federal government to which the TCU has access by reason of its constitutional and legal powers.

The Panel provides internal information related to the inspection, investigation and trial of Government Audit proceedings and on compliance with the institutional goals of the Court. Through the Panel one can track activities in progress, areas and institutions under inspection and the georeferenced distribution of these inspections across the country.

In it, external data relate to the budget and financial execution of the institutions included the Federal Budget and to voluntary transfers such as Transfer Agreements and Contracts. The primary metric used refers to the expenses of Federal Government agencies and entities. To that end, the Panel uses SIAFI as a primary source of data. Therefore, the expenses considered therein are limited to those incurred by institutions of the federal direct public administration, autonomous agencies and foundations, whose expenses are contained in that system.

To facilitate reading the information, cross-cutting views of these expenses have been defined according to their nature, with an emphasis on: IT; per diem; travel fares and commuting expenses; civil works; outsourcing and labor costs; consumables; consulting; and other third party services and corporate card. Each cross-sectional view is built from rules that define an expense as relevant to that view.

In addition to enabling the timely observation of federal government spending, the Panel also provides interactive screens with official indicators such as the Basic Education Development Index (IDEB), the Human Development Index (HDI), per capita income, and infant mortality rates among others. Thus, the system enables analyzing, in a graphic and georeferenced way, the allocation of federal funds to states and municipalities as well as the results achieved.

The use of the Business Discovery technology, as it is used by the Observatory, materialized in dash-

boards in the QlikView tool, enables providing data and information to Court authorities and staff in the form of panels that facilitate the visualization and interpretation of contents. These panels can be viewed on computer terminals and on TVs, which have been purchased for this purpose.

This tool has reinforced the strategic vision adopted by the Court, which is focused on citizens, on the services provided to them, on the governance of these services, and on the measurement of results.

The President of the TCU, Justice Augusto Nardes, officially presented the Control Panel during the plenary session of November 13, 2013.

## 7. CONCLUSION

Over the past 20 years TCU has sought, in various areas and different forms, to collect and process data to generate useful information and knowledge for the exercise of Government Audit. Some of these initiatives have achieved the desired objective. Others, however, have failed to achieve the expected success, due particularly to the low level of compliance by end users, insufficient culture in the use of data, and lack of knowledge about the needs of the end users' work process.

Today, however, the Court is able to anticipate the strengthening of data collection and processing. This expectation is combined with a new era, which will naturally encourage and induce control through the use of information technology, since some once non-existent requirements have now become part of the work routines. The Always On culture that we experience today, coupled with the strategy of and the need for internal expertise favors the use and the permanent and continuous processing of data in various units and audit actions of TCU. Activities such as those carried out by SEFIP, which are strongly based on data collection and processing, are beginning to be replicated and expanded in various areas of Government Audit. The Social Security SECEX initiative is proof of that change. The inspection of public procurement, for example, under the responsibility of the Logistics Procurement Secretariat (SELOG), also has great evolutionary potential through the use of technologies such as Big Data Analytics, continuous audit and monitoring, predictive audit, etc., including the prevention, detection and investigation of fraud, since much of its control object is registered and stored in systems like SIAFI, SIASG and Comprasnet.

This unquestionable optimization of control through information technology tools has the potential to offer the most varied benefits to TCU units, such as leveraging results and improving the capacity to assess programs and government actions and detect irregularities and fraud. Like the 1988 Federal Constitution, by expanding the Court's audit jurisdiction the use of IT can translate into increased Government Audit quality, as it brings significant advances and expands the boundaries of information collection and use.

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# Open Data: a Strategy for Increased Public Management Transparency and Modernization



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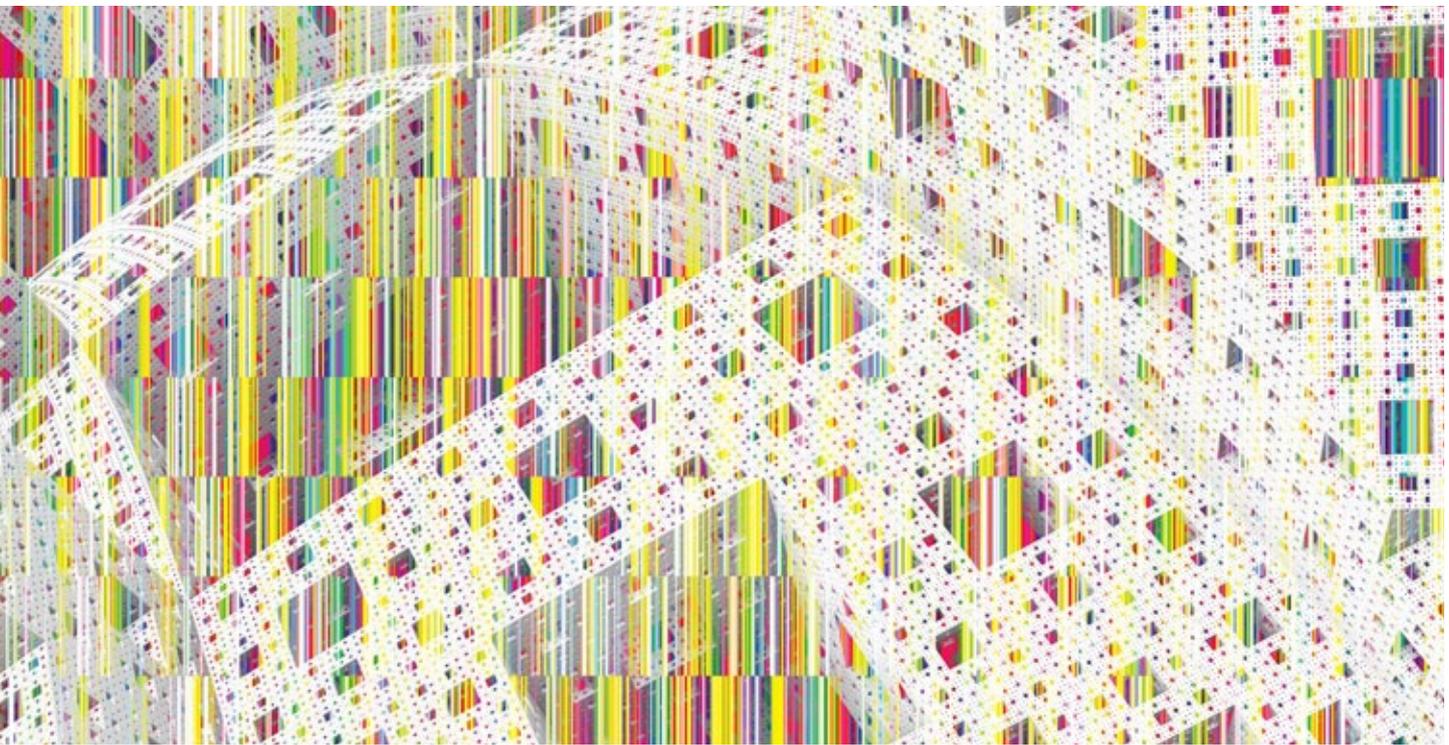
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## SUMMARY

At a time when improving public management, promoting social participation and the meeting need to provide better public services are high on our agendas, the open government data policy is a key input for the construction and consolidation of open government. This new paradigm allows citizens to obtain information about government actions, thus enabling their active contribution to decision-making and improving the functioning of the State. The contemporary nature of the topic as well as the evolution of practices at the international level have motivated this article, which provides an overview of the concepts, characteristics and risks associated with open data. It also describes the international scene as regards the opening of government data, discusses some local initiatives, and presents the Brazilian regulatory framework on the matter.

## 1. INTRODUCTION

Government transparency is one of the cornerstones of democracy and becomes effective through citizen access to government information. This match between transparency and information has given rise to the concepts of Open Government and Open Data. The first highlights the broad intention of a government to be transparent while the latter indicates the path to be followed for bringing this transparency into fruition.

For years, organizations in various countries have been striving to share open government principles and practices and disseminate them among governments. Nevertheless, open data is still an evolving and underexplored subject, with much room for progress as regards consolidating the open government culture.

In addition to ensuring transparency, the open government data policy has several other potentials, such as improving public management, fostering social control, promoting social participation, and stimulating innovation.

The implementation of this policy leads organizations, citizens, academics, businesses, and public institutions in different countries to build solutions for sharing information produced by or in the custody of public institutions, besides bringing knowledge to citizens and establishing channels of communication between civil society and the government.

The Brazilian government has formally committed to the topic by joining the Open Government Partnership (OGP) in 2011. Since then, it has carried out actions related the topic in the Public Federal Administration, having enacted the Access to Information Act and published the Open Data Policy in 2012, in addition to fostering the implementation of websites for the centralized provision of open government data.

Given the relevance and contemporary nature of the topic, the objective of this paper is to present related concepts as well the international context and data

publishing initiatives introduced in Brazil as a key instrument of the transparency and public management modernization strategy.

This paper is organized as follows: Section 2 addresses concepts and characteristics based on open data and open government publications and academic studies as well as benefits and associated risks. Section 3 describes global-level on data opening and discusses the international open data scenario. Section 4 presents the national situation, describing the regulatory framework on the matter in Brazil and existing initiatives. The conclusions are presented in Section 5.

## 2. CONCEPTS AND CHARACTERISTICS

This section will address the main concepts related to open data and list the benefits and some of the risks inherent in the initiative.

### 2.1 OPEN GOVERNMENT

According to the OGP, the term open government refers to projects and actions aimed at promoting transparency, fighting corruption, increasing social participation and developing new technologies with the aim to making governments more open, accountable for their actions, and able to meet the needs of citizens (OGP, 2011a). It is an international initiative that seeks to globally disseminate and encourage government practices related to government transparency, access to public information and social participation.

Brazil is recognized as a protagonist in the international scene with regard to open government and was invited to be one of the founding countries of the OGP, alongside other countries. It was also the first chair of the Partnership, together with the United States. Currently, Brazil is a member of the OGP Steering Committee, which now has 65 member countries.

At the launch of the Partnership, the eight founding governments (South Africa, Brazil, United States, Philippines, Indonesia, Mexico, Norway and the United Kingdom) signed the Open Government Declaration (OGP BRAZIL, 2011), in which the countries recognized the demand of civil society for more openness in government and committed to uphold the principles and goals of open government.

According to the Open Government Declaration (OGP BRAZIL, 2011), for a government to be considered open it must commit to: 1) increase the availability of information about governmental activities; 2) support

civic participation; 3) implement the highest standards of professional integrity throughout the Administration; and 4) increase access to new technologies for openness and accountability.

Additionally, OGP commitments should be structured around a set of five areas of action, which the Partnership refers to as Grand Challenges: 1) improving public services; 2) increasing public integrity; 3) more effectively managing public resources; 4) creating safer communities; and 5) increasing corporate accountability.

For the OGP (OGP 2011b), improving the quality of the country's governance as well as of public services provided to citizens is the basis for the sustainability of a government that is more transparent, more open to popular participation and more willing to promote accountability.

As seen, the concepts of open government and transparency are strongly correlated. Open government and, consequently, transparency, are often considered inducers of responsibility and accountability as well as of the fight against corruption, inefficiency and waste.

### 2.2 OPEN DATA

With the advancement of digital technologies, the practice of open government with regard to information and governmental transparency gradually began to make use of resources for processing and disseminating electronic data in large amounts and high speed. Currently, transparency is strongly associated with the availability of so-called open data, which, in principle, enable scrutinizing the universe of governmental actions in more detail.

As defined by the Open Knowledge Foundation (OKF), "data are open when anyone can freely use them, reuse them and redistribute them, being subject, at most, to the requirement of attribute and sharealike" (OKF; BRAZIL).

The expert in public policy David Eaves proposed three laws, and although originally presented for open government data, it can be said that they apply to open data in general (EAVES, 2009):

1. If it can't be spidered or indexed, it doesn't exist;
2. If it isn't available in open and machine readable format, it can't engage; and
3. If a legal framework doesn't allow it to be repurposed, it doesn't empower.

In 2007 an OKF working group also established the eight principles of open government data:

In the genesis of these laws (rules) and principles, there are reasons and justifications strongly linked to the reality of the digital world and the principles of public transparency.

### 3.1 POTENTIAL BENEFITS FROM OPENING DATA

In an article entitled *Effective Open Government: Improving Public Access to Government Information*, published in 2005, the Organization for Economic Cooperation and Development (OECD) pointed out that data transparency and openness are an essential part of any modern government (OECD, 2005), highlighting as benefits democratic participation and understanding, improved decision-making processes, improved government data management, efficient management of services provided to citizens, in addition to less corruption.

Literature lists other potential gains from open public information. The OKF emphasizes citizen participation in government management, since the availability of government data not only brings information to citizens, but also creates the possibility for them to engage in decision-making processes and contribute to public actions. It is the empowerment of citizens, who become agents of social transformation by monitoring and overseeing government actions and public policies.

By making its data available, the government also contributes to the generation of business and innovative services with both commercial and social value. Organizations, citizens, academics, businesses and even public institutions have the possibility to use public data for producing and sharing new knowledge and new services, based on the concept of co-participation between private entity and government in the provision of public services. Since the State has limited capacity to provide the quantity and diversity of services that society can and wants to consume, combined efforts seem to be timely.

An international example of civic application built along these lines is England's best places to live (ILLUSTREETS, 2013). Developed in England, the service proposed by this website helps citizens to choose where they want to live in the country, with indicators on the selected region. Through an interactive map, colored according to the standard of living, citizens choose a focal point (region) for research. After that, indicators on the selected region are presented such as: standard of living, crime rate, average prices of rents, characteristics of the local population, unemployment rate, distribution of the use of facilities (parks, buildings, homes, roads, etc.), local and nearby schools, and public transportation. The Solution also provides the details of this information. Open data used by the Solution come from various government sources, including transportation, police, education, and health departments. Other civic solutions can be found in the report justifying Decision 2569/2014-TCU-Plenary.

In Canada, open data brought to light a fraud scheme related to tax exemption on charitable donations, which resulted in the claim of \$32 billion in taxes due (EAVES, 2010). In Spain, a study shows that about 5,000 jobs are related to companies that create applications, products and services, using public sector information (ZIJLSTRA, 2012). In Uganda, the access to information policy and the resulting disclosure of public funds received by each school contributed to reducing the corruption that encroached upon those funds, and the schools, which previously received only 20% of the funds to which they were entitled began to receive 90% of said funds (HUBBARD, 2007).

### 3.2 2.4 OPPORTUNITY TO USE OPEN DATA WITH SOCIAL PARTICIPATION

Social participation is one of the pillars of open government, encouraging citizens to become acquainted with, check, oversee and monitor public actions of interest to them. On the other hand, with

**Tabela 1:**  
princípios dos dados abertos governamentais

1. Complete	All public data is made available. Data is electronically recorded information, including but not limited to documents, databases, transcripts and audiovisual recordings. Public data is data that is not subject to valid privacy, security or privilege limitations, and is regulated by statutes.
2. Primary	Data is published as collected at the source, with the highest possible level of granularity, not in aggregate or modified form.
3. Timely	Data is made available as quickly as necessary to preserve the value of the data.
4. Accessible	Data is available to the widest range of users for the widest range of purposes.
5. Machine processable	Data is reasonably structured to allow its automated processing.
6. Non-discriminatory access	Data is available to everyone, with no requirement of identification or registration.
7. Non-proprietary formats	Data is available in a format over which no entity holds exclusive control.
8. License-free	Data is not subject to any copyright, trademark, patent or trade secret. Reasonable privacy, security and privilege restrictions may be allowed as regulated by statutes.

the communication channels established, citizens can also provide information to the State, thus contributing to the assessment and adjustment of public policies as well as to the improvement of public data, among other benefits.

This relationship between the State and civil society is already seen in solutions based on open data. OKF (2013) lists some examples in which social participation has enabled, for example, improving the quality of government data (GRAY, 2013). As an illustration, the United Kingdom, by providing data on 300,000 bus stops in the Open Street Map (OpenStreetMap), has made it possible for the community to contribute by correcting information on 18,000 bus stops, ultimately leading to the improvement of public transport information in that country (BOLY-CHEVSKY, 2013).

However, for civil society to actually participate, the mere publication of government data is not enough. The availability of public information, easily accessible to citizens, needs to be disseminated and attract the interest of users, for both the creation of new products and services and the construction of new and different views on the information provided.

Moreover, the provision of open data by governments should not be considered an end in itself. Various professionals and researchers have been warning about a certain “illusion” of transparency that open data can create. In addition, they shed light on a number of issues underlying the topic that are not being discussed at the necessary depth, such as the difficulty to interpret and take from government data information that is useful to the reality of citizens, and the risks of invasion of privacy or disclosure of confidential or incorrect data.

The set of risks inherent in the adoption of open data are divided into three main groups: 1) costs of the continued availability of data; 2) quality, usefulness, and usability of data; and 3) privacy and protection of personal data.

#### 4. INTERNATIONAL CONTEXT OF OPEN GOVERNMENT DATA AVAILABILITY

OGP, Open Data Institute (ODI), W3C, W3C Brazil, OKF, OKF Brazil, Open Institute, Fundar, Sunlight Foundation, and Global Open Data Initiative are some of today’s organizations engaged in open data.

The British government was the first to publish open data, with the initial goal of providing the

largest amount of public data possible by establishing a small infrastructure and conducting experiments (W3C BRAZIL, 2013). Since then, it has maintained its leadership position in open government practices. Despite being a reference, the country believes that much has yet to be done and, therefore, the efforts to consolidate an open data culture remain high on the government agenda.

International studies indicate that, in general, countries have not yet developed their full capacity to provide raw government data. Consequently, the international community is becoming increasingly concerned about measuring the data opening level of nations and assessing their value added, i.e., the social and economic impact of their initiatives. In order to stimulate innovation and improve transparency and accountability for public expenditure, nations and organizations around the world are seeking to find out how open data add value.

One of the indicators used in this measurement is the number of datasets provided by the country. However, a simple comparison of that number can lead to wrong conclusions, since what matters the most is the information being provided (its content) and its potential impact. The total number of datasets can be considered in evaluating the degree of openness of a country or state, in conjunction with other indicators.

The Open Data Barometer (NETWORK, 2013), a project of the Open Data Institute and the World Wide Web Foundation, seeks to develop evaluation methods for open data. Its goal is to gauge the impact of open data initiatives, taking into account the dissemination of the government policy on open data and its use worldwide. The project analyzes global trends and ranks countries using a methodology that factors in the readiness to ensure the benefits of open data, the actual levels of implementation and the impact of open data initiatives.

In 2013, a study covering 77 countries was conducted and published in the Open Data Barometer Global Report (DAVIES, 2013). This initiative showed the UK as the most advanced country in terms of open government data, followed by the United States, Sweden, New Zealand, Denmark and Norway, with Brazil holding the 28th position. In this regard, it should be pointed out that, in the analysis, open government data initiatives in our country were considered to have no economic impact whatsoever (W3C BRAZIL, 2013; BAROMETER, 2013; ODI, 2013).

The report argues that the success of initiatives requires more than just the provision of datasets. It requires action by agents, known as intermediaries, able to transform government data into platforms and products with social and economic value, equipped to work with data in different ways. In this regard, the Open Data Barometer (DAVIES, 2013) recognizes that achieving the benefits of open data and ensuring its sustainability requires addressing a diverse number of variables in order to build and maintain an ecosystem around the central data infrastructure of an open government data program.

OKF created the Open Data Census (OKF CENSUS), in which seventy countries participate on a voluntary basis by contributing information about the databases made available. This information served as input for the publication of the Open Data Index (OKF INDEX), which measures the availability of open data. In this index Brazil ranks 24th, with 480 points out of 1,000. The ranking is led by the United Kingdom, with 940 points.

The World Wide Web Foundation created the Web Index (WEB INDEX, 2013) to assess the contribution of the internet to developing and strengthening the rights of citizens in 81 countries, with indicators covering four areas: Universal Access; Freedom and Level of Openness; Relevant Content; and Empowerment. In the Web Index 2013 the top five positions are held by Sweden, Norway, the United Kingdom, the United States and New Zealand, with Brazil ranking 33rd.

In an attempt to standardize an open data classification, Tim Bernes-Lee suggested a progressive open data-publishing model, known as Five Stars of Linked Data (BERNES-LEE). The model seeks to induce governments to take the first step to open information by publishing data online in their original format and gradually improve the level of openness.

The U.K. National Health Service (NHS) recently published an article prepared by the GovLab, proposing a conceptual structure to assist in measuring the impacts of data opening on healthcare and in assessing specific circumstances that maximize said impacts (VERHUST et al, 2014). The aim of the authors is to enable this model to be used by researchers and program managers when defining open data initiatives in healthcare by establishing priorities and ways to measure their impact, not only at the end of the implementation process of the initiatives, but also throughout it. The relevance of the study, which

with the necessary adaptations can be extended to all other areas of public administration, lies in measuring results in an initial moment, when the data opening initiative is defined.

Special mention should also be made of the first report on open data trends conducted by the Court of Accounts of the Netherlands, completed in March 2014. The report, like this Article and the report that informed Decision 2569/2014-TCU-Plenary, addressed open data concepts, policies and related legislation, besides the local national scene (REKENKAMER, 2014), and highlighted the concern about assessing controls related to the topic.

## 5. NATIONAL CONTEXT OF OPEN GOVERNMENT DATA AVAILABILITY

This section presents the main aspects of the Brazilian legislation on open data, as well as some examples of data opening initiatives in progress at federal, state and local level.

### 5.1 OVERVIEW OF BRAZILIAN LEGISLATION

Subsection II, Article 37, § 3, and Article 5, item XXXIII of the Brazilian Federal Constitution, when addressing the need to regulate forms of citizen participation in the public administration, emphasize the access of users to administrative records and to information about Government initiatives.

As for the right of access to information, Law 12,527/2011 – the Access to Information Act (LAI) was published in order to ensure compliance with the aforementioned provisions of the Federal Constitution, and the procedures established therein are binding upon the Union, States, the Federal District and Municipalities. In this regard, LAI provides for the obligation of the State to provide passive transparency, i.e., the obligation to respond to society's demand for information, and establishes new obligations regarding active transparency to be met by public agencies and entities, such as those relating to the so-called open government data.

With respect to open data, Article 8 of Law 12,527/2011 and its paragraphs 2 and 3 provide for the duty of public agencies to promote, the disclosure of information of collective or general interest produced by and in the custody of said agencies, regardless of requests. This information must be made available in places easily accessible to all persons, in

addition to establishing the requirements for disclosure on the official websites.

A more detailed and specific non-statutory regulation on open data is Normative Instruction SLTI/MP 4 of April 18, 2012, establishing the National Open Data Infrastructure (INDA). Pursuant to Article 1 of IN-SLTI/MP 4/2012, INDA is “a policy to ensure and facilitate access by citizens, society and, in particular, the various public sector spheres to data and information produced by or in the custody of the Federal Executive Branch”. IN-SLTI/MP 4/2012 establishes as members of INDA, on a mandatory basis, all entities of the Information Technology Resource Management System (SISP) and, optionally, by signing the term of agreement, all other agencies and entities of the Executive, Legislative and Judicial Branches at Federal, State, District and Municipal level.

According to the provisions of Article 1 of IN-SLTI/MP 4/2012, the objectives of INDA are: to: define, organize, and coordinate the open data policy; define and regulate the standards and technical aspects relating to the availability and dissemination of data for use by the Federal Executive Branch and society; seek to continuously improve the publication of open data, based on best practices implemented at national and international level; and promote social participation in building an ecosystem to reuse and add value to open data, among others.

In relation to the open government legislation, Decree n/n of September 15, 2011 established the national action plan on open government, which is intended to promote actions and measures aimed at increasing transparency and access to public information, improving the delivery of public services and strengthening public integrity.

The aforementioned Decree, in its Article 3, also provides for the creation, by the Federal Government, of the Interministerial Committee on Open Government (CIGA), a decision-making body responsible for guiding the implementation and development of Brazil’s open government action plans. The committee is composed of eighteen ministries represented by their respective ministers, and coordinated by the Office of the Chief of Staff.

Article 1, items II and III of the same Decree, also highlights the duty of public administration to promote social participation. It establishes as guidelines of the national action plan on open government, among other actions: 1) fostering social participation in decision making; and 2) encouraging the use of

new technologies in the management and delivery of public services, which should foster innovation, strengthen public governance and increase transparency and social participation.

Likewise, one of the objectives of IN-SLTI/MP 4/2012 (Article 1, section X) is the promotion of social participation in building an ecosystem to reuse and add value to open data. Within this spirit, the normative instruction also determines that citizens and civil society organizations interested in INDA activities may be part of its organizational structure and participate in its implementation (Article 3, §1 and §2).

Therefore, the Access to Information Act and all other regulations mentioned herein are important instruments to enable and demand the implementation of actions aimed at ensuring the transparency and openness of government information. However, considering the innovative nature of the topic, some subjects are still to be regulated, such as the processing of personal information, which is essential to define which public data are of collective or general interest.

## 5.2 NATIONAL OPEN GOVERNMENT DATA INITIATIVES

Research on open data initiatives at the federal level has shown heterogeneity in the degree of openness between Public Federal Administration entities and agencies.

The Chamber of Deputies, for example, stands out among Federal Public Administration agencies for having a specific physical and personnel structure to implement open data initiatives, namely the Hacker Lab, in addition to counting on the support of the upper levels of the House. Opened in early 2014, the Hacker Lab provides physical space for free access and use by all citizens, especially programmers and developers, who can use public data to develop citizenship-related actions. In order to promote collaborative actions to improve legislative transparency and understanding of the legislative process, in 2013 the Chamber of Deputies held a Hackathon, a marathon with a very busy agenda, in which applications developed by citizens were selected and awarded prizes.

The Ministry of Justice is another institution that has implemented initiatives to promote open data, having even published its Open and Spatial Data Plan in August 2014. The Ministry held two Hackathons in 2013, and has around a dozen datasets cataloged on the Brazilian Open Data Portal.

Brazilian entities providing data and information about the country also make available part of the large amount of information produced by them or in their custody. The Institute of Applied Economic Research (IPEA) provides access to statistical series data generated by it or in its custody (IPEADATA). The information covers economic, financial, demographic, and geographic data and social indicators, and may be surveyed by topic, data source and other filters. The Brazilian Institute of Geography and Statistics (IBGE), in turn, provides information from official data taken from its surveys as well as from other government sources (IBGE).

With respect to the open government data websites created by the Federal Government, special mention should be made to the Brazilian Open Data Portal (BRAZIL). Besides serving as a catalog of open data produced by or in the custody of public administration entities, it provides links to technical guidelines on the topic for both the internal public and civil society, especially application developers. Another website related to the topic is the Transparency Portal (UNION), an initiative of the Comptroller General's Office launched in November 2004 to increase the transparency of public management. The portal, which allows citizens to learn how public funds are being used and exercise social control, also provides multiple open format datasets, thus allowing users access to spreadsheets with data posted on the portal.

At state and municipal levels, it should be pointed out that the State of São Paulo launched the SP Open Government initiative, a Knowledge Management and Innovation policy, and has recently entered into a partnership with the United Kingdom to expand the databases available, improve access to the state's official portals and stimulate the development of new applications, services and businesses (SP OPEN GOVERNMENT). The state of Rio Grande do Sul also has an open data portal (RS DATA) which, at the moment, provides seventy datasets, many of which are historical series. In its search for qualified management based on incentive to innovation and entrepreneurship, the municipality of Porto Alegre created DataPoa (DATAPOA), the open data portal of Porto Alegre aimed to invite the community to participate in the development of intelligent solutions for the city, thus establishing collaborative ties between local government, businesses, developers, and citizens.

An example of a Court of Accounts engagement in open-data related actions is the Court of Accounts of the State of Pernambuco (PE-TEC), which developed

its Citizen Portal in order to democratize access to information on government management. The portal features an open data section, with files available on budgetary and financial execution, as well as government procurement and contracts (PERNAMBUCO).

Although still modest, the country already has some civil applications, an example of which is the QEDu solution, in the educational area, an open and free portal containing information about the learning level of 5th and 6th grade students from municipal and state schools in Brazil. Using data from the Brazil Test, the School Census and IDEB, the QEDu provides information on the educational infrastructure; the profile of students, teachers and principals; and some indicators of student learning and teaching quality (QEDU).

The main difficulties faced by agencies in the data opening process include: the sustainability of the initiatives generated, particularly of the solutions developed by society or collaboratively; lack of staff and governance in managing the process; and lack of standardization.

## 6. CONCLUSION

The reasons that motivated the implementation of the open government data policy are clear and pressing. The availability of public data promotes increased social participation; citizen empowerment through the understanding and monitoring of government actions; and improved quality of government data, management efficiency, services delivered to citizens, and public policy design and implementation process.

Notwithstanding the existing regulatory framework and the work already done by the actors engaged in this policy, much still remains to be done for the establishment of an open data culture in Brazil. In principle, improving the expected results of this policy requires establishing a larger set of incentives to institutions, including awareness campaigns on the importance of the topic, so as to further stimulate the coordinated and active participation of public institutions in open data initiatives covering the three government branches: Executive, Legislative and Judiciary.

By describing international cases and discussing the topics revolving around open data policies, we hope this paper has contributed to clarifying fundamental concepts as well as to motivating actors to implement open data-related actions.

# Open Government: technology contributing to promote closer relations between the State and Society



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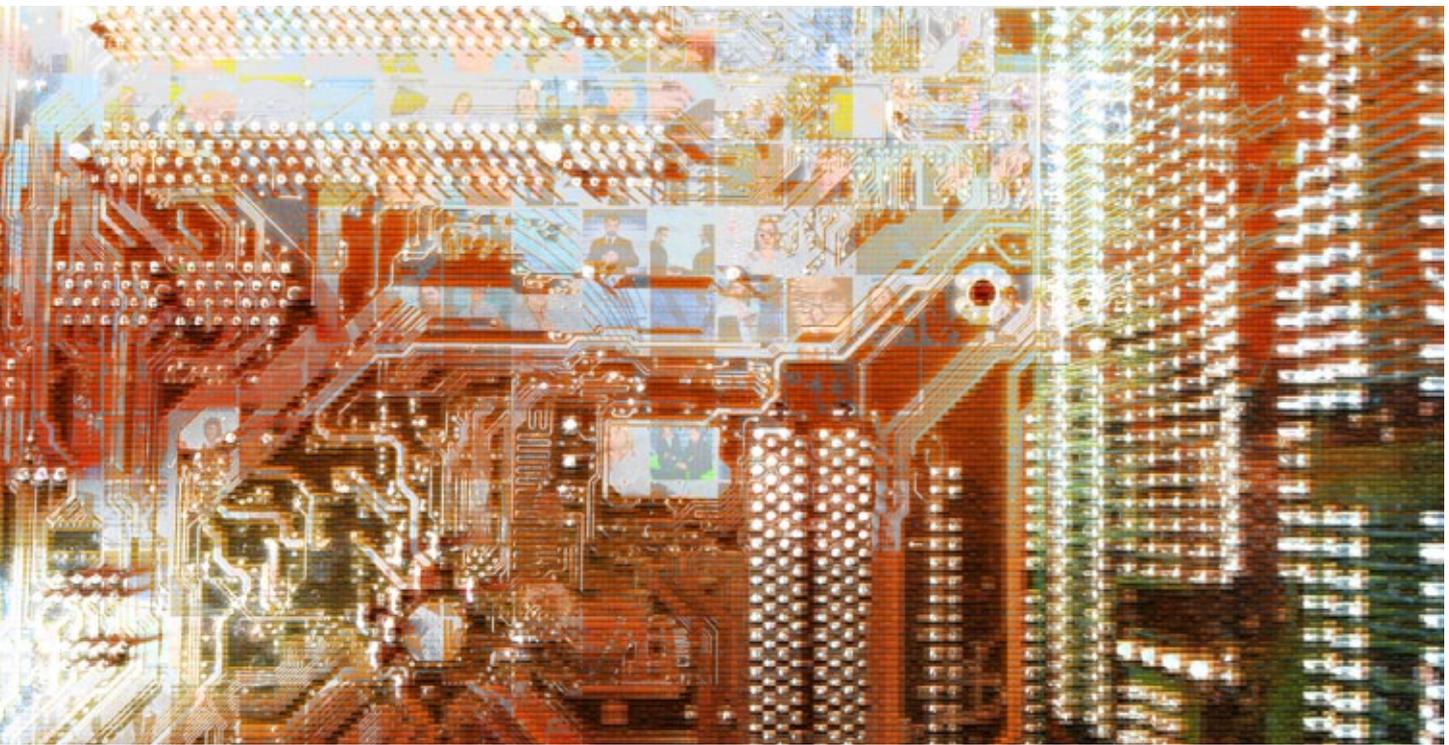
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## ABSTRACT

Openness, transparency, collaboration and social participation are some of the topics covered in this paper, the object of study of which is Open Government and the contribution of information and communication technology to promoting closer relations between the state and society. In methodological terms, it is a descriptive study based on a literature review, analysis and summarized information provided by organizations committed to transparency. Throughout this paper, the Open Government concept, its purpose, principles and pillars will be discussed. The US experience, one of the benchmark countries in this area, and that of Brazil will be presented. Detailed information will be provided on how the education sector has been using the technology and foundations of Open Government to provide new and better solutions. Certain challenges faced in the data opening process will be pointed out, and the final section will present a reflection on the performance and role of Brazil's Federal Court of Accounts (TCU) in stimulating and controlling Open Government practices, data and information and in promoting government transparency, collaboration and social participation.

**Keywords:** Open Government; E-Government; Information and Communication Technology. Education; Good Practices; Participatory Democracy; Transparency; Social Participation; Collaboration.



## 1. INTRODUCTION

New technology platforms, their expansion, cost reductions and ease of access have contributed to the development of a new information and knowledge-based model of society. In this environment, ways of interacting between individuals and organizations have changed, bringing about new challenges and opportunities for public-sector action. One of these challenges is meeting an increasing demand for new mechanisms for developing closer relations between government and society, involving not only the provision of data and information, but also the actual participation of society in government decision-making and actions.

In this context, Open Government solutions, particularly those based on information technology, have been adopted by national and foreign governments with the aim of bringing the state closer to citizens and of facilitating their relationship. Many of these initiatives are designed to facilitate services, speed up processes and increase transparency and social participation.

This study began with a survey of the Scopus database, which indicated an increase of over 400 percent in the number of scientific articles on the subject published between 2000 and 2013. In that same survey, it was seen that the United States and England lead the ranking of published studies, followed by Australia,

China, Canada and Germany. This fact led to the need of understanding this movement toward openness and the contribution of information and communication technology (ICT) to achieving the potential outcomes of such an initiative – Open Government.

## 2. FROM E-GOVERNMENT TO OPEN GOVERNMENT

There is a global trend toward using technological resources and adopting policies that can facilitate the implementation of an “information society.” In public administration, this is happening not only because it is a tool that can enhance government efficiency, but also due to the potential of technology to create new conditions for the exercise of citizenship (CARDOSO, 2003).

E-Government emerged as part of this evolution in technology use and expansion of the Internet. “In its narrowest definition, E-Government refers to making more tools available to government through technology” (RAMINELLI, 2014 p. 2). It includes, for example, replacing hard-copy forms with electronic versions and the provision of public services using the Internet. It also includes replacing over-the-counter services with services provided through the Internet (BRANCO, 2014). E-Government is intended to streamline services and ensure universal access to them, as well as to increase the transparency of government actions.

More generally, it is a way of organizing knowledge that allows for merely bureaucratic acts and structures to simply disappear and for tasks requiring more complex human activity to be facilitated (ROVER, 2005).

Over time, it was seen that simply using technology without an actual corresponding dialogue with citizens is insufficient to produce effective results. This is how the Open Government topic emerged (RAMINELLI, 2014). Although seemingly modern, it is not a new concept. Actually, it is something that has been evolving in society since the last century, when we began to rely on social capacity to demand the right to public information, accountability and government transparency (OSIMO, 2008). Initially seen as a mechanism for making government information under public domain available to be freely used by society (AGUNE, et al., 2010), it now comprises new elements beyond the opening of data, namely: transparency, collaboration and social participation.

In relation to ICT and in a narrow sense, Open Government refers to the adoption of interactive and participatory practices that allow for the population, on a collaborative basis, to act as an active subject in building and monitoring public policies, using the Internet and social media as a support platform. It should be observed that this concept has become more popular and feasible due to the recent development of technologies that enhance transparency and the availability of public data that enable and facilitate the availability of information and access to it, especially through the Internet (MATHEUS, et al., 2012).

The difference between E-Government and Open Government is not a detail. In general terms, Open Government is expected to change the status quo and operation of the administrative machinery, empowering citizens, challenging the limits of representative democracy and creating new channels of participation and support to decision-making, using social media and the Internet as a platform for this purpose (BRANCO, 2014). Thus, unlike E-Government, which is focused on process automation and on enhancing the efficiency of public administration, Open Government practices are intended to increase the transparency of government actions for the purpose of promoting access to public information, encouraging social participation and fighting corruption with the ultimate goal of stimulating economic growth (BRASIL, 2014).

The benefits afforded by Open Government in terms of transparency and social control are, at least theoretically, evident: the availability of public data

tends to contribute to increasing government transparency, creating better opportunities for social control over government actions. It can also increase citizen participation and the creation of new information and applications based on government data made available initially. Under the Open Government initiative, new data and even services can be created from the interaction between government and society, as citizens are treated as much more than just passive receivers of information (MATHEUS, et al., 2012).

### 3. THE U.S. EXPERIENCE

The United States lead the ranking of publications on Open Government. This is why we were motivated to reflect on what that country has been doing in this area, with the aim of seeking best practices and both lessons for Brazil and opportunities for TCU's action.

Access to information and data opening have been the subject of debate in the U.S. for several years. More recently, in January 2009, President Barack Obama issued a Memorandum on Transparency and Open Government, which gave rise to the Open Government Directive. This action had a huge effect on the country's initiatives in terms of data opening.

The memorandum and directive laid the three pillars of Open Government that are used as a benchmark in this area today: Transparency, Participation and Collaboration. Transparency promotes accountability and provides information to citizens on what government is doing. Participation improves the effectiveness of government and the quality of its decisions and collaboration involves citizens in government actions actively (EUA, 2009).

The directive guides and regulates the provision of information by U.S. government agencies to the public and guides the use of new technologies. The directive provides that government should offer more opportunities for citizens to participate in policy-making, including by requesting suggestions from citizens on how to increase public participation in government. The law provides that executive departments and agencies should use technology in innovative ways to create methods and forms of cooperation between all levels of government and with non-profit organizations, businesses, and private-sector entities (EUA, 2009).

It is crucial to understand that the innovations introduced by the Obama administration were based on several laws and regulations that had existed in

the U.S. for several years. As a result of this track record of promoting transparency and of more recent actions taken by the Obama administration, agencies have been making a lot of financial and non-financial information available to the public. Federal agencies have done more than publishing information and have launched initiatives to improve the availability and reliability of data on federal spending.

In December 2001, a board was set up (GAT - Government Accountability and Transparency Board) to challenge the government to “do better.” This board standardizes key elements of information with the aim of ensuring the integrity and credibility of published data. GAT’s plans are incremental and are intended to leverage initiatives of agencies to improve existing business processes and increase the transparency of data. These initiatives are at an early stage and some progress has been made to increase the consistency of published data (GAO, 2013).

The GAO - Government Accountability Office, the oversight agency of the U.S., has been actively involved in implementing the transparency, participation and collaboration proposed by President Obama. Several reports check the data provided by agencies. The focus of these evaluations has been on measuring whether the agencies are reporting the required information and if the data made available on their websites are consistent with official records. Because of these reports, the GAO points out the need to improve the reliability of the information posted on those websites. For this purpose, it issues recommendations (1) for improving the guidance provided on how information is to be disseminated and records supporting it kept and (2) for developing and implementing monitoring processes to ensure that the data are consistent with the agency’s records (GAO, 2012).

The GAO supports the initiative and recommends necessary improvements. As a result, the most important and relevant data is made available to the public in an accessible, organized and reliable way. It should be noted, however, that many challenges remain improving data consistency and the actual participation of society are goals that the U.S. is still striving to achieve.

#### **4. OPEN GOVERNMENT AND THE BRAZILIAN EXPERIENCE**

The movement for opening data and implementing the Open Government concept is a worldwide

phenomenon, as governments and local authorities in countries such as the U.S., Australia, New Zealand, the Netherlands, Sweden, Spain, Denmark and Austria are making their data accessible to the public by publishing it on the web.

In Brazil, the discussion on the right and access to information is not new. Article 5 of Brazil’s Federal Constitution provides that “all persons have the right to receive, from the public agencies, information of private interest to such persons, or of collective or general interest” (CF, 1988).

In May 2000, Complementary Law No. 101, the Fiscal Responsibility Law, introduced the concept of fiscal transparency. It provides for public finance rules designed to ensure accountability in fiscal management.

The Office of the Comptroller General of Brazil (CGU) has also launched major initiatives in Open Government and for promoting transparency. It manages the Transparency Portal of the Federal Government, launched in November 2004, a channel through which citizens can monitor the financial implementation of government programs at federal level. The portal provides information on federal public funds transferred by the federal administration to states, municipalities, the Federal District and directly to citizens, as well as data on federal government spending with procurement, construction projects and services.

Law No. 12,527 of November 18, 2011, which regulates the right to access information provided for in Article 37, Item XIV, Paragraph 3, and Article 216, Paragraph 2, of the Constitution, is another major milestone in promoting transparency in Brazil. Known as the Access to Information Act (LAI, in its Portuguese acronym), this law came into force on May 16, 2012 and created mechanisms that make it possible for all citizens to receive public information requested from agencies and entities without the need to explain why.

CGU also created the Transparent Brazil program, which helps states and municipalities to implement transparent government measures set out in the Access to Information Act. The goal is to join efforts around the process of increasing public transparency and adopting Open Government measures (CGU, 2014).

As part of other Open Government initiatives, the federal government launched the Brazilian Open Data Portal ([dados.gov.br](http://dados.gov.br)) in December 2010. This website is the central point for browsing and accessing Brazil’s public data. Its aim is to organize and provide

reliable government information that can be accessed easily and is useful for both government and society. The data is provided by federal government agencies, ministries and other public agencies and are open to anyone interested in accessing them. The Ministry of Planning (MP) is in charge of managing the portal and has invited all federal agencies to publish data and information on this portal. (BRASIL, 2014).

The Brazilian Open Data Portal is part of the National Open Data Infrastructure (IN SLTI MP 4/2012 INDA). The National Open Data Infrastructure (INDA) constitutes the government policy for open data and is made up of a set of standards, technologies, procedures and control mechanisms required to meet the conditions for disseminating and sharing public data and information in the Open Data model.

The Open Government Partnership (OGP) was launched in 2011 with the commitment to make governments more transparent, reliable and responsive to citizens (OGP, 2014).

Brazil has been taking part in the OGP since it was created and took on the commitment to strengthen practices related to promoting transparency in government acts, preventing and fighting corruption, improving the delivery of public services and promoting access to public information and social participation in government.

Brazil's action plan in connection with the OGP is publicly available and is coordinated by the Inter-Ministerial Committee on Open Government (Ciga), made up of representatives from 18 ministries and the Civil House (Office of the Chief of Staff). The Ciga committee has an Executive Group made up of representatives from seven ministries that is coordinated by CGU. The first Brazilian action plan, launched in September 2011, included 32 commitments. In a review carried out in October 2012, it was seen that 21 actions had been completed, 4 were in progress, 5 were behind schedule and 2 had not been initiated. After this review was published, the Federal Government started to develop a second action plan with greater participation of society: CGU set up a working group with the General Secretariat of the Presidency (SGPR) and 10 Brazilian civil society organizations to draft this second action plan (NEVES, 2013).

The progress made by the Brazilian government to increase transparency and make public information more accessible was significant. Over the past 10 years, Brazil has built its active transparency framework and consolidated social participation mechanisms. To-

day, several federal and state agencies keep transparency pages and websites where information can be accessed, contribute to ensure compliance with OGP commitments and hold conferences to discuss topics of interest to society (NEVES, 2013). However, many challenges remain in relation to Open Government in Brazil: there are several gaps to be filled to migrate from the model in which citizens are mere consumers of government solutions to one in which citizens act as partners in building these solutions.

## 5. THE PRACTICE OF OPEN GOVERNMENT AND THE EXAMPLE IN EDUCATION

For one to better understand, in practical terms, the motivation of citizens and how they collaborate with and participate in the Open Government (OG) initiative, it will now be analyzed how the area of Education has been developing and implementing its actions. Practical data opening applications in education, both in Brazil and in other countries, confirm the full materialization of the Open Government initiative through three pillars: transparency, participation and collaboration. The increasing number of academic papers on the subject and competitions for publications on educational data (hackathons) are examples of the relevance of the subject for Open Government in Education.

### 5.1 TRANSPARENCY

Transparency provides information to citizens on what governments are doing and, therefore, allows them to have an informed participation in their actions. It also increases the level of accountability of governments and creates economic opportunities (McDERMOTT, 2010). Transparency mechanisms are designed to make available information being generated, managed and stored by a specific entity, in a relevant way, including information on decision-making processes, procedures and performance. Thus, transparency mechanisms can allow for value creation and reduce asymmetries in information (JETZEK, et al., 2013).

The area of Education is one that has been making a large amount of information available both in Brazil and abroad. According to Meijer (2009), publishing information on the performance of schools on the Internet has become a trend worldwide. Many countries publish such information because they believe that it can be beneficial for schools and parents. However, this expectation does not necessarily reflect reality. Despite

increased transparency and several data on schools being published, performance indicators are not always used by parents to support their final decision as to the school where they want their children to study. This does not mean that publishing data on school performance on the Internet has no results. School managers often refer to this information to find out what is happening in other schools. They interpret and analyze this information with the aim of competing, comparing and learning from the experiences of other institutions.

After the Access to Information Act was passed, Brazilian public organizations operating in the area of education promoted access to evaluation data for the Brazilian education system. Table 1 lists some examples of open education data available in Brazil. The same data can also be found on the Open Data portal of the federal government, facilitating the gathering of all educational information in a single email address.

Much of this data is made available in its basic form and citizens have a hard time understanding it due to their lack of analytical capacity or knowledge of the database semantics. There are websites with the required granularity to provide information about public education institutions across the country. However, due to how the data is presented, this information does not always create value for citizens, since they need to have the technical knowledge required for understanding and analyzing the data. Contents are often not appropriate for the target audience, making it difficult for society to consume the information. In other cases, depending on the desired information, citizens would need to combine data from several public websites to be able to get to the information they want.

A positive evolution was observed in the area of education in terms of Open Government, for which a large number of data is available. However, for actual results to be achieved, for transparency to be actually exercised, and for collaboration and participation to exist between the relevant areas, many challenges remain to be overcome.

## 5.2 COLLABORATION

Collaboration is the bridge between transparency and participation that allows for agents of the Public Administration to either act or not act in order to turn public data into information for citizens. Collaboration takes place within the Public Administration, with agents validating and promoting improvements in the quality of such data, and outside it, with other agents translating public data into tangible information for ordinary citizens.

Jetzek explains that the number of agents who access data generated by transparency mechanisms has been growing and that they need to have the ability to process that information, as well as an opportunity and incentive to act upon it. In this context, collaboration among the various actors involved in the information value chain is a must (JETZEK, et al., 2013). The value chain for producing useful information for citizens is dynamic and needs to be constantly re-evaluated, and this is why the cost for producing and maintaining it is too high to be borne by the Public Administration alone. This scenario suggests that the best path to be followed is that of encouraging collaboration within and without the Public Administration with the aim of turning public data into relevant information. In the case of Education, organizations have been adopting collaborative solutions, combining and translating data into information for specific target audiences.

In Brazil, competitions for publications on educational data (hackathons) have been held (2014). Relying on the support from the Lemann Foundation, Inep held the 1st edition of the Educational Data Hackathon. In the marathon, 30 hackers from around the country worked for 36 hours straight and developed applications, websites and platforms using data from the Brazil Test and from the Brazilian National System for the Evaluation of Basic Education (Saeb). The purpose of the softwares produced during the Hackathon is to disseminate educational information, helping to mobilize

**Table 1:**  
Examples of Open  
Data for Education

Institution	Description
Anísio Teixeira National Institute for Educational Studies and Research (INEP)	School census in basic and higher education nationwide. The School Census collects data on institutions, enrollment, teaching functions, school movement and performance.
National Fund for Education Development (ENDF)	Data from the information system for public education budgets (SIOPE). The data available refer to education budgets of the Federal Administration, states, the Federal District and municipalities.
National Treasury Secretariat (STN)	Data from the accounting and tax information system for the Brazilian public sector (SICONFI). This system was set up to receive accounting and financial information and fiscal statistics from 5,564 municipalities, 26 states, the Federal District and the Federal Administration. This data makes it possible to evaluate the budget execution in the area of Education.

**Table 2:**

Examples of websites created by agents who are not of the Public Administration consuming open data education

Name of the website	Description	Information used
The School we want – <a href="http://www.aes-colaquequeremos.org.br">www.aes-colaquequeremos.org.br</a>	Promotes social participation with the aim of improving the quality of public schools. Citizens can compare the performance of their school with the Basic Education Development Index (IDEB) and act to improve their educational institution.	Data from INEP
<a href="http://www.Qedu.org.br">www.Qedu.org.br</a>	Open and free website where citizens can find information on the quality of learning in each school, municipality and state in Brazil. Through the Qedu website, we want Brazilian society as a whole to be afforded opportunities to learn more about education in Brazil.	Data from Ideb/Inep; school census/Inep
PNE (National Education Plan) Observatory	The PNE Observatory is an online platform designed to monitor indicators for each of the 20 goals of the National Education Plan (PNE) and their respective strategies and to analyze public educational policies already implemented or that will still be implemented over the ten-year period covered by the Plan.	Uses various public data. For example: IBGE/Phad
Fora da escola não pode! (Staying out of school is not an option!)	The web documentary Fora da escola não pode! provides data on children out of school in all Brazilian municipalities.	2011 Demographic Census carried out by the Brazilian Institute for Geography and Statistics (IBGE).

society in support of quality public education. In this first competition, the winner was the website called The School we want. These competitions are great examples of the application of the collaboration pillar of the Open Government framework. Table 2 shows this and other examples of public education data turned into information that can be easily consumed by citizens:

### 5.3 PARTICIPATION

Actual use of data provided by the Public Administration to promote citizen involvement in the management of public affairs translates the idea of the participation expected under the Open Government initiative. However, going beyond the mere publication of data and actually promoting citizen participation is not an easy task. If the goal of open government is to ensure the engagement of citizens, initiatives under way should be reassessed and new approaches explored beyond the provision of data (EVANS, et al., 2013). Participation consists in enabling citizens to become protagonists in the management of public affairs, allowing them to take part in decisions and in control and management mechanisms related to public spending in all its aspects. According to Jetzek, participation mechanisms are designed to enable and encourage public participation in government through voluntary contributions of ideas. These mechanisms afford citizens opportunities to influence public policy directly (JETZEK, et al., 2013).

In Brazil, the website The School we want (2013) is an example of an initiative designed to promote citizen participation. In the application, citizens are guided on how to demand better performance of a given school. This guidance ranges from showing them how

to work with the school for this purpose to teaching them how to report undesired situations to the Public Prosecutor's Office.

Open Education is another global movement in favor of participation in the area of education. Much more than freely sharing educational content, open education involves experts, stakeholders and students in a virtual environment, generating knowledge and innovation dynamically. According to Adler (2008), open education benefits from the new version of the Internet - the Web 2.0 version. The differences between this new Internet and the previous one lie in the use of tools such as blogs, wikis, social media, identification systems and websites for sharing content, which are examples of a new information infrastructure focused on users. Participation usually takes place around a content/prior presentation that stimulates focused and direct conversations (often using informal, less technical language), instead of traditional posts, facilitating innovative exploration and experimentation, which often form the basis for a better action-oriented understanding of issues, instead of promoting passivity.

The initial movement and some examples of Brazilian websites that discuss education-related issues and share ideas are: [www.educacaoaberta.org](http://www.educacaoaberta.org) and [www.convivaeducacao.org.br](http://www.convivaeducacao.org.br).

## 6. CHALLENGES FOR IMPLEMENTING THE OPEN GOVERNMENT INITIATIVE

The Open Government concept and its application have grown considerably over the past few years. This topic has been widely debated by scholars. Many academic papers and also those published in the media

highlight the challenges faced in this regard and also those that must be overcome to ensure transparency, participation and collaboration.

### 6.1 TECHNOLOGICAL CHALLENGE: GOVERNMENT 2.0

How can the Open Government initiative be promoted and the Web 2.0 features used? The Government 2.0 concept answers this question. According to Teixeira (2011), the term Web 2.0 was first used in 2005 by O'Reill, based on the perception that an "architecture of participation" was emerging as a major facilitator for the co-production of information, social media and spaces for individuals to interact for different reasons. Unlike the Web 1.0 version, the new version of the Web has the ability to build networks that connect individuals and organizations within a community in which information is shared, adapted and updated by all members who choose to take part in it, leading to the democratization of information online. The main innovation is not the programming techniques and the tools themselves. It is how users generate content and influence its organization according to their preferences. Facebook, Blogs, GoogleDocs and Wikipedia are examples of Web 2.0 tools, among others.

According to Nam (2012), Government 2.0 refers to using Web 2.0 technologies to share government data, processes and services. Collaborative tools will allow a two-way interaction between government and citizens through online comments, live chats and messaging. Nam also explains that information privacy, security and standards are factors that influence the slow pace of use of Web 2.0 resources by government.

### 6.2 LEGAL, ADMINISTRATIVE AND CONFIDENTIALITY CHALLENGE

Full implementation of the Open Government initiative has high costs and depends on sound strategy and clear regulation. In this context, legal support is fundamental and constitutes a critical initial step to motivate the Public Administration to manage and know the information under its responsibility.

Initiatives of the Obama administration such as the Memorandum on Transparency and Open Government (White House, 2009) and the Open Government Directive (Office of Management and Budget, 2009) have been often cited in discussions on legal support for Open Government. These are consistent standards,

as they were built based on several previously existing laws and regulations.

The history of relevant laws in the United States is extensive. The Freedom of Information Act (FOIA, 1966) was a milestone. It provided for the right to obtain information from federal agencies and was intended to ensure an informed citizenry, vital to the functioning of a democratic society, needed to check against corruption and to hold the governors accountable to the governed. The Red Tape Reduction Act of 1995 and the Paperwork Reduction Act (PRA, 1980) were also passed with the aim of reducing paperwork in government processes and maximizing the use of information. More recently, the E-Government Act of 2002 changed the way that government identified and made information available. In 2007, after many years, amendments were made to the FOIA through the Open Government Act.

However, legal support alone is not enough to ensure a dialogue between citizens and policymakers. Despite the existence of normative acts that represent a critical first step to motivate the Public Administration to manage and know information under its responsibility, the challenge of promoting its engagement should be considered. Information management is critical for ensuring access to it: the public cannot ask for something that it does not even know exists and government cannot disseminate or even find what it doesn't know (McDERMOTT, 2010). According to Ganapati (GANAPATI, et al., 2012), political and organizational dynamics can undermine open government efforts. Organizations can employ several strategies to avoid opening data and adopt a false pro-transparency stance that hides information.

In addition, striking a balance between open government and security is a difficult task. Despite the existence of a legal framework that promotes freedom of information and, consequently, transparency, the issue of confidentiality and privacy should not be disregarded (GANAPATI, et al., 2012). As an additional contribution, Evans and Fields (2013) explain that as a result of comprehensive directives on data opening, U.S. agencies have made an effort to ensure the availability of data and information that do not pose confidentiality and privacy risks as a means of achieving the Open Government Directive's objectives.

We see that legal support alone cannot ensure the success of the Open Government initiative. The action of both government and non-government agents is necessary to overcome the administrative challenges

involved and ensure the correct and safe publication of data.

### 6.3 THE CHALLENGE OF CREATING VALUE FOR CITIZENS

One of the greatest challenges for Open Government is ensuring the integration of data for them to become information of value for citizens. Many data have been published, but several authors have been challenging the real value of making them available. The National Audit Office (NAO), the UK’s watchdog, issued several reports analyzing the return on investing in Open Government.

The difficulty lies in providing information that is of interest to citizens in their everyday life. According to Jetzek (2013), in order to encourage citizens to participate by expressing their opinions on policy-making or participating in projects directly, they must have access to specific information on an issue under discussion. In the opinion of Evans and Campos (2013), the ability of agencies to use technologies has a bearing on civic engagement. In their assessment, they reached the conclusion that processing and incorporating suggestions from citizens into Open Government projects has been a challenge for government agencies.

Table 3 presents a list of practical examples in the area of Education that show how citizens are motivated to participate when information relevant to their daily lives is provided. Support for these initiatives is presented in the publication of the UK government called Open Public Services (Cabinet Office, 2011), which presents a government reform program designed to ensure that key data on public services is publicly available and accessible. This program includes a component of dissemination of data on user satisfaction, spending, performance and equality of all public service providers in all government sectors.

When information creates value for citizens, it is useful and tangible for their everyday life and more substantially consumed. This is what the British report Implementing Transparency (NAO, 2012) points out, confirming an increase of 84% in viewership on the

website that provides school performance information as compared to the same period the year before.

Finally, publishing information is not enough, as there must be a direct relationship between data that is disseminated and the interests of citizens in their daily life. This is the only way to promote citizen engagement, participation and collaboration with government, so as to generate better and more effective results for society.

### 6.4 THE CHALLENGE OF MEASURING RESULTS

Measuring the effects of Open Government is a complex task. According to Meijer (2012), the direct and indirect effects of Open Government make it difficult to analyze the synergistic and complementary links between transparency and participation. Access to information can facilitate participation, but it can also lead to a risk aversion behavior within government. On the other hand, the mere fact that citizens are entitled to participate can actually lead to greater transparency directly.

Hubbard provides a practical example of the difficulties involved in measuring the results of Open Government (2007) after he analyzed the role of information in reducing corruption in the education sector in Uganda. Disseminating information contributes to reducing corruption, but a more detailed study points out that this result is not achieved simply by disseminating information. At the same time, Meijer (2012) warns that corruption can be reduced simply by making it compulsory for public officials to provide information about their actions on the Internet. Even if no one accesses this public information, its public nature can still inhibit corruption due to the effects of the expected social control over it.

## 7. REFLECTION ON THE ROLE OF TCU IN THE OPEN GOVERNMENT INITIATIVE

Open Government is a comprehensive and new topic for the global society. Many governments invest in implementing an Open Government that promotes

**Table 3:** Examples of British websites - the National Audit Office (NAO) report - Implementing transparency (NAO, 2012)

Name of the website	Description
<a href="http://parentview.ofsted.gov.uk/">http://parentview.ofsted.gov.uk/</a>	Website that collects and reports opinions of parents on schools
<a href="http://www.education.gov.uk/schools/performance">www.education.gov.uk/schools/performance</a>	Website that publishes data that is useful for parents to choose schools
<a href="http://www.police.uk/">http://www.police.uk/</a>	Website that disseminates public safety information by region

transparency, participation and collaboration. There are no ready-made paths or clear expectations as to its desired results, but there is international consensus around the importance of this initiative for building a truly democratic society.

This is an area in which the Brazilian Federal Court of Accounts (TCU) can act and take part in efforts to stimulate and control Open Government practices, data and information, as well as to promote transparency, collaboration and social participation.

In fact, TCU's strategic map includes the objective of "contributing to transparency in Public Administration." The map shows two other objectives related to data opening, participation and collaboration: "inducing Public Administration to disseminate information about its management" and "facilitating social control."

TCU's actions to validate, develop, and ensure the convergence of Open Data initiatives can speed up greater social participation in government, similarly to what GAO and NAO have been doing. GAO reviews published information and their reliability, while NAO focuses on analyzing the benefits generated by the Open Government initiative in England.

After discussing and understanding the magnitude and importance that the Open Government initiative has been gaining, it is time to reflect on how the Court could be even more proactive and efficient when guiding those under its jurisdiction - that have budgetary and accounting data - regarding how such data should be published and validated. The Court should also analyze the data and contribute to the added value for citizens and society.

## 8. CONCLUSION

Among the challenges mentioned here for building the Open Government initiative, producing information of value that promotes society's participation in the actions of governors is the main goal to be achieved. Publishing specific data on issues of national interest, ranging from public policy indicators to budget and accounting data, with the granularity and language required for citizens to materialize such information in their daily lives, promotes social participation and thus helps to control and ensure sound management of public funds while inhibiting corruption.

Both in the academic context and in the context of foreign governments, discussions and investment in Open Government have been growing significantly.

In Brazil, the topic has not gone unnoticed. The area of education provides examples of what can be done and achieved by promoting Open Government. The information made available by Inep to create the The School we want website provides a good example of how Open Data can be used to promote civic engagement. On this website, citizens can easily access evaluative data for a given school and compare them with the national index. Additionally, if citizens had access to education budgets by municipality, they could carry out comparative analysis between the quality of schools and the budgets made available to municipalities. Expanding horizons, data on topics such as health, safety and urban planning, among others, could also be disseminated, benefiting projects in these areas. There are also opportunities for expanding the actions of the Federal Court of Accounts with the aim of validating and stimulating the publication of public data on budgets and accounting in these areas and, ultimately, of promoting transparency.

On the other hand, the challenges mentioned here illustrate part of the actions to be taken. Taking a careful look at published data and providing advice on coordinated initiatives at the local, state and federal levels are major steps for ensuring the successful implementation of Open Government in Brazil.

We hope that this paper fulfilled its objective of shedding some light on the Open Government topic and contributing to a Public Administration that strengthens democracy by ensuring greater citizen participation in the responsibility of governing.



# Information and Communications Security - Environmental Analysis of a Public Institution: methodological framework for the implementation of security controls applied to information assets



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## ABSTRACT

In today's society, where information takes a strategic role in the formulating of organizational policies to obtaining favorable economic results, the efficient use of information resources has been a constant. This article aims to analyze, in a public institution, some information assets that need to be protected against threats as well as checking the current structure of physical security of this institution in which these assets are included, exemplifying some physical risks and associated controls that can be treated by contingency plans.

**Keywords:** Information Security; Information Management; Risk; Contingency.

## 1. INTRODUCTION

Information security requires the organization to implement and maintain an adequate structure of physical controls in order to ensure the information assets are protected from threats that may damage or disable them causing possible risk of immensurable loss.

This article aims at analyzing the current structure of the physical and environmental security of a certain public institution and verify, through means of observation, some of the information assets that need



to be secure and protected against possible threats. It also presents some risk examples with a brief analysis of its effects on the institution and of associated physical controls.

## 2. ORGANIZATIONAL STRUCTURE

The analyzed institution refers to a typical federal public body, which comprises public agents, public servants, outsourced employees and positions of trust.

On its organic structure, in addition to the sectors responsible for the administrative, financial and assets management that are essential for the proper functioning, there are also several units responsible for the general customer services, which represent the primary activities for the compliance with regulatory purposes of that body.

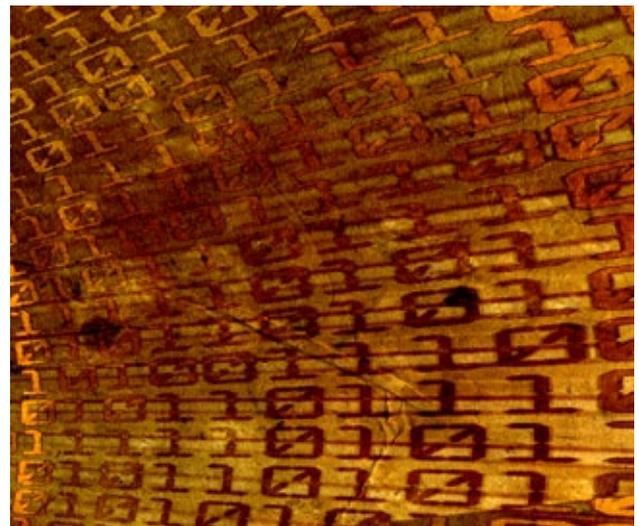
Subsidized financial resources are used for the performance of organizational activities, and a specialized control core must manage them, once the execution of expenses must be previously approved and the results must be measured and monitored, generating information that will be used in the decision making process.

The amount of people walking through the facilities of the institution is great, either for the amount of services delivered to an specific public or for the means of access to the facilities shared with other

agencies, which increases the need of keeping a system of information management and information and communication security at adequate levels.

## 3. ASSOCIATED RISKS

Based on the observation of the information assets that comprise the institution's assets collection it is possible to list some of the most relevant in order to exemplify the specific threats involved and how to proceed to risks analysis and evaluation level, as presented on table 1.



**Table 1:**  
Risks assessment

Id.	Asset	Specific Threat	Vulnerability	Risk - R	Probability	Impact	Risk Level
A1	Archive activities area	Unauthorized access	Absence of an access control system	R1 – Information integrity loss	High	Very Deep	Very High
A2	Official documents recorder computer equipment	Unauthorized copy of sored information by company hired by the institution.	Enables the company to have information access without the proper control.	R2 – Information confidentiality loss.	Very High	Deep	Very High
A3	Document Management System	Server connection interruption.	Absence of redundancy activation routine.	R3 – Information availability loss.	Very Low	Critical	Low
A3	Document Management System	Server does not hold the system access demand.	Server access limitation.	R4 – Information availability loss.	Medium	Low	Low
A3	Document Management System	Document unauthorized visualization.	The system has only two restriction levels for document access, which does not address all circumstances.	R5 – Confidentiality loss.	Very High	Very Deep	Very High
A4	Printer	Unauthorized people obtaining information stored in the printer memory.	Absence of routines of memory cleaning or disposal of the printer information storage device.	R6 – Information confidentiality loss.	Very High	Deep	Very High
A5	Laptops	Theft.	Critical information storage inside the laptop.	R7 – Information confidentiality loss.	Medium	Very Deep	Very High
A6	Desktops	Unauthorized visualization of business critical information.	Operation system accessible in the absence of the user-owner.	R8 – Confidentiality loss.	High	Critical	High
A7	Physical documents	Document unauthorized visualization.	There are no mechanisms of documents access control.	R9 – Confidentiality loss.	Very High	Very Deep	Very High

Source: the authors

Chart 1 shows the risk matrix, in which the probability relation between the occurrence of an event and the level of impact on the information resources or information assets functionality is presented.

The following definitions were applied in this context:

**Probability**

- Very Low:** Very unlikely to happen – (0% - 10%);
- Low:** Unlikely to happen – (10.1% - 30%);
- Medium:** Occasionally happens – (30.1% - 70%);
- High:** Likely to happen – (70.1% - 90%);
- Very High:** Frequently happens – (90.1% - 100%).

**Impact**

- Insignificant:** The damages are insignificant for the organization;
- Low:** The organization is able to fix the damage with its own resources;
- Critical:** The damage recovery requires resources that were not foreseen by the organization;
- Deep:** Damage that may harm the body image or generate incidents that may be difficult to fix;
- Very Deep:** Damage or irreparable loss of the body image or of the resources functionality.

For an information management system, some adequate processes of identification and risks control

**Chart 1:**  
Risk Level

		Probability				
		Very Low	Low	Medium	High	Very High
Impact	Very Deep	High Risk	High Risk	Very High Risk	Very High Risk	Very High Risk
	Deep	Medium Risk	Medium Risk	High Risk	High Risk	Very High Risk
	Critical	Low Risk	Medium Risk	Medium Risk	High Risk	High Risk
	Low	Very Low Risk	Low Risk	Low Risk	Medium Risk	Medium Risk
	Insignificant	Very Low Risk	Very Low Risk	Very Low Risk	Very Low Risk	Very Low Risk

**Quadro 2:**  
Definição de prioridades

		Control Actions Efficacy				
		Strong	Satisfying	Unsatisfying	Weak	Inexistent
Risks Ranking	Very High Risk	High Priority	High Priority	Very High Priority	Very High Priority	Very High Priority
	High Risk	Medium Priority	Medium Priority	High Priority	High Priority	Very High Priority
	Medium Risk	Low Priority	Medium Priority	Medium Priority	High Priority	High Priority
	Low Risk	Very Low Priority	Low Priority	Low Priority	Medium Priority	Medium Priority
	Very Low Risk	Very Low Priority	Very Low Priority	Very Low Priority	Very Low Priority	Very Low Priority

must be established, in which “the risks are identified through an inspection of threats and weaknesses of which these documents are vulnerable to and the resulting impact, in case a threat explore any vulnerability”. (PORTELA, T.N.O; SILVA, N.P. 2011).

Therefore, some security actions and controls able to mitigate or eliminate the risk must be implemented, following a priority order.

According to PORTELA et SILVA (2011), the risk treatment must be started by the risk that presents the highest probability of occurring and that may cause an impact relevant to business.

Chart 2 presents a priorities definition scale that assist the implementation of actions, facilitating the efficiency of resources allocation for the organization.

#### 4. ACTIONS PLAN

The selection of information security controls, as described on ISO/IEC 27002 ( ABNT, 2005), depends on the decisions of the organization, based on the risk acceptance criteria, on the options of risk treatment and on the risk management general focus applied to the organization. It is also subject to all international and national relevant laws and regulations. (SILVA, E.M. 2011a).

Nevertheless, according to SILVA (2011a), these controls must not be independent, they must be part of the Information and Communication Security Policy – PoSIC in order to comply with the rules of access and provision of supervision and monitoring devices.

##### 4.1 CRISIS MANAGEMENT PLAN - CMP

Organizational plans must be defined in the security policy in order to face possible incidents, as the Crisis Management Plan – CMP, which accurately defines the functionality of the teams before, during and after the occurrence of the incident. It aims at defining the procedures that must be executed until

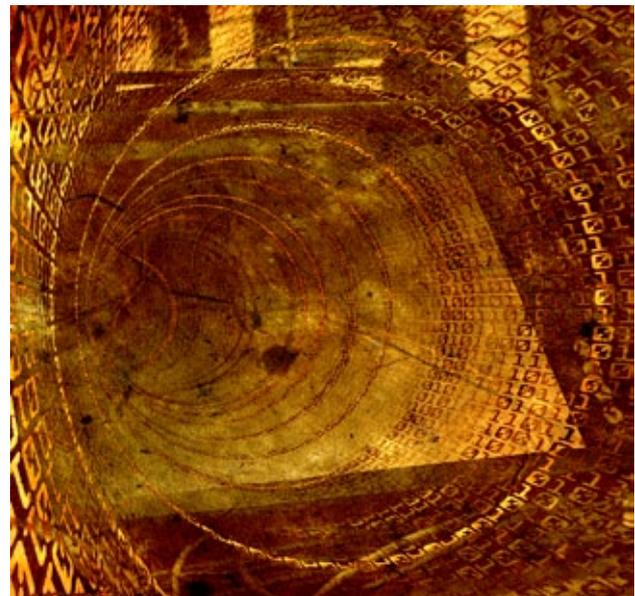
the activities return to their normal course. (SILVA, E.M. 2011).

##### 4.2 DISASTERS RECOVERING PLAN - DRP

All institutions are subject to loss of information assets for the vulnerabilities inherent to business that may be jeopardized by external and internal threats. Therefore, “it is necessary to ensure the continuity of important processes and information of the institution as soon as possible in order to avoid or minimize the impacts of an incident”. (OLIVEIRA et SILVA SAVIO, 2011).

In this context, the DRP comprises the recovery and restoration of the functionalities of human, operational and technological assets, in addition to those that support the business. It aims at reestablishing the environment to the original conditions of operation.

Table 2 presents a draft of the actions that will be executed as an integral part of the DRP, considering the risk associated to the information assets, as described on table 1.



**Table 2:**  
CMP Model

Crisis Management Plan		
Id.	Asset	Actions
R1	A1	1) Activating the building security team. 2) Verifying if there was damage to the archive, access to confidential information and changes in archived data. 3) Informing about the incident and the service reestablishment forecast to the proper hierarchical level.
R2	A2	1) Consulting the identification record of people that had access to the equipment room. 2) Verifying the logical access records and data integrity. 3) Informing about the incident to the proper hierarchical level, requesting the opening of an investigation.
R3	A3	1) Contacting the information support team. 2) Requesting the activation of the system for replacement processing center. 3) Verifying the service term in the contract of the respective supplier. 4) Informing about the incident and the service reestablishment forecast to the proper hierarchical level.
R4	A3	1) Contacting the information support team. 2) Requesting the temporary permission of a greater number of simultaneous access to the server. 3) Verifying the service term. 4) Informing about the incident and the service reestablishment forecast to the proper hierarchical level.
R5	A3	1) Identifying violated information. 2) Identifying documents related to the information. 3) Verifying records of access to the violated documents. 4) Informing about the incident to the proper hierarchical level, requesting the opening of an investigation.
R6	A4	1) Verifying which printers are being discarded. 2) Suspending the printers discard process. 3) Informing about the incident to the proper hierarchical level, requesting the opening of an investigation.
R7	A5	1) Verifying if the stolen laptop had any systems of information distance blocking or tracking. 2) Verifying the place the theft occurred, activating the building security team, if it took place in the organization's facilities. 3) Informing about the incident to the proper hierarchical level, requesting the opening of an investigation and a police report.
R8	A6	1) Verifying which critical information was available and accessible. 2) Verifying if there were changes in the integrity and information access permissions. 3) Informing the information support team to perform the adequate security procedures. 4) Informing about the incident to the proper hierarchical level and to the areas involved with the compromise of that information.
R9	A7	1) Identifying violated information. 2) Identifying documents related to the information. 3) Informing about the incident to the proper hierarchical level, requesting the opening of an investigation.

Source: authors

## 5. ORGANIC SECURITY

Considering the patterns suggested by the ISSO/IEC 27.002/2005M, it is possible to perform an analysis of the variables that compose the requirements set related to the physical controls necessary to an adequate management of the Information and Communication Security applied to the organizational environment.

The creation and implementation of physical access controls were suggested for the control of identified information assets. Thus, the areas classified as sensitive must be protected by appropriate entrance controls in order to ensure that only authorized personnel have access to them, considering:

- a. Visitors in security areas must be monitored or led by the security staff and the dates and time of their entrance must be recorded.

- b. The access to sensitive information must be controlled and restricted to authorized personnel only. Authentication controls with identification systems, as magnetic cards, must be used to authorize and validate all accesses.
- c. All personnel must use any visible identification and must be encouraged to question unaccompanied strangers and anyone without visible identification.
- d. The materials received must be inspected regarding possible danger before they are transferred from the storage to the place of use.

The implementation of a training policy was suggested once the cooperation of authorized users is essential for the efficacy of the security, for all must be aware of their responsibilities regarding the main-

**Table 3:**  
Security controls and compatibility with the identified information assets

ISO/IEC Control	Existing or suggested controls	Asset
7.1.2	It is necessary to implement a physical access control in order to consider the controls suggested by ABNT 27002 standards. There is an access control through the ratchet, the building and the receptionist in the reception. There is no restriction of internal crossing, even if the sectors present doors and restrictions on defined office hours.	A1 to A7
7.1.5	The access to the delivery and loading area from an external area must be allowed for identified and authorized personnel only. It is necessary that external doors of a delivery and loading area are protected when the internal doors are open.	All
7.2.4	An equipment preventive maintenance is performed from time to time (laptops, computers and printers). It is necessary to elaborate and implement a capacity management process. The resources and systems monitoring is performed in an informal manner, not periodically.	A2 to A6
7.2.6	It is necessary to elaborate standards for the Organic Security (Physical and Environmental) considering section 9.2.6 – Reuse and safe alienation of the equipment (ABNT 27002) in order to ensure all sensitive data and licensed software have been removed or safely overwritten.	A2 to A6
7.3.1	It is necessary to create a training policy for the sensitization and awareness of matters related to the Information and Communication Security and attention it must be given by the users.	All

Source: the authors, adapted from the ISO/IEC 27002/2005

tenance of effective access controls, especially the use of passwords and equipment security.

## 6. CONCLUSION

Based on the observation of the information assets that compose the institution’s assets collection, the relevance of the use of standards and methodologies for the implementation of a security structure that considers the information assets inventory and the associated risks analysis, among other aspects, was verified.

After the verification of the compliance of the assets with the existing physical controls, the prioritization of security actions was performed according to the evaluated risk level, which assists on the management of resources that must be allocated in these actions.

A model of the Crisis Management Plan - CMP was presented with those procedures, detailing the actions that must be followed if an incident occurs, including the functioning of the teams before, during and after the event.

With this instrument, it is possible to elaborate the Disasters Recovery Plan –DRP in order to comprise the recovery and restoration of the functionalities of the assets previously mentioned, once the plan aims at reestablishing the environment to its original operation conditions.

Finally, it was verified that the physical security controls that will be improved must consider the features established in the ISSO/IEC 27.002/2005, aiming at providing a reasonable guarantee that the environment will be protected against existing threats, which will facilitate the studied institution to have a better management of information resources.



# Benford's Law and Public Works Audit: an analysis of overpricing in the maracanã remodeling



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## ABSTRACT

The pricing analysis in public works audits is a time consuming task and sometimes the auditor spends weeks of his work time doing it, since, in many cases, the budget spreadsheets are long and difficult to analyze. The Newcomb-Benford Law constitutes a data mining tool to be used in conjunction with the ABC curve and is supposed to contribute with a more efficient selection of the services in the spreadsheets for the overpricing analysis. Such law proposes that the frequencies of the leading digits in a multitude of databases are decreasing from 1 to 9; the digit 1 appears in, approximately, 30% of the data, while the digit 9 does not reach 5% of such values. This study aims at demonstrating the application of the Newcomb-Benford Law to the pricing spreadsheets of public works. The methodology consisted of: an introduction to the Newcomb-Benford Law and its main applications; the presentation of the relevant tests of the Law in question; the development and application of such tests to the Maracanã remodeling works; the comparison of the results obtained with the analysis carried out by the Brazilian Federal Court of Accounts (TCU); and the presentation of the results, conclusions and next research. It has been found, in a general way, that the work in question presented a marginal compliance with the Benford Law. However, the tests allowed for the identification of 17 services in the spreadsheet which did not respect the Law and repre-



sented 71.54% of the total overpricing found by TCU (R\$ 149,972,318.01)

**Keywords:** Audit. Public Works. Newcomb-Benford Law. Overpricing.

## 1. INTRODUCTION

If one throws a dice at random, the odds on rolling number 5, for example, are  $1/6$ , since the dice has six sides. When one tosses a non biased coin, there is 50% chance of getting heads or tails. Therefore, we tend to think that, in a numerical database, the chance of randomly choosing a figure whose leading digit is 1 is  $1/9$ , and the same goes for any other figure from 2 to 9.

Simon Newcomb (1881), an astronomer and mathematician of the 19th century, observed that the pages of books of logarithms were dirtier in the beginning and progressively cleaner throughout, which indicated that, usually, 1 was the most accessed digit, and the frequency decreased up to 9. Such finding was contrary to the common understanding of uniform distribution of frequency of those digits. As Newcomb did not compile numerical data or provide any other evidence of his finding, it was only half a century later, when the physicist Frank Benford (1938) incidentally came to the same conclusion, that such fact began to gain ground. In 1938, Benford published his seminal work, *The Law of Anomalous Numbers*, in which he used data collected

from different types of sources. Such data were random and unrelated to each other. They varied from numbers obtained from the pages of the main newspapers and all the figures of an important topic from Reader's Digest to mathematical tables and scientific constants. His work analyzed the first digits of the collected data and showed that 30.6% of the numbers had 1 as the leading digit; the first digit 2 occurred in 18.5% of the cases; and that, by contrast, only 4.7% of the numbers had 9 as the leading digit. Such first digit frequencies apply to a number of data sources, including energy bills, addresses, stock prices, population figures, mortality rate, among others. This distribution is now known as Benford's distribution. On the other hand, the property found out by Newcomb and Benford is known as the Newcomb-Benford Law or, more simply, Benford's Law.

In order to better understand the reason for the frequency differences, suppose you invest R\$10,000 in a pension fund that offers a yearly fixed rate return of 7%. Your investment, then, will double in approximately every ten years. Therefore, after ten years having 1 as the leading digit, the amount of your investment will finally reach 20,000. After another ten years, the resource will double to 40,000 (in most part of these ten years the figures will begin with 2 and in the other smaller part they will begin with 3). After another decade, the amount will reach 80,000 (the numbers 4, 5, 6 and 7 will appear as first digits in only ten years). At a certain time, the amount will reach 100,000 and the

leading digit 1 will appear for another ten years. In this way, when choosing a random date, it is more likely that the amount of your investment on that day will have 1 as the leading digit, rather than any other number. This same logic applies to several data in nature, such as the size of populations, among others.

A database is more likely to represent a Benford distribution if the data are collected from different distributions (Hill, 1995). On the other hand, figures assigned by human intervention, such as Social Security numbers, postal codes, bank accounts, telephone numbers or numbers fabricated by students in experiments, usually do not comply with Benford's Law (Nigrini, 2000). Such observation suggests that the Law of Anomalous Numbers can be used to detect signs of human manipulation of data.

Several studies have assumed the hypothesis that fabricated data are identified by the deviation of digits in relation to Benford's distribution. Nigrini (1992, 2000, 2012), assuming that accurate accounting data followed Benford's distribution closely (as his research showed they did), argued that substantial deviations in relation to such Law suggested possible frauds or fabricated data. The author developed several tests to measure compliance with Benford's Law, and the Wall Street Journal (Berton, 1995) reported that the Brooklyn Attorney's Office, in New York, had detected frauds in seven New York companies by using such tests. In this case, the evidence provided was the finding that fraudulent and random data had a few figures beginning with 1 and many beginning with 6. Based on such previous successes, Nigrini was invited to give advice to tax agencies in several countries and to install the Benford's Law tests in most computer programs for fraud detection.

Rauch Göttsche, Brähler and Engel (2011) published a paper in the German Economic Review, in which they demonstrated that Benford's Law could be used to test macroeconomic data, revealing which ones needed to be more tightly inspected. They analyzed the compliance of the first digit of macroeconomic data reported to the Eurostat - European Union Statistical Office - by EU member countries with Benford's Law. A ranking of the 27 member countries was built, based on the extent of deviation found. The country with the greatest deviation was Greece, whose data manipulation had been confirmed by the European Commission (2010).

Walter Mebane, an American statistician from the University of Michigan, analyzed the data from the Iranian elections in 2009 and found deviations which

strongly indicated the occurrence of fraud in Ahmadinejad's victory (Mebane, 2009). Mebane had previously studied electoral data of several countries, including the United States, Russia and Mexico. In 2006, he found out that vote counting tended to follow Benford's Law for the second digit (Mebane, 2006). When testing the Iranian data referring to 2009, Mebane observed that, in the cities where there were not many invalid votes, Ahmadinejad's figures were a long way from Benford's distribution and that the candidate, in such situations, was well ahead in number of votes.

The research in question aims to present a case study of the application of the NB Law to public works, by using the budget spreadsheet of the Maracanã remodeling work. Such work was selected because it presented a relevant amount of data and due to the possibility of comparing the test results with the price analysis carried out by TCU. Firstly, the pertinent Benford's Law tests will be presented. Subsequently, such tests will be applied to the above mentioned spreadsheet; the comparison between the results and the TCU price analysis will be carried out and shown in the conclusion.

## 2. BENFORD'S LAW TESTS BASED ON THE PROBABILITIES OF THE DIGITS

The tests described below, characterized according to Negrini (2012), have been applied in this study.

### 2.1 THE FIRST TWO DIGITS TEST

The expected frequency of occurrence of a number  $D_2=d_2$  as second digit in a set of values, given that the first digit is  $D_1=d_1$ , according to the NB Law, is given by:

$$\text{Prob}(D_1D_2 = I_1d_2) = \log\left(1 + \frac{1}{d_1d_2}\right) \quad (I)$$

$$D_1D_2 = \text{First two digits and } d_1d_2 \in \{10, 11, \dots, 99\}$$

### 2.2 SUMMATION TEST

The Summation Test constitutes an Advanced Test developed by Nigrini (2012). When simulating a Benford distribution, he found out that the sum of the numbers in each first digit group 10, 11, 12, ..., 99 resulted in approximately similar values, that is, 1/90.

However, the author found that actual data hardly comply with such pattern, since they present very

high values or many repetitions of average value figures. The usefulness of the summation test is exactly to warn about such situations.

When the Summation Test is compared to the First Two Digits Test, the data volume in each group is compared to the sum of their values. Therefore, in the case of public works budget, the materiality and the relevance of each group are observed, in order to select the digits that deserve a more rigorous critical eye by the auditor.

### 3. ANALYSIS OF THE MARACANÃ REMODELING WORK

The analysis of this research focused on the Maracanã remodeling budget originally presented to TCU, totaling R\$ 931,885,382.19, as other budgets that virtually eliminated overpricing from most items in the spreadsheet were presented afterwards. The original budget was selected, so that the data analysis occurred in the most effective way possible, encompassing all the overpricing initially pointed out by the TCU technical unity. The research in question included only the unitary costs, however, the service costs and the total prices could also have been tested. 828 items were examined. Values under R\$10.00 were excluded because they did not have a second digit.

#### 3.1 FIRST TWO DIGITS TEST

In order to obtain a more detailed analysis, and to reduce the size of the critical digits sample, the first two digits test was carried out. The results are reported on table 1, where "Dig." refers to the first two digits of the values; "C" corresponds to the absolute frequencies with which the digits are repeated in the spreadsheet; "Real" refers to the relative frequencies with which the digits are repeated in the spreadsheet; "LB" refers to the standard frequencies of the NB Law; "Dif." means the difference between "Real" and "LB"; "Z Test" refers to the Z Test results used to measure compliance with the NB Law; "QQ." shows the results of the Chi-square test; and "MDA" presents the result of the Mean Absolute Deviations.

As table 1 shows, there were more intense peaks in the digits 11, 16, 25, 28 and 42 in relation to the proportions of the descending curve of the NB Law. The results of the Z Test were: 11 (2.954), 16 (2.105), 25 (2.524), 28 (2.303) and 42 (2.060).

Therefore, as only five of the 90 digits surpassed the limit of 1.96, it can be said that the proportions of

the first digits of the Maracanã unitary costs, in general, did not deviate from the NB Law for the test in question, based on Nigrini (2012), who considers the occurrence of up to five peaks acceptable for this test.

The critical value for 89 degrees of freedom and 0.05 degrees significance is 112.02. Hence, as the calculated value in the test did not exceed the critical value, the null hypothesis cannot be rejected, which suggests compliance with the NB Law.

The Mean Absolute Deviation (MAD) test was the last one to be applied. The value found for Maracanã was 0.0031, which was above 0.0022 (borderline value between compliance and non-compliance adopted by Nigrini, 2012). Such fact placed it in the non-compliance range of the reference values.

Regarding all the applied tests, it can be said that the Maracanã budget spreadsheet has passed the Mean Absolute Deviation Test for the first two digits of the unitary costs, but presented a satisfactory result in the Chi-square Test and in the Z Test.

#### 3.2 SUMMATION TEST

The Summation Test was carried out, in a complementary way, in order to properly select the critical digits. The test in question checked the materiality of each pair of digits in the budget spreadsheet. The previous tests checked the number of repetitions in relation to the standard of the NB Law; however, they did not observe the magnitude of the services corresponding to those digits. The results are shown on table 2.



**Table 1**  
First Two Digits Test for the Maracanã unitary costs

Díg.	C	Real	LB	Dif.	ZTest	QQ	MDA	Díg.	C	Real	LB	Dif.	ZTest	QQ	MDA
10	43	0,052	0,041	0,011	1,435	2,222	0,011	55	7	0,008	0,008	0,001	0,008	0,042	0,001
11	48	0,058	0,038	0,020	2,954	8,925	0,020	56	11	0,013	0,008	0,006	1,645	3,376	0,006
12	28	0,034	0,035	-0,001	0,054	0,021	0,001	57	10	0,012	0,008	0,005	1,303	2,244	0,005
13	26	0,031	0,032	-0,001	0,029	0,016	0,001	58	8	0,010	0,007	0,002	0,548	0,559	0,002
14	28	0,034	0,030	0,004	0,548	0,410	0,004	59	2	0,002	0,007	-0,005	1,447	2,706	0,005
15	31	0,037	0,028	0,009	1,535	2,616	0,009	60	5	0,006	0,007	-0,001	0,183	0,150	0,001
16	32	0,039	0,026	0,012	2,105	4,772	0,012	61	6	0,007	0,007	0,000	0,063	0,004	0,000
17	26	0,031	0,025	0,007	1,105	1,443	0,007	62	1	0,001	0,007	-0,006	1,780	3,927	0,006
18	18	0,022	0,023	-0,002	0,216	0,107	0,002	63	4	0,005	0,007	-0,002	0,490	0,488	0,002
19	16	0,019	0,022	-0,003	0,458	0,324	0,003	64	6	0,007	0,007	0,001	0,181	0,032	0,001
20	18	0,022	0,021	0,001	0,110	0,012	0,001	65	2	0,002	0,007	-0,004	1,280	2,219	0,004
21	14	0,017	0,020	-0,003	0,550	0,445	0,003	66	5	0,006	0,007	0,000	0,176	0,031	0,000
22	12	0,014	0,019	-0,005	0,880	0,993	0,005	67	3	0,004	0,006	-0,003	0,794	1,017	0,003
23	10	0,012	0,018	-0,006	1,240	1,838	0,006	68	1	0,001	0,006	-0,005	1,642	3,440	0,005
24	12	0,014	0,018	-0,003	0,574	0,489	0,003	69	7	0,008	0,006	0,002	0,585	0,644	0,002
25	24	0,029	0,017	0,012	2,524	6,944	0,012	70	6	0,007	0,006	0,001	0,177	0,159	0,001
26	7	0,008	0,016	-0,008	1,662	3,182	0,008	71	4	0,005	0,006	-0,001	0,237	0,211	0,001
27	10	0,012	0,016	-0,004	0,718	0,724	0,004	72	5	0,006	0,006	0,000	0,018	0,000	0,000
28	4	0,005	0,015	-0,010	2,303	5,887	0,010	73	7	0,008	0,006	0,003	0,729	0,908	0,003
29	7	0,008	0,015	-0,006	1,353	2,210	0,006	74	4	0,005	0,006	-0,001	0,149	0,142	0,001
30	13	0,016	0,014	0,001	0,208	0,124	0,001	75	4	0,005	0,006	-0,001	0,121	0,122	0,001
31	9	0,011	0,014	-0,003	0,571	0,512	0,003	76	6	0,007	0,006	0,002	0,370	0,359	0,002
32	13	0,016	0,013	0,002	0,434	0,338	0,002	77	2	0,002	0,006	-0,003	0,996	1,502	0,003
33	15	0,018	0,013	0,005	1,157	1,694	0,005	78	3	0,004	0,006	-0,002	0,506	0,546	0,002
34	15	0,018	0,013	0,006	1,271	2,009	0,006	79	5	0,006	0,005	0,001	0,225	0,050	0,001
35	8	0,010	0,012	-0,003	0,515	0,448	0,003	80	3	0,004	0,005	-0,002	0,459	0,482	0,002
36	13	0,016	0,012	0,004	0,848	1,005	0,004	81	7	0,008	0,005	0,003	0,997	1,518	0,003
37	10	0,012	0,012	0,000	0,133	0,018	0,000	82	5	0,006	0,005	0,001	0,068	0,094	0,001
38	9	0,011	0,011	0,000	0,112	0,012	0,000	83	2	0,002	0,005	-0,003	0,873	1,235	0,003
39	10	0,012	0,011	0,001	0,132	0,088	0,001	84	4	0,005	0,005	0,000	0,124	0,015	0,000
40	12	0,014	0,011	0,004	0,884	1,097	0,004	85	5	0,006	0,005	0,001	0,144	0,150	0,001
41	10	0,012	0,010	0,002	0,285	0,206	0,002	86	5	0,006	0,005	0,001	0,169	0,171	0,001
42	2	0,002	0,010	-0,008	2,060	4,934	0,008	87	3	0,004	0,005	-0,001	0,302	0,300	0,001
43	7	0,008	0,010	-0,002	0,268	0,194	0,002	88	4	0,005	0,005	0,000	0,031	0,001	0,000
44	8	0,010	0,010	0,000	0,029	0,001	0,000	89	2	0,002	0,005	-0,002	0,759	1,013	0,002
45	7	0,008	0,010	-0,001	0,144	0,103	0,001	90	7	0,008	0,005	0,004	1,271	2,305	0,004
46	4	0,005	0,009	-0,005	1,168	1,802	0,005	91	2	0,002	0,005	-0,002	0,723	0,948	0,002
47	4	0,005	0,009	-0,004	1,121	1,684	0,004	92	1	0,001	0,005	-0,003	1,214	2,145	0,003
48	6	0,007	0,009	-0,002	0,337	0,270	0,002	93	4	0,005	0,005	0,000	0,079	0,006	0,000
49	6	0,007	0,009	-0,002	0,285	0,220	0,002	94	2	0,002	0,005	-0,002	0,671	0,856	0,002
50	9	0,011	0,009	0,002	0,519	0,496	0,002	95	4	0,005	0,005	0,000	0,121	0,015	0,000
51	8	0,010	0,008	0,001	0,197	0,148	0,001	96	3	0,004	0,005	-0,001	0,118	0,142	0,001
52	12	0,014	0,008	0,006	1,784	3,873	0,006	97	1	0,001	0,004	-0,003	1,142	1,959	0,003
53	6	0,007	0,008	-0,001	0,086	0,077	0,001	98	1	0,001	0,004	-0,003	1,128	1,925	0,003
54	4	0,005	0,008	-0,003	0,820	1,023	0,003	99	5	0,006	0,004	0,002	0,467	0,531	0,002
N	828												$\chi^2$ Real	106,65	MDA
													$\chi^2$ Limit	112,02	0,0032

In the previous Table, the 1st and 6th columns refer to the first two digits of the values; the 2nd and 7th columns correspond to the sum of the items presenting the first two digits shown in the 1st and 6th columns; the 3rd and 8th columns show the proportions of the calculated Sums in the 2nd and 7th col-

umns, in relation to the summation of all the unitary costs in the spreadsheet; the 4th and 9th columns present the standard frequencies of the NB Law; and the 5th and 10th columns show the difference between the proportions of the Sums and the frequencies of the NB Law.

**Table 2**

Summation Test for the Maracanã unitary costs

Digit	Sum	Real	Benford	Difference	Digit	Sum	Real	Benford	Difference
10	1.117.783,14	0,002	0,011	-0,009	55	1.393,43	0,000	0,011	-0,011
11	35.228.545,85	0,060	0,011	0,049	56	11.333.846,10	0,019	0,011	0,008
12	9.996,90	0,000	0,011	-0,011	57	9.859,91	0,000	0,011	-0,011
13	1.427.480,57	0,002	0,011	-0,009	58	3.104,83	0,000	0,011	-0,011
14	149.926,09	0,000	0,011	-0,011	59	1.184,83	0,000	0,011	-0,011
15	7.327,10	0,000	0,011	-0,011	60	7.413,72	0,000	0,011	-0,011
16	12.400,03	0,000	0,011	-0,011	61	7.613,46	0,000	0,011	-0,011
17	19.334.196,90	0,033	0,011	0,022	62	626,58	0,000	0,011	-0,011
18	18.810.868,98	0,032	0,011	0,021	63	636.977,00	0,001	0,011	-0,010
19	22.983.744,00	0,039	0,011	0,028	64	2.706,05	0,000	0,011	-0,011
20	20.216.982,58	0,035	0,011	0,024	65	723,09	0,000	0,011	-0,011
21	23.621.379,30	0,040	0,011	0,029	66	8.734,92	0,000	0,011	-0,011
22	22.910.130,11	0,039	0,011	0,028	67	2.028,35	0,000	0,011	-0,011
23	3.365,19	0,000	0,011	-0,011	68	68,92	0,000	0,011	-0,011
24	2.441.496,65	0,004	0,011	-0,007	69	6.930.295,76	0,012	0,011	0,001
25	282.240.352,41	0,483	0,011	0,472	70	2.955,46	0,000	0,011	-0,011
26	3.516,32	0,000	0,011	-0,011	71	1.568,94	0,000	0,011	-0,011
27	3.699,11	0,000	0,011	-0,011	72	2.322,08	0,000	0,011	-0,011
28	629,84	0,000	0,011	-0,011	73	4.482,65	0,000	0,011	-0,011
29	9.100,20	0,000	0,011	-0,011	74	1.632,72	0,000	0,011	-0,011
30	3.041.197,41	0,005	0,011	-0,006	75	3.028,68	0,000	0,011	-0,011
31	1.124,59	0,000	0,011	-0,011	76	3.899,28	0,000	0,011	-0,011
32	32.871.298,35	0,056	0,011	0,045	77	7.708.500,52	0,013	0,011	0,002
33	40.266,66	0,000	0,011	-0,011	78	945,72	0,000	0,011	-0,011
34	3.453.111,19	0,006	0,011	-0,005	79	3.254,91	0,000	0,011	-0,011
35	8.277,56	0,000	0,011	-0,011	80	241,03	0,000	0,011	-0,011
36	14.275,68	0,000	0,011	-0,011	81	3.495,51	0,000	0,011	-0,011
37	5.748,38	0,000	0,011	-0,011	82	1.892,95	0,000	0,011	-0,011
38	40.635,97	0,000	0,011	-0,011	83	919,55	0,000	0,011	-0,011
39	2.169,59	0,000	0,011	-0,011	84	3.373,90	0,000	0,011	-0,011
40	6.314,11	0,000	0,011	-0,011	85	4.275,98	0,000	0,011	-0,011
41	85.478,77	0,000	0,011	-0,011	86	4.330,92	0,000	0,011	-0,011
42	8.514,19	0,000	0,011	-0,011	87	1.054,65	0,000	0,011	-0,011
43	6.138,93	0,000	0,011	-0,011	88	353,98	0,000	0,011	-0,011
44	4.472.961,24	0,008	0,011	-0,003	89	1.789,15	0,000	0,011	-0,011
45	4.557.697,21	0,008	0,011	-0,003	90	4.705,38	0,000	0,011	-0,011
46	605,18	0,000	0,011	-0,011	91	182,34	0,000	0,011	-0,011
47	5.356,92	0,000	0,011	-0,011	92	924,80	0,000	0,011	-0,011
48	48.849.864,06	0,084	0,011	0,073	93	2.895,08	0,000	0,011	-0,011
49	7.018,04	0,000	0,011	-0,011	94	1.034,26	0,000	0,011	-0,011
50	2.718,91	0,000	0,011	-0,011	95	11.507,03	0,000	0,011	-0,011
51	1.805,57	0,000	0,011	-0,011	96	1.154,44	0,000	0,011	-0,011
52	3.010,93	0,000	0,011	-0,011	97	976,28	0,000	0,011	-0,011
53	2.242,23	0,000	0,011	-0,011	98	98,55	0,000	0,011	-0,011
54	584.727.527,67	0,000	0,011	-0,011	99	9.975.775,86	0,017	0,011	0,006
TOTAL						584.727.527,67			

As observed on Table 2, there were peaks as regards the first two digits 11, 17, 18, 19, 20, 21, 22, 25, 32 and 48. It is rather striking to observe the proportion found for the digit 25, which represented 48.3% of the total unitary costs. According to the Summation test, the data were not nearly as close to a Benford sequence.

### 3.3 COMPARISON BETWEEN THE FIRST TWO DIGITS TEST AND THE SUMMATION TEST

Next, the digits detected as critical in the First Two Digits Test and the Summation Test were selected. The two tests results were confronted, with the purpose of confirming the criticality of the digits. This was done

by comparing their relative frequency in the spreadsheet with the proportion in material terms. The results are presented on table 3.

Table 3 shows the selected digits from both tests (column 1). Column 2 presents the relative frequencies of such digits in the spreadsheet, based on the “Real” column on Table 1. Column 3 displays the proportions of the digits in the budget spreadsheet, according to the “Real” column on Table 2. Column 4 shows whether or not the criticality of such digits is confirmed.

As observed in the comparison between the Tests, the digits 28 and 42 were excluded from the sample. They were only selected for the First Two Digits Test because of their insufficient frequency in the spreadsheet.

The results of the First Two Digits Test pointed to the digits 11, 16 and 25 (excluding the digits 28 and 42). On the other hand, the Summation Test identified excessive values for the proportions of the digits 11, 17, 18, 19, 20, 21, 22, 25, 32 and 48. It was observed that the digits 11 and 25 were identified in both analyses as excessive and, consequently, were more likely to be overestimated. In the case of an audit, an a priori analysis involving the first two digits 11 and 25 would be recommended, and only then the others should be examined.

### 3.4 COMPARISON BETWEEN THE RESULTS OF THE NB LAW TEST AND THE TCU ANALYSIS

When comparing the digits 11 and 25 with the overpricing found by TCU, the result shown on the table below was obtained.

**Table 3:** Comparison between the selected digits in the First Two Digits Test and the Summation Test

Digits	Two First Dig.T.	Summation T.	Critical Digits
11	0,058	0,060	Yes
16	0,039	0,000	Yes
17	0,031	0,033	Yes
18	0,022	0,032	Yes
19	0,019	0,039	Yes
20	0,022	0,035	Yes
21	0,017	0,040	Yes
22	0,014	0,039	Yes
25	0,029	0,483	Yes
28	0,005	0	No
32	0,016	0,056	Yes
42	0,002	0	No
48	0,007	0,084	Yes

It was observed that seven of the items on the ABC Curve had the digits 11 and 25 as the first two digits of the unitary costs, and that the summation of the overpricing found by TCU for those services totaled R\$ 41,601,247.32 It was also noted that the tensioned roof System item had the highest overprice on the ABC Curve and it also represented the most expensive service of the work (R\$ 256,714,917.00). Its first digits 2 and 5, in addition to being identified by the Summation Test as materially relevant in the budget, were pointed by the First Two Digits Test as excessively frequent in the spreadsheet.

TCU has found a total overprice of R\$ 149,972,318.01. The highest amount - R\$ 41,601,247.32 - represented 27.74% of the total overprice.

Following the examination of the two most critical digits, the other digits were also analyzed.

Having Table 5 as basis, 10 more items on the ABC Curve - whose overprice had been pointed out by TCU - were identified. Overpricing was detected for all the first two digits examined, except for 18 and 20. However, services 18.052.222-6 - Information board systems, displays (...) and 18.052.259-6 - Transformers, generating sets, no-breaks and (...), whose unitary costs were, respectively, R\$ 20,206,546.09 and R\$ 18.600.382.98, were not analyzed by TCU. Therefore, it is not possible to prove whether or not their prices were suitable.

The overprice detected for the items on Table 5 totaled R\$ 65,692,812.51, which represented 43.8% of what had been pointed out by the Court of Accounts (R\$ 149,972,318.01).

When adding the overpricing for the services on Tables 4 and 5, the total amount was R\$ 107,294,059.83, which represented 71.54% of all the overpricing detected by TCU.

## 4. CONCLUSION

The present study tested the application of the Newcomb-Benford Law, used as a data mining tool, to the unitary costs of the budget spreadsheet of the Maracanã remodeling works. The First Two Digits Test and the Summation Test, both from the Benford Law, were carried out. The Z Tests, the Chi-square Test and the Mean Absolute Deviation were applied in order to measure compliance with the NB Law. The tests, in a general way, showed that the unitary costs marginally complied with the Benford Law.

**Table 4:**

Comparison between the results of the NB Law Tests and the TCU analysis for the digits 11 and 25

Dígitos	Service	Unitary Cost	TCU overprice
25	Tensioned roof system, including metal structure, fully locked cables and "PTFE" membrane, according to Hightex project, ref.jop/juv, for Maracanã Stadium World Cup 2014.	256.714.917,00	26.961.972,80
	Sports furniture, and auditorium furniture for the Maracanã Stadium World Cup 2014 – as specified on proposal by Mackey Indústria de Móveis Ltda	25.518.649,48	4.057.726,58
	Demolition of reinforced concrete structures, using compressed air equipment, except floors or pavements.	258,38	699.201,19
11	Aluminum window frames for the Mário Filho – Maracanã Stadium as specified on Itetal proposal n. 12011-0131-000 and complementary frames.	11.920.282,97	1.935.661,95
	Pre-molded parts for Maracanã grandstand, built in reinforced concrete, including from manufacturing to onsite installation, as specified on budget spreadsheet 001/2011-Maracanã World Cup 2014.	11.771.177,22	3.605.433,06
	Sound system (internal areas and grandstand), for the Mário Filho – Maracanã Stadium, as specified on proposal pp 95981/10rev. by Prosegur Forn. and Inst. (Maracanã Worl Cup 2014).	11.512.097,16	3.748.888,14
	High resistance monolithic floor in Polyurethane flakes 3000 with varnish or satin finish and 4 mm nsbrasil or sim. applied on counter-floor and 3mm. incl. this. Maracanã 2014.f/i.	113,28	592.363,60
Total			41.601.247,32

**Table 5:**

Comparison between the results of the NB Law Tests and the TCU analysis for the remaining digits.

Dígitos	Serviço	Custo unitário	Sobrepço TCU
16	Wedge wire metal grid lining, mesh 30x100mm h=20cm, primary bar 20x2mm, carbon steel SAE 1006/1020, electrostatic painting finish, supply and installation, for Maracanã World Cup 2014.	163,52	1.514.293,41
17	Limited and public access control system, for Mário Filho Stadium – Maracanã, as specified on proposal pp 95981/10 rev.1 by Prosegur. Forn. and Inst. (World Cup 2014).	17.544.505,41	12.370.588,70
	Soil drilling for the molding of root piles, 410mm diam. for Maracanã work World Cup 2014.	177,96	373.048,34
19	Services (wiring, connectorization and interconnection of softwares, assisted commissioning, startup and operations), as specified on prop. pp 95981/10. Prosegur. For. Inst. Maracanã.	19.081.957,09	4.241.578,74
	Floor covering: polished polar white granite plates, measure (60x60) cm. 2.00cm thick laid with a fine layer of cement over cement, sand and lime mortar, proportion 1:2:2 and white cement grouting.	196,72	435.709,44
	Draining, top soil, natural and artificial grass and irrigation system for the Maracanã Stadium lawn – World Cup 2014, as specified on the Campanelli company proposal.	1.919.536,42	722.897,49
21	Demolition of reinforced concrete roof over Maracanã grandstand (marquee), as specified on budget spreadsheet n002/2009-EMOP.	21.439.722,66	13.464.684,58
22	Recovery of the structure of the Mário Filho Stadium – Maracanã – World Cup 2014, as specified on spreadsheet 004/2011 – EMOP.	22.904.212,57	10.839.664,36
32	Local management for remodeling works with changes and additions for the Mário Filho Stadium, Maracanã World Cup 2014, as specified on spreadsheet n 003/2011 EMOP.	32.863.882,27	12.563.282,35
48	System of central air conditioning and complete mechanic ventilation, for the Mário Filho Stadium – Maracanã World Cup 2014, as specified on proposal PR-078620 (Ambienter) supply and assembly.	48.844.340,89	9.167.065,10
Total			R\$ 65.692.812,51

In the individual analysis of the digits of the unitary costs, the first two digits 11 and 25 were detected on the First Two Digits Test and the Summation Test. Such first two digits were contained in seven of the items analyzed by TCU, including the service with the highest overpricing, the Tensioned Roof System (...). The overprice identified for those items totaled R\$ 41,601,247,32 and represented 27.74% of all the overpricing identified by the control agency.

In addition, the Summation Test alone identified over 10 services pointed out by TCU with amounts above the market reference prices. The total amount of overprice for the 17 items detected by the NB Law was R\$ 107,294,059.83, which represented 71.54% of the total overprice found by TCU (R\$ 149,972,318.01).

This study constitutes only the beginning of a research on the application of the NB Law to public

works audit. There was an attempt to present the applicability of such tool to budget spreadsheets, so that future research can further develop effective methods for selecting audit samples, by using the NB Law. Such research could seek to study the possible interdependence between the NB Law Tests proposed in the study in question. Furthermore, other significance levels, such as 0.01 and 0.10 – as opposed to 0.05 – could be adopted for the statistical tests, in order to measure compliance. Another interesting possibility for research would involve testing the variable amount on the budget spreadsheet individually, as an alternative to the variable price, with the purpose of checking the applicability and effectiveness of the NB Law in the identification of possible tendencies, as well as comparing those with the analyses carried out by the control agencies for detecting overprice by quantitative increase.

# Financial Audit the era of Big Data: new possibilities for evaluating and responding to risks in financial statements of the Federal Government



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## SUMMARY

This study analyzes the possible implications of the Big Data era when performing audits of Federal Government financial statements. Financial audit is characterized as a work of assurance and certification. This type of audit is usually carried out annually, based on aggregated data and limited by approaches based on risks, materiality cuts, and statistical samples. In contrast, the practices of Audit Analytics and Continuous Audit allow financial information of the entities to be analyzed in an integral way and with shorter periodicity, contributing to form timely and more reliable opinions regarding the status of the audited entities. Finally, this paper presents data on the information systems that keep the financial records of the Federal Accounting System and makes considerations on the potential contributions of the new audit practices supported by information technology, aiming at improving financial audit activities within the Federal Court of Accounts – Brazil (TCU) and other oversight institutions.

**Keywords:** financial audit, continuous audit, Big Data; Audit Analytics.

## 1. INTRODUCTION

If financial audit were compared to a game between the auditee and the auditor, it would be possible



to say that the auditee always starts out winning. The reasoning is simple: it is the auditor's responsibility to provide **reasonable assurance** that there is no error or fraud in the financial statements. Therefore, it is his/her responsibility to determine if there are relevant distortions that could compromise the content. If the auditor cannot find it, he/she will have to issue an opinion with no reservations and, therefore, certify the quality of the information contained therein.

However, auditing is not a game and, in thesis, the objectives of the auditor and auditee should be the same: give the maximum **transparency** and **credibility** to financial information, thus enabling better decision making and more efficient and effective allocation of resources. Even so, one cannot disregard the possibility of an auditor issuing an opinion saying that the statements are reliable when actually they are not. This is called **audit risk**, which takes on new proportions in face of the speedy development of information technology (IT).

The technological advances have greatly increased the ability of individuals and organizations to produce and exchange information. As a result, we can say that we live in the **Big Data era**: an increasing amount of information that is generated in a frantic rhythm and in different formats, requiring innovative and economic ways of processing in order to support decision-making and process automation (BUYTENDIJK, 2014). In this context, the traditional mechanisms for communicating results, such as annual statements,

compete with financial information that is disseminated on the internet and other means. Many times, this happens almost simultaneously with the occurrence of the respective transactions. This favors quicker decision-making and contributes to make operation of economy and governments more dynamic.

Almost unrestricted access to information contributes to the creation of a **risk society**, an expression used by sociologists Anthony Giddens (1999) and Ulrich Beck (1992) to show the changes in social behavior resulting from greater awareness of the risks they are exposed to. Thus, if on one hand increase in the amount, speed and variety of information favors more timely decisions, on the other, greater awareness of the risks increases caution in the decision-making process demanding information that is more and more reliable. An analytical view of the past is no longer enough; it is necessary to develop a predictive ability regarding future events in order to make decisions in the present (DELOITTE, 2013).

Accounting and IT are developing in order to make this new paradigm of financial transparency and accountability, both in the private and public sectors. However, **information is not useful if it is not reliable**. Therefore, it is imperative to modernize the processes of risk evaluation and information reliability assurance, as well as to execute such processes in shorter intervals of time, without reducing the quality of the audit procedures. As online information is made avail-

able each time closer to the date of the event it refers to, **continuous audit** presents itself as a systematic process to obtain electronic evidence capable of providing a **reasonable** basis to issue an opinion regarding the correct presentation of financial statements, practically in real time. (REZAEI *et. al.*, 2001).

Thus, the present study attempts to evaluate how analytical and continuous approaches contribute to the results of financial audit in the Big Data era. To achieve this, the main concepts related to the topic are described and the challenges and opportunities regarding their application to Federal Government financial statements are analyzed. At the end of the study, we propose a reflection on the potential of these new approaches to increase efficacy and efficiency of financial audit within the scope of the Federal Court of Accounts – Brazil (TCU).

## 2. ASSURANCE, CERTIFICATION AND FINANCIAL AUDIT

The word audit comes from the Latin word *audire*, which means “to listen” (COSTA, 2010). In a direct meaning, one can imagine a meeting of the auditor with the auditee to ask questions and “listen to” explanations regarding the functioning and problems of the audited entity. However, the scarce time of those involved and the large amount of data available have directed the audits towards more complex approaches, in which information does not need to be requested from the auditee if it can be obtained from other sources.

The essence of the concept is maintained regardless of the type of audit: we seek to know the real situation (object) in order to compare it to a desired situation (criterion). Thus, what changes between one and another type is the object – entities, contracts, programs – and the objective – to check reliability, compliance or performance. In the case of financial audit, we attempt to check the reliability of the information contained in the annual statements. In this case, the adjective “financial” is used in a broad sense to portray financial management in general and covers the areas of budget, treasury (financial in a strict sense), accounting and asset-related.

The role of financial audit in the governance structure of public institutions is established in International standards for government audit issued by the International Organization of Supreme Audit Institutions (INTOSAI). According to ISSAI 100, **financial audit is a work of assurance and also of certification** (INTOSAI, 2013). These two concepts are important in order

to understand why this kind of audit should be based on risk, should use sampling and issue a timely opinion.

As for the concept of **assurance**, the central idea is that the role of a government auditor is to assure the level of proximity between a real and a desired situation. Thus, the greater the trust regarding this diagnosis, the greater the safety of the decision –making process. Nevertheless, the mentioned standard makes it clear that it is not possible to offer absolute safety and, thus, explains that there are two types of assurance: reasonable and limited.

Reasonable assurance is high but not absolute. The audit conclusion is expressed in a positive way, conveying that, in the auditor’s opinion, the subject matter is or is not in compliance, in all material respects, or, when it is the case, that the information regarding the object provides a fair view, with the applicable criteria.

When giving limited assurance, the audit conclusion states that, based on the procedures carried out, nothing has come to the auditor’s attention to cause him/her to believe that the subject matter is not compliant with the criteria. (INTOSAI, 2013)

In the case of financial audit, the two levels of assurance are largely used. Generally, the audits of annual financial statements are of reasonable assurance, while audits of semiannual or quarterly statements have only limited assurance. This is justified due to operational and financial reasons. Many tests in a short period would be necessary and, in view of this, the cost of audits could increase a lot in case financial statements with smaller intervals were awarded positive opinions assuring the reliability of their figures.

Still according to ISSAI 100, there are two types of audit work related to the concept of **certification**: assurance engagements and direct reporting engagements.

In **assurance engagements**, the responsible party measures the subject matter according to the criteria and gives information on the subject. The auditor then obtains enough appropriate audit evidence on the subject matter to provide a reasonable basis for expressing a conclusion.

In **direct reporting engagements**, the auditor is the one who measures or assesses the subject matter according to the criteria. The auditor selects the subject matter and the criteria, taking into consideration risk and materiality. The result of the measurement of the subject matter according to the criteria is presented in

the audit report as findings, conclusions, recommendations, and an opinion (INTOSAI, 2013).

This differentiation is important in order to understand the peculiarities of the objective and of the financial audit process since, according to ISSAI 100, financial audits are always assurance engagements because they are based on financial information presented by the audited entity (responsible party). Therefore, the auditor must assure the financial situation and results of the audited entity (the subject matter), based on a set of financial statements produced by the entity itself (the information on the subject matter).

Translating the normative references into more practical language, during the year there may be many transactions that will have an effect on the financial situation and result of an entity and that are organized according to accounting rules and consolidated into a summarized set of financial statements. The auditor should ensure to the user of such statements that they are reliable. However, it would not be feasible to certify, in a timely fashion, that all the transactions and accounting balances are correctly registered. That is why we work with the aggregate level of an accounting entity, in elastic periodicities, and use mechanisms such as risk-based approach, materiality cuts and statistical sampling to limit the scope of the tests and, in the end, make it possible to achieve cost-benefit in the financial audit works.

The **accounting entity** level establishes the criterion to consolidate information (by department, sector, enterprise, etc.) according to the needs of the users of the information, to the laws, the governance structure and the accountability model, as well as to the interests of investors and creditors. There is an attempt to identify a point of balance that will make it possible to prepare general purpose statements that have enough information on allocation of assets and resources that enable analysis of the financial situation (assets minus liabilities) and of the results (income minus expenses) by all interested parties.

Annual **periodicity** is practically a natural consequence of the International standard of preparing financial statements in this same period, since there is some expectation from external parties that the statements be published together with the audit opinion. Thus, when analyzing the situation of the entity, the statements users consult the auditor's opinion to see if there are any distortions that may affect the credibility of the information.

Among the mentioned mechanisms used to limit the scope of the audit, the risk-based approach directs

the work towards accounts that have high levels of Relevant Distortion Risks, established based on the combination of inherent risk and risks resulting from internal control deficiencies. From there, the auditor establishes the audit approach which best responds to residual risks, choosing control tests, detailed tests and analytical procedures to be carried out. The later have increasing importance in the financial audit approach (COSTA, 2007).

In turn, the **materiality** cut reduces the scope of audit Works based on criteria that determine the minimum threshold from which one considers that amounts are relevant enough to affect the general view of the financial situation and results of an entity. In financial audit, materiality is a synonym of relevance, except in a situation of fraud and high level of sensitivity to the activities of the entity.

The third mechanism refers to **sampling**, that can be carried out based on statistics or not. However, due to systemic crises and financial scandals, auditing has become a work that is more and more scientific and statistical approach a necessity for auditors to be able to test only one sample of transactions and extend their conclusions to the whole population.

In traditional financial audit approaches, the mechanisms mentioned are essential in order for the auditor to be able to reach conclusions and issue an opinion in a short period of time regarding a large number of financial transactions.

### 3. AUDITING IN THE BIG DATA ERA: AUDIT ANALYTICS AND CONTINUOUS AUDIT

More than a mere technological trend, it can be said that the Big Data era is paving the way for new methods of understanding the world and the business decision-making process (ISACA, 2013). From the technical point of view, Big Data refers to sets of data whose **size**, **diversity** of format and generation **speed** surpass the processing capabilities of traditional IT infrastructures (IIA, 2013), which is a challenge to be overcome. On the other hand, from the business viewpoint, a great opportunity arises: the possibility of discovering behavior patterns, co-relation between events and other useful information in order to make decisions that would not be available if this amount and variety of data were not analyzed in a timely fashion.

Thus, a new discipline gains emphasis: Big Data Analytics. It can be defined as the application of statistical methods and other analytical techniques to trans-

action data, financial information and different sources of data that are internal or external to the organization. The purpose is to extract knowledge from the history of past events, monitor and react to present events in a timely way or even foresee possible future developments based on the data available.

The main objective of Big Data Analytics is to contribute to better decision making by businesses (ISACA, 2013). By transferring this concept to the context of oversight, one can say that application of the same statistical methods and analytical techniques to auditing activities – which some authors call Audit Analytics – has the purpose of contributing so auditors can make better decision regarding audited entities. To be more specific, it becomes possible to understand and quantify risks, test controls and assess business processes in a quick and efficient manner (PWC, 2013).

When one compares the advances brought about by analytical tools and techniques of the Big Data era with the mechanisms mentioned before to achieve satisfactory cost-benefit in financial audits, important findings arise:

- Using technologies that are appropriate to analyze a large amount of data allows tests to be applied to all financial data of the audited entities, in an efficient way, suppressing the need for previous cuts of **materiality** and **sampling**;
- additionally, such tests may be applied simultaneously in different levels of **accounting entities**, making it possible for auditors to evaluate, in the same audit, both aggregate information and specific accounts of greater relevance;
- results thus obtained can be used, together with inherent risk analysis and internal control evaluations, to improve the targeting of the audit towards the points that have greater probability of showing relevant distortions, thus improving the **risk-based approach**;
- finally, once one has access to the data of systems and transactions that are the basis for financial statements, it becomes possible to repeat the tests with shorter **periodicity**, and this may contribute to a more timely identification of possible distortions.

Therefore, the recent technological advances enable application of analytical procedures and statistical tests on the totality of transactions of one or more entities, in very short intervals, materializing the concept of

**continuous auditing** defined originally by Vasarhelyi and Halper (1991) as a type of audit that produces results simultaneously or in a short period of time after a relevant event occurs. Furthermore, the same tools can be used by the manager himself/herself to implement a **continuous monitoring** process to ensure that the policies, procedures and business processes are operating effectively.

It is important to highlight that the applicability of Audit Analytics is not limited to the transactions. It is possible to use analytical methods and techniques to evaluate performance and risk of audited entities according to three dimensions: transactions, results, and controls (KPMG, 2012). Based on this, it can be said that **continuous assurance** occurs when auditors perform continuous audit of both the performance and the risks of an entity such as the evaluation of controls and continuous monitoring activities adopted by the manager, as shown in Figure 1.

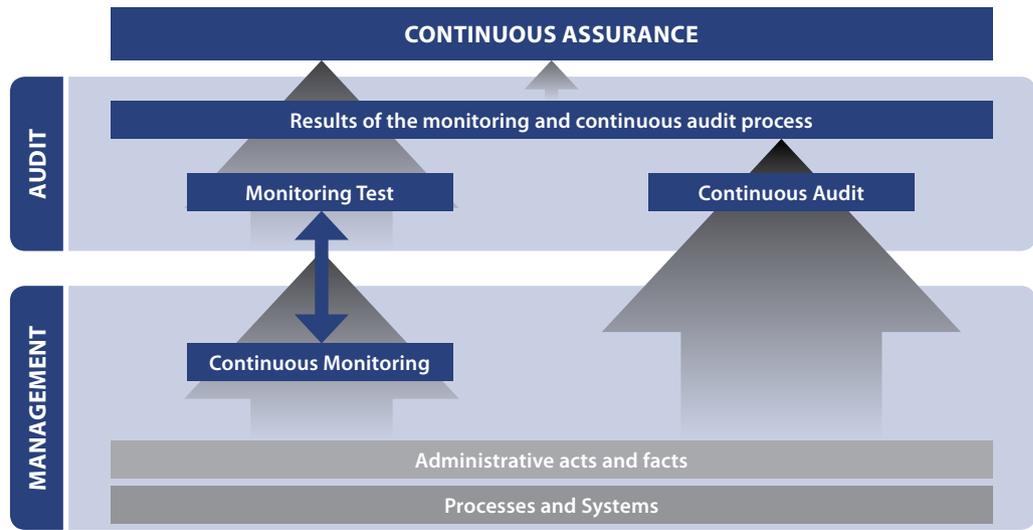
The implementation of this conceptual model, enhanced by the capacity to treat data and by the analytical methods and techniques of the Big Data era, represents a significant advance in relation to the traditional model of financial assurance, based on risk, carried out annually and with limitations created by the use of sampling and materiality cuts.

#### 4. PERSPECTIVES FOR CONTINUOUS FINANCIAL AUDIT IN THE FEDERAL GOVERNMENT

The Federal Government is one of the largest entities in the world from the accounting perspective. On 12/31/2013, the General Federal Balance Sheet showed almost R\$ 4.6 trillion in assets and income close to R\$2 trillion. In order to manage these assets and resources there is a structure that is larger than that of the majority of government and business entities at the national, multinational and international levels. Currently, there are over 300 federal agencies and entities and more than one million active civil and military servants.

In an entity this size, allocating resources adequately, at the right moment and right place is not an easy task. For this to happen, in 1980 the Integrated Financial Administration System (Siafi) was created. It is the IT system used to register, monitor and control the Federal Government's budget, finance and assets execution. In addition to facilitating the process of consolidation of the federal public accounts, because it is used by all agencies and entities that depend on the Fiscal

**Figure 1:**  
Conceptual model  
of Continuous  
Assurance (IIA, 2005)



and Social Security Budget, the Sifi is also integrated with other systems that manage federal resources and assets. Among them, the Integrated Human Resources Management System (Siape), the Integrated General Services Management System (Siasg), and the Management System for Special Use Real State of the Federal Government (Spiu). Several other systems produce financial information that is channelled to, recorded and consolidated in Sifi, according to identification and respective balances or amount of transactions represented in Figure 2.

In spite of the level of informatization, the challenge faced by audit work remains big. In 2013 alone 30 million data entry accounting documents were registered in Sifi and approximately 10 percent of this total referred to manual register. The financial information contained in these documents are organized and con-

solidated in order to enable production of the financial statements of the Federal Government that are consolidated in the General Balance Sheet of the Union (BGU). It also enables production of over three hundred individual financial statements of federal agencies and entities.

From the perspective of internal controls, Sifi has some tests that are similar to the concept of continuous monitoring: automatic and manual analyses of statements, data consistency tests and checks regarding integration with other systems. There are also specific mechanisms to visualize the inconsistencies generated automatically, based on accounting equations, and inconsistencies that are not corrected within the established deadline generate an automatic registry of accounting restriction. The system also offers a module for accounting regularization focused on the correction of errors identified by automatic and manual controls.

**Figure 2:**  
Systems to manage  
federal resources and  
assets, with the respective  
amounts managed

Sole Account System: Sisbacen Balance on 12/31/13: R\$635 billion	Federal Debt Systems: SID, DPI and SEORFI Balance on 12/31/13: > R\$ 3 trillion	Social Security Expenses Systems: SUB, SIBE, COMPREV 2013: R\$350 billion	
Active Debt System: SIDA Balance on 12/31/13: R\$1.4 trillion	Actuarial Liability RPPS-civilians System: SRPPS Balance on 12/31/13: > R\$1.1 trillion	Personnel Expenses System (Executive): SIAPE 2013: R\$184 billion (Executive)	
State-owned Enterprises System: Siest Balance on 12/31/13: R\$291 billion	<b>SIFI</b> <b>General Balance Sheet of the Union</b> <b>R\$12 trillion</b>	Expenses with Health Actions and Public Services Systems: SISGERF and SIOPS 2013: R\$83 billion	
Special Use Real Estate System: Spiunet Balance on 12/31/13: R\$ 321 billion		Expenses with Education Maintenance and Development Systems: SIMEC and SIOPE 2013: R\$54 billion	
Special Use Real Estate System: SIAPA Balance on 12/31/13: R\$34 billion		Per diem and airline tickets System (Executive): SCDP 2013: R\$2.7 billion (total)	
Highways System: SICRO 2 Balance on 12/31/13: R\$ 197 billion		Expenses with Material and Outsourced Services Systems: SIASG and ComprasNet 2013: R\$70 billion	
		Tax Income and Contributions Systems: SIEF and CLACON 2013: > R\$1 trillion	Voluntary transfers System: Siconv 2013: R\$73 billion

This way, the continuous monitoring does not end after the flaws are detected but after the errors identified are corrected.

Despite the whole chain of internal controls of the Federal Accounting System, it is necessary that an external and independent institution certify the efficacy of these controls and the reliability of the information produced taking into account the concept of financial assurance. This mission is the responsibility of the Federal Court of Accounts due to the constitutional mandate to analyze the accounts rendered by the President of the Republic (article 71, I, of the Federal Constitution/88). The accounts include the General Balance Sheet of the Union (BGU). As for the mandate to audit financial statements of federal agencies and entities, it is provided for in article 71, item IV, of the Federal Constitution/88 and article 16 of the TCU Organic Law.

Even so, we need to acknowledge that financial audit is a fairly recent function if we consider the 120 years of existence of the Court. In view of this, in 2011 TCU signed an agreement with the World Bank with the objective of aligning the audit of the BGU with the international standards and good practices in financial audit. Since then, TCU has improved its approach based on risk, sampling and on the concept of materiality, aiming at giving more effectiveness and efficiency to this activity. The changes implemented favor identification of distortions that are materially relevant in the 2013 BGU. Thus, an alert was issued to the Federal Government advising of the possibility of an adverse opinion being issued on the 2014 Asset Balance Sheet of the Union in case the distortions and deficiencies in internal controls are not corrected in a timely fashion.

In spite of advances, there are still challenges regarding the financial audit function in TCU. Overcoming them can be made easier by using information technology. This is true because in audits of large entities, it is common to adopt approaches that privilege **control tests and analytical procedures** as a response to risks identified in the initial phase of the audit. Thus, the main internal controls are already automated in the Siafi system and can be also checked automatically. In addition, the analytical procedures are evolving by means of equations and indicators that show the behavior of the accounts and make it possible to identify uncommon situations, as parts of continuous audit systems (KOGAN *et al.*, 2010).

Also relevant is the fact that, as of January 2015, the new Accounts Plan Applied to the Public Sector (PCASP) will enter into operation: it is a standardized ac-

counts operation, created with the purpose of enabling consolidation of the National Public Accounts according to the Fiscal Responsibility Law (LRF). Therefore, both the Federal Accounting System and similar ones in the state and municipal spheres will begin dealing with financial information according to the same standard. This will increase the opportunity of elaborating automated analytical procedures that can be applied in large scale. The project for the implementation of the System of Accounting and Fiscal Information of the Brazilian Public Sector (Siconfi), conducted by the National Treasury, intends to make feasible the consolidation of this information in one sole data base that may also be used for audit purposes.

Together with the standardization generated by PCASP, Siafi itself will evolve to become a more modern technological platform that will allow analysis of accounting registries with a one day lag for on online registries, in addition to making it possible to divide information to the level of transactions by means of individual consultations of the input document in Siafi. With the expected increase in analytical capacity offered by the new solution, the potential becomes even greater to apply the Audit Analytics techniques and the paradigm of continuous audit as tools for evaluation and response to risks in Federal Government financial statements.

An example is the bookkeeping account related to expenses with social security, which in 2013 was over R\$ 350 billion; undoubtedly, an account that is materially relevant in an audit of the General Balance Sheet of the Union. In order to transform such a large subject matter into an auditable one, it is necessary to understand the underlying public policies and the internal controls of the account. In cases such as this, the analytical procedures are highly recommended in order to evaluate risks by carrying out horizontal analyses (balance evolution), vertical analyses (composition) and analyses of financial and operational indicators. As an illustration, one could carry out analyses of the behavior of concessions, grants, suspensions and cancellations of social security benefits as compared to the evolution of the social security expenses. This in order to obtain evidence of over or under evaluation of the account.

Continuing with the example, in relation to the tests of details in the payment of social security benefits, we know that there is probably more than four hundred Bank Orders, some of them of billionaire amounts and related to payment of thousands, or even millions, of beneficiaries. By using continuous audit and Audit Analytics tools, it would be possible not only to evaluate

risks at the transaction level, but also the application of tests throughout the population – and not only a sample – as a response to the risks evaluated. Such tests could be performed weekly or monthly so that possible inaccuracies could be detected and corrected in a timely way, once the events are identified.

## 5. FINAL CONSIDERATIONS

As we saw, traditionally financial audit is performed in areas of high risk and by means of statistical sampling, thus making it possible to carry out procedures related to positive cost-benefit and in periodicities that are compatible with the traditional annual financial statements. However, due to technological and social evolution, the financial information flows more quickly and needs to be validated in order to ensure to the users that they are making decisions using the most rational choice, based on reliable and quality information.

Therefore, in the Big Data era, transparency and accountability in real time are already a reality. In the governmental scope, it is the responsibility of the internal and external oversight agencies to monitor this movement by adopting Audit Analytics practices and continuous audit, in order to make it possible to analyze big amounts of information that is varied and in more and more smaller periodicities. In view of this, it is expected that the audit activities will become more efficient, effective and timely.

In face of the magnitude of Accounting and finances of the Federal Government, especially, it will be more and more necessary to innovate in technology. In 2015 the new accounts plan will enter into force, supported by improvements in the Siafi system and by innovations such as the Siconfi project. Finally a new accounting and technology paradigm. This change will also require and enable the advance of financial audit, aiming at ensuring reliability of the data in a more detailed level and in a more timely fashion. The trend is that the annual audit of the General Balance Sheet of the Union be divided into several audits with smaller scopes and periodicities. For this end, continuous audit could be an important tool in identifying the areas of risk and the relevant accounting distortions, while its logic is exactly to function at the transaction level and in real time.

Undoubtedly, with the current paradigm for supply and demand of financial information, continuous audit is a trend in Brazil for the public and private sectors. Nevertheless, this trend depends significantly on

the very development of auditing in the country. According to Alles *et al.* (2006a), in Brazil there is one independent auditor for every 25 thousand people, while in the USA there is one for every 2.300, in the United Kingdom, one for every 1.300, and in Holland, one for every nine hundred. Thus, technological resources can favor the growth of audit in Brazil, but we must build the capacity of human resources. Evolution towards automation of financial audit should be accompanied by the development of competencies of the auditors to deal with this new reality. It is worth mentioning that technology does not replace human knowledge; it increases the potential for its use.

Meanwhile, continuous audit is a vision for the future. Despite this fact, awareness regarding the evolution of technological solutions is the starting point for this future to be nearer and nearer. To take advantage of this innovation means to improve management of financial resources, by detecting and correcting in a timely way the deficiencies of internal controls, errors and frauds, as well as to improve risk management and governance. As a result, it is expected that the oversight agencies begin counting with tools that are more and more efficient and effective, in order to ensure good management of public resources, reliability of accounting information and financial sustainability of government institutions.

# Physical and Technological Resources Management in Health



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## ABSTRACT

Refit is the so-called management for Physical and Technological Resources in Health. Refit management is concerned about Health infrastructure and medical equipment resources, inventories and diagnosis of technological parks, maintenance (preventive, corrective and predictive), outsourcing, training and professional training, planning, control and monitoring, software as a tool. Refit management is also responsible for creating and maintaining indicators, thinking of future technological developments, incorporating human resources (architects, civil, electric, electronic and mechanic engineers, general practitioners, biomedical doctors, technologists and technicians), drawing up contracts, documentation and norms, listed as its activities and duties. The basic ingredients for being a manager include: capability (know how), attitude (know what to be) and knowledge (know about). Moreover, the manager should have the knowledge and experience of the health network (from basic to large hospitals), the hierarchical network, the policy and paperwork process, micro and macro situations and situations of interdependency of local realities as far as each case is different. Being a manager implies being an aggregator of the professionals involved in the process, knowing the norms and laws (Law 8.666, Differential Public Procurement Regime - RDC 50 etc), planning as a whole, being able to take decisions, managing



physical, financial and human resources, efficiently and effectively, and being committed to the National Brazilian Health Service (SUS). What does society expects from this new social actor? Ability to plan optimization of the increasingly scarce resources, to articulate with the involved spheres; a Refit manager should have long term vision (concerning the available technology) and strategic vision, have managerial and operational ability, be a good mediator, be objective regarding the actions, exercise leadership and professional ethics regarding SUS, delegate, possess critical capacity for new investments and retain existing ones, have managerial capacity, be dynamic regarding the SUS policy as a social actor, to apply the knowledge and lessons learned in each of the regions of such a large country with different practices and costumes as Brazil.

**Key words:** Physical and Technology Resources in Health, REFIT Manager, Future technological mergers in Health.

## 1. THE REFIT MANAGER IS BORN

Over the centuries, several were the scholars who had tried to understand the rationale of the operational process of the institutions. In the process, new “ways of thinking and understanding” that supported the different streams (or schools) that comprise the Administration Theories were shaped.

In short, for companies to survive, they must have the ability to change internally by creating new or different constituent parts by adapting themselves to the new requirements imposed to them.

The demands placed on contemporary companies towards the adjustment to contingencies, whether internal or external, to match their constituent parts to the intrinsic needs of the production processes, facilitates the organization of each of these parts according to the guiding principles of each School mentioned before.

Such configuration implies the need for an organizational model that allows for the coexistence of a more rigid structure to cope with the hierarchical system of authority, dedicated to technical and logistical supporting activities, with a more flexible and participatory structure regarding welfare activities.

On the other hand, health care organizations can be classified into a professional organization model (MINTZBERG apud AZEVEDO, 1993:40), to which professional nature authority is given and where power comes from knowledge (in this case medical knowledge) and professional specialization. This model requires a complex and specialized work process whose result is difficult to measure. In summary, health care organizations are one of the most complex organizations of contemporary societies (WILSON apud BRAGA NETO, 1991:50).

Despite such findings, health care management is a recent issue: “... it has become recent, in the area

of health, greater concern with administrative issues.” (MOTTA, 1990:1). These concerns have gained importance from the recommendations made by the 30th World Health Assembly, held in 1977, and from the discussions at the International Conference on Primary Health Care, in the Declaration of Alma Ata, in 1978. Both events set the overall goal of achieving health equity in the year 2000, considering, however, that the obstacles to its accomplishment lie in the scarcity of available resources, mainly in the so-called countries of the Third World.

When it comes to optimizing resources in a professional body, emphasis is given to the assistance provided for administrative areas and logistical support. Given the operational high cost of these bodies, it becomes critical that such areas receive good managerial performance.

In the midst of the discussions to develop management tools and strategic actions that allow for the proposed objectives, some questions arise as to the efficiency and effectiveness of the physical network management of health services. Considering the available resources, the physical and technological stand out, comprising the building, its facilities and equipment.

It was found, at the time of the discussion about resource optimization that both the network maintenance and the mechanisms used to adapt and expand the existing physical network take place haphazardly. At the same time, we acknowledge that the incorporation of technology, inherent to the transformation and expansion of the physical network process in the health sector, has also occurred unsystematically - a fact that probably contributes to unnecessarily raise the cost already high in the sector.

The current health system in Brazil was developed relatively recently. It settled a changing process in the 70s, accelerated in the 80s and gained institutional status at the end of this decade. Result of an internal process of strong social and political density, also influenced by several external models, particularly by those in force in welfare states, our system was established by the Federal Constitution of October 5th, 1998, governed by laws 8.080 and 8.142, both from 1990. It is known as Unified Health System (SUS) precisely because its shaping corresponded to the unification of several existing subsystems, by overcoming the institutional fragmentation that prevailed both at federal level (social security and health, public health and etc) as well as at different government levels (federal, state and municipal) and also by separating the state sector from the private.

In setting principles such as universality, equity and comprehensive care, according to the organizational guidelines of decentralization and participation of society, SUS broke up with the previous system, founded new institutional, managerial and assistance basis to provide for the actions and health services in the country, then regarded as universal rights of citizenship and responsibility of the State. Besides that, the health system was designed and institutionalized in the opposite direction of a trend that, at international level, at that moment, pointed to a revaluation of the market, as an alternative to the classic welfare model, seen as unfeasible due to the fiscal crisis and the State legitimacy.

As the world discussed the structural adjustment of the economy, the decline of the State apparatus and public cost containment, here, the social rights were enhanced and the state responsibility was broadened with its provisions.

The new institutional framework of the Health sector was first designed in 1986, at the VII National Health Conference, held in Brasília. The conference decisively contributed to build consensus on the critical diagnosis of the current health system and on the agenda for changes. This agenda became known as the Agenda for Brazilian Sanitary Reform. Health was consecrated as a universal right and as a duty of the State under the theme Health: a right for everybody, the State's duty. The Federal Constitution of October 5th, 1998 provides in its Section II, the precepts that would regulate the sector policy for the following years. These precepts can be summarized in a few basic points: individual and collective needs. They are regarded as being in the public interest and their interpretation, a State's duty; the integral medical-sanitary assistance gains universal status and is meant to ensure everyone access to its services; such services should be prioritized according to technical parameters and their management decentralized. Mainly the government resources from the Union, states, and municipalities should fund the system. The services of business nature purchased are to be complementary and subordinated to the more general strategies of the sectoral policy. The government actions will be subjected to official collegiate bodies, the Health Councils, with equal representation between users and service providers. They will be devoted to political and administrative decentralization and to social participation.

In the legal sense, the right for everybody is expressed by means of ensuring universal and equal access to services, that is, within the precepts of equity and

universality. The State's duty is expressed in a solidarity pact of society as a whole and is based on a funding model which establishes that the responsibility for funding SUS should comprise the three levels of the government; each level should ensure regular supply of resources to its respective Health Fund, as provided in the Article 194 of the Federal Constitution, in which Health integrates Social Security, together with Social Welfare and Assistance.

Funding is a major obstacle to SUS public performance, because resources are insufficient, the sources are unstable and the division of responsibilities for its provisions unclear. The Public Budget Information System (Siops) was implemented by the Joint Ordinance n. 1.163/00. It is a planning, management and social control tool of the Unified Health System whose target is the improvement of management and evaluation of the public expenditure on health, the strengthening of social control, the measurement of the participation of states and municipalities in funding Health, and the monitoring of the Constitutional Amendment n. 29/2000. This Joint Ordinance was replaced on March 16th, 2004 by the Inter-ministerial Ordinance n. 446.

It is important to highlight that federal transfers far behind the needs of the local systems induce to adjustments in the Health agenda by means of organizational innovations related to cost containment, use of own resources, prospective budget, budget ceiling, management contracts and to the flexibility of public management.

The SUS network from the XXI century relies on 5.881 hospital units, 36.512 basic units and 5.218 SADT units (Support Service for Diagnosis and Therapy or Assistance Service for Diagnosis and Therapy) representing 47.611 health facilities. However, of this amount, 4.351 (9.1%) are located in the North region; 15.322 (32.1%) in the Northeast; 15.458 (31.2%) in the Southeast 8.963 (18.8%) in the South; and 3.517 (7.4%) in the Midwest (AMS -Multidisciplinary Medical Insurance, /IBGE-Brazilian Institute of Geography and Statistics/DATASUS-SUS Computer Department).

Although the figures reveal a slowdown in the growth of new hospital units, this fact does not mean that there will be less investment in the health sector. On the contrary, the edited tables and graphs show that, a new investment model in the SUS Hospital Network has just started; a model focused on the transformation of existing hospital units, so that they can incorporate new technologies. In such context, the key word is reorganizing.

In turn, Dimas (2003) states that the costs for operation and maintenance of the existing Network have become increasingly challenging. In contemporary societies, the conditions for the merger of technologies in health and, more specifically, medical and hospital care have broadened man's capacity to intervene in the phenomena of life to reduce human pain, and to provide a significant increase in quality of life expectancy. There will be, however, the unavoidable increases in the economic costs such investments entail.

In the process of incorporating technologies, the Unified Health System experiences a duality regarding investment priorities, as, on the one hand, it would be necessary to incorporate new and modern machines within tertiary healthcare. These machines have been emerging faster and faster, such as the ones in the Neonatal Intensive Care Units. On the other hand, new prevention and health promotion technologies have been sought to deal with the so-called diseases of poverty via primary healthcare, as for example, the Family Health Strategy.

In parallel, scientific and technological advances make effective solutions available to an increasing number of diseases, mainly, for those who can afford their treatment. Therefore, the pressure on financing the sector increases without the implementation of cost-effectiveness studies to define choices and priorities over investment resource allocation, and consequently, over the adoption of new healthcare technologies.

Undoubtedly, the technology incorporation process of medical assistance happens at an accelerated, irreversible and relentless pace. Such process is marked by four "structuring" dimensions, which stamp on the process greater degree of complexity.

- the incorporation of biomedical machinery and equipment does not replace the existing labor force.
- the incorporation of technologies to provide support to diagnosis is cumulative – new technology does not disregard the old;
- the incorporation of health technologies presupposes ongoing training/vocational training of operators;
- the incorporation of health technologies implies extra care with the technological park "health", with a view to reliability;

If we consider the contribution of new and complex technologies in recent decades, expressed by

the increase of high cost and high complexity services - such as Intensive Care Units - and the significant dissemination of intermediate complexity services (image services, graphic and optical methods), we will find large quantitative and qualitative gaps. They are related to qualified technical work labor to operate and maintain such services: Nursing Technicians, Bio Diagnostics Technicians, X-Ray Technicians, Biomedical Equipment Maintenance, among others. They all need to be incorporated to the SUS workforce.

According to the document issued by the Ministry of Health, in recent years, what can be seen is poor utilization and waste of resources, duplication of efforts and difficulty in defining targets for social action. This situation is worsened and characterized by poor choices regarding criteria for allocation of resources resulting from amendments and external resources. There is also excessive political influence on these decisions.

On the other hand, sustainability and effective results are left out in favor of physical results, without proper evaluation of the impact of a certain action on public health.

As a result, “we have a public health system that, despite having improved in recent years, shows a performance far below of what is needed for economic development and for the composition of social justice” (MINISTRY OF HEALTH, 2005).

If we try to understand the meaning of the growth of such health facilities, in the last three decades, driven by Investment Projects occurred at the time, and focused on a given region – and on a given health territory – it is possible to observe the composition and current organization process of SUS Health Units Network.

The mission of pursuing objectives relying on resources smaller than the needs, in order to cope with dynamic situations, even if subjected to constant change, also means that things can be uncertain at a lesser or greater degree.

Planning in such context becomes a daily necessity, but this process should be permanent, to guarantee the directions of the actions involved. To adjust the course and face unforeseen circumstances, it is necessary to walk towards the goals to be achieved. Planning means thinking ahead, during and after acting. It involves thought (reasoning) and therefore we can understand that planning is calculation (rational) that precedes (before) and presides (during and after) the action. It is a systematic calculation that articulates

the immediate situation and the future, supported by theories and methods.

The actor who plans cannot take ownership of situational complexities. Therefore, both the specialists’ proposals (and the technical – scientific point of view) as well as the different views or the politicians’ points of view that grasp reality to carry out their projects or reaffirm their commitments should be taken into account.

It is understood that strategy is basically a way to build feasibility to an elaborated planning to pursue certain goals.

It is proposed that planning be developed as a participatory process to enable the incorporation of the views of several social sectors, including the population. In the process, various social actors explain their demands, proposals and solution strategies, within a negotiation perspective of the several interests involved. This participation enriches the planning process by creating co-responsibility between the actors and the accomplishment of the action plan, by providing it with more legitimacy and political feasibility. Therefore, the conceptualization of the social actor is very important. That is, for the plan to “succeed” it has to be made clear who the actor who plans is and what other actors are also involved in the situation.

It is also essential to consider that each actor sees and acts on reality from different perceptions. Thus, it is necessary to develop a central action (not centralized, but unifying) able to build global coherence among partial actions from several social actors. A social actor is defined as a collection of people or, in the extreme, someone who acting on a determined situation is able to transform it. Therefore, it is important that the actor possesses an intervention project, control or ability to mobilize resources needed for the plan and a minimally stable organization to run it.

In 2006, against the background of Health and the SUS system, a social actor was born and named Refit (Physical and Technological Resources in Health) manager, graduated as specialists in Physical and Technological Resources under guardianship of Oswaldo Cruz Foundation – FIOCRUZ – in conjunction with the National School of Public Health Sergio Arouca (Arouca-ENSP), with the participation of professionals from the areas of Architecture, Engineering and Clinical Engineering, coming from the State and Municipal Secretariats of Ceará, Pernambuco, Mato Grosso do Sul, Distrito Federal, Minas Gerais, Rio Grande do Sul

and Rio de Janeiro itself, meeting monthly, with the difficult challenge of implementing the Unified Health System Refit Management. Initially, the proposal was to call these professionals Tutors, in 2006, after graduating. As replicators of knowledge to others, initially totaling 600 (six hundred), these professionals have not been distributed in the country so far.

The challenge posed by reality is to adapt the technological incorporation to the structure of health needs, as there is not in the world, let alone in a country as Brazil, enough financial resources able to support the logic of diagnostics and supplementary tests, based on a high-cost health technology that can quickly become obsolete. It is necessary to redefine the role of Healthcare Establishments – EAS in the organization of care, by enhancing outpatient and home-based care, the articulation of the variable demand for an organized supply of services and the use of epidemiological and social knowledge to implement health practices.

The use of epidemiological knowledge, information technology, permanent and qualified monitoring of clients/patients may be signs of a new model of care focused on quality of life. In this model, health policies will aim at the promotion of health, prevention of diseases, the recovery of those who get sick and the maximum rehabilitation of those who may have limited functional capacity. In addition, adopting such model may represent a low cost solution and, mainly, the answer to provide better resolutions.

The recognition of comprehensiveness as a principle or guideline, which can cover biological, psychological and social dimensions of the health/disease process by promoting protection, recovery and rehabilitation, with a view to the integrality of human beings, should be disseminated as a new health culture in professional education.

Comprehensive care tries to see the client/patient pairing as a whole. The health team (in which the technical professional is part of) should solve health conditions in their totality.

Ethical issues that should permeate human labor in any activity assume a peculiar connotation in the health professionals' permanent practice. It is crucial that these professionals include, primarily, in their actions, science, technology and ethics in the service of life. Ethics in the service of life is concerned with commitment to human life in all conditions, regardless of the stage of life cycle, the genre or what social class the client/patient belongs to.

The conceptualization of health as an end in itself, while a condition of citizenship, addresses to certain specific features towards the work of its professionals. Diversification in the scope of the activities of health professionals today, together with their unsegmented practices, as long as it involves care models addressed to quality of life, demands from these workers a broad view of health.

The modern sense of health quality includes the humanization of assistance, the respect for patient/client's autonomy, as well as his/her rights as a service consumer, the satisfaction of needs and individual expectations, technology in its broader sense and the appreciation of the autonomy of the people involved in health management issues.

In the area of the building structures and hospital facilities, the situation is the same. It can be seen that there is a lack of professionals in management and maintenance of the physical infrastructure in health, once the life of a building, especially in the hospital area, is straightly related to the quality and regularity of appropriate maintenance, with effective routine actions, preventive and corrective procedures.

It is also possible to see that the irregularities in maintenance contracts, their technical monitoring concerning quality, is due to the inexistence in many hospital units of maintenance management experts (clinical engineers, maintenance engineers, biomedical engineers, technicians and etc.). The organizations are restricted to the practices of bureaucratic monitoring of contracts carried out by professionals, who, in several cases, lack technical knowledge in this specific area.

In 2012, Rio+20 called for the position of governments, businessmen and social movements to discuss themes such as development sustainability, including the sustainability of health systems, due to the possible deterioration of the traditional health social protection systems, as the world trend is focused on prioritizing health universal policies. SUS, based on the conception of health social determination, possesses all the necessary credentials of a sustainable system. The hopes are that in the following years, SUS good international fame is founded on the principle that health is present in our everyday lives (BAHIA, 2011).

Health needs more resources. However, these resources should be linked compulsorily to very clear and transparent management contracts, so that they can effectively broaden the universality of the right to health (CÔRTEZ, 2011).

# Audit Strategies in a Great Data Base Context: the SecexPrevidência Experience



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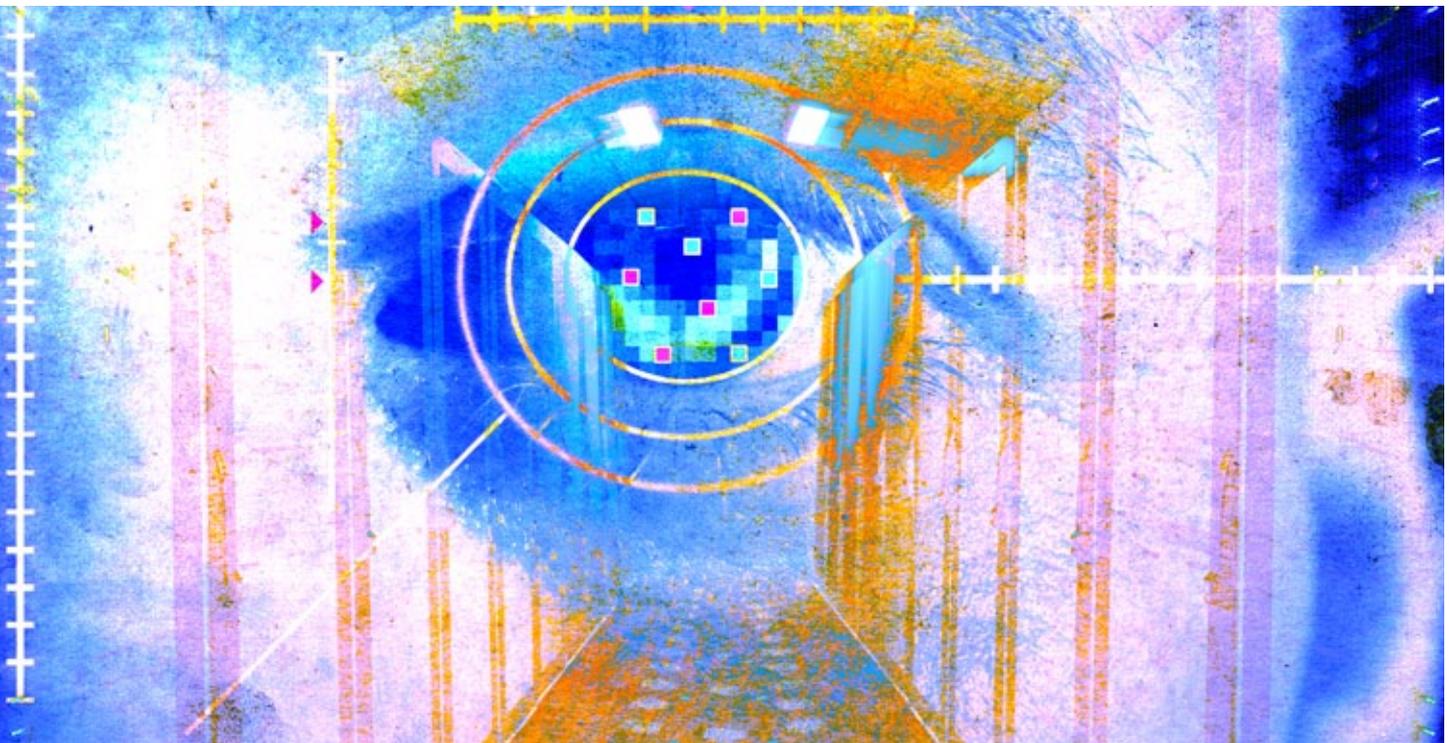
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## ABSTRACT

The nature and volume of the expenses, as well as the amount of available data facing the government functions related to work, social assistance and social security, imposed upon Secex Previdência (Department of Social Security, Labor and Social Assistance Audits) the need to employ a data analysis in order to improve the effectiveness of their audits and evaluations. For that purpose, public and private basis crossing and analysis of quantitative efficiency, governance and of the impact of social expenses in inclusive growth were performed. The Secex Previdência implemented, with a software enterprise, an analytical board to test a methodology that could integrate several quantitative analyses for the generation of better diagnosis, prescriptions and predictions for the identified problems in order to improve the currently used analyses. In this sense, it was possible to test the enterprise's IT solutions in the integration of the results of several techniques of data analysis for two benefits operated by the National Institute of Social Security, age benefits and for people with disabilities.

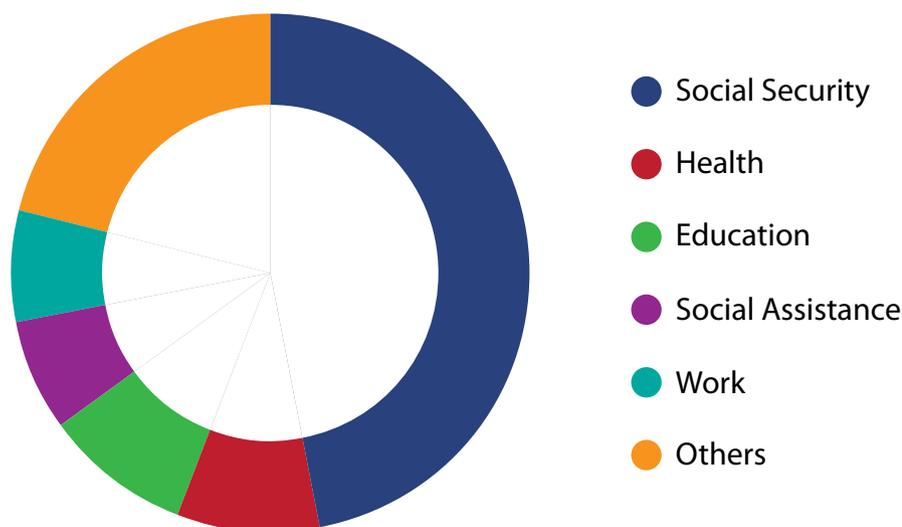
**Key words:** Data analysis, quantitative methods, IT, Social Security, Assistance, Work

## 1. INTRODUCTION

SecexPrevidência performs in Social Security, Social Assistance and Labor areas. These areas represent 61% of the Federal Government Budget (graph below), not including in this figure the expenses with the public debt duty. Retirement, pensions, Unemployment Insurance, Special Salary Raise, the Bolsa Família Programme, Continuous Benefit Conveyance, agreements and transferences from one fund to another are among the main expenses monitored by the Audit Department.

Due to the relevant amount of information that Secex Previdência monitors (over 50 million of beneficiaries, 900 Social Assistance Reference Centers, 1500 Social Security Agencies, 1200 Sine Agencies, database with a great amount of records (MACIÇA, CNIS, RAIS, SISOBI, Folha PBE, CadÚnico, CAGED, SIAPE, CensoSUAS))<sup>1</sup>, the development of several strategies using quantitative methods and data analyses were necessary.

Among the Audit Department's experiences, the Audit and Oversight Strategy of the Social Security Benefits that comprised the analysis of internal controls and the implementation of three audits in the databases on the benefits of greater materiality (rural retirement, death pension, retirement due to age or contribution times) was mentioned. In addition to the review of possible irregular benefits, these audits pro-

**Graphic 1:**Expenses engaged -  
by function (2013)

Source: Siga Brasil

vided the strengthening of concession systems, once the scripts from the database crossing were transferred to the NISS, enabling the body to apply more efficient controls in over 30 million active benefits, reducing the probability of errors and frauds. The cessation of the benefits granted is equivalent to a potential economy estimated at approximately R\$140 billion per year (Ruling 456/2010-P, Ruling 715/2012-P, Ruling 666/2013-P).

Similar to this strategy, in the Board of Works, data audits have been performed since 2012, in the Unemployment Insurance on the formal worker and artisan fishermen modalities. The Unemployment Insurance represented an approximate expense of R\$32 billion in 2013 and it benefited 5 million people. The information of the administrative record of the Unemployment Insurance were crossed with the following public database in those audits: CPF, RAIS, CAGED, CNIS, SIAPE, MACIÇA, SISOB, TSE (Supreme Electoral Court) candidates and Bolsa Família). Millions of instalments of the Unemployment Insurance identified were irregularly paid, for that reason the recovery of the resources and the improvement of control systems were determined, estimating a potential control benefit of approximately R\$150 million (Ruling 2.089/2013),

Efficiency analyses were also performed in the agencies of Sine, Social Assistance and Social Security. For that purpose, a quantitative approach was sought for the efficiency measurement, the Data Envelopment Analysis – DEA. The technique enables the quantification of the relative efficiency level between opposites, showing the lines of productivity improvement and benchmarking units.

The DEA has its use disseminated in several economic sectors, such as: electric power, telephony, ports, highways, schools, hospitals, among others. The technique enables the efficiency forecast in administrative units, once it builds a production frontier comprising efficient units, which are compared to inefficient units. The efficiency comparison, performed with the technique, is always relative. In other words, some units are considered inefficient because there is a more efficient unit with a similar production profile. In addition to demonstrating the feasibility of improving the efficiency, the relativity presented by the technique also shows the possibility of improving efficiency for more effective units that compose the production frontier.

In relation to the results, from the 1,207 agencies of Sine, 1,500 Social Security agencies and 6,893 Social Assistance Reference Centers, only 19, 23 and 406 are on the efficiency frontier, respectively. The results of these efficiency analyses were very promising, for the possibility of enhancing the amount of attendance was noticed in all three functions of the government (Social Security, Social Assistance and Work), which means services to citizens with no need of raising costs.

Another quantitative analysis performed using the National Household Sample Survey (PNAD) of the Brazilian Institute of Geography and Statistics (IBGE) was the evaluation of the impact of the social security on the inclusive growth (Ruling 1274/2013 – Plenary). The analyses performed indicated that the rural subsystem of the Social Security General Regime (RGPS) performs a relevant social inclusion function, as: 1) it

generates an income increase proportionally larger in household with lower per capita income; and 2) proportionally forwards more resources in relation to the GDP to municipalities that present the lowest GDP per capita. This report was presented in the 2012 Government Accountability.

A quantitative technique named “main components analysis” was also performed using the CEN-SOSuas to define a governance rate for the Municipal Boards of Social Assistance. The action had the participation of a sociometric expert from the Federal University of Brasília (UnB) and it enabled an indication of the capacity of those boards to operate and audit the resources transferred from one fund to another. This result is expected to be used as a definition for future audits and to evaluate the social control that has been performed by those institutions in a more accurate way.

Although the data alignment methodologies and the quantitative methods currently applied by SecexPrevidência involve important results, it was understood that it would be necessary to develop a methodology able to integrate several analyses in order to generate better diagnosis, prescriptions and predictions. For that purpose, an analytical board was performed with a software company, from February to June 2014, aiming at testing the enterprise’s IT solutions on the integration and automation of the results of several data analysis techniques for two benefits operated by the NISS, by age and for people with disabilities.

Therefore, the following benefit types were selected: retirement due to age and Continuous Benefit Conveyance for people with disabilities. In a general way, the joint collaboration with the software enterprise consisted on the cleaning and integration of used databases, on the identification of typologies that characterize irregularities, on the use of several data mining techniques that highlight fraud patterns and abnormality patterns and, finally, on the integration of these results in the elaboration of a metric indicating the probability of irregular benefit.

In relation to the cleaning and basis integration, a Data Quality was performed, which enabled the identification of the Issuance of Individual Taxpayer Registry of 99.2% of all beneficiaries identified on the MACIÇA of February 2014 with the probability of over 95%. Phonetic identification of match-code generation and record duplication techniques were used, resulting in the identification of the beneficiary’s CPF through the analysis of the data contained in the

MACIÇA and in the CPF of the Brazilian Federal Revenue (RFB), considering the content of the following fields: CPF number, name, birth date, mother’s name, voter ID card and home address.

Several data analysis techniques were used, from which the following must be highlighted:

1. **BublePlot:** the technique was used to analyze the amount of Unemployment Guarantee Fund (FGTS) payment forms and Social Security Information (GFIPs) presented by and employer in each month. The standard is that an employer presents only one statement of employment relationship through the GFIP system each month. Occasionally, for the amendment of any error or omission, the employer may present a second statement. The objective was to highlight the cases considered abnormal, different from the standard and with a great number of amended statement.
2. **Logistic Regression:** the technique was used to detect the cases considered abnormal, different from the standards of concession of benefits (in this case, only two types of benefits were analyzed, which were the scope of the analytical board).
3. **Relationship networks:** the technique was used to analyze the existing relationships between the data of benefits that were proved irregular and the data of benefits paid in February 2014. The analyzed relationships refer to benefits of a same holder, settlor, recipient or prosecutor. In other words, all benefits that are being paid and present relationships of that nature with benefits that are proved irregular or that were selected as suspects or demanding a more detailed analysis.

Finally, the consolidation of the results from all analyses was performed using IT solutions from a specific enterprise and it enabled the score definition for each benefit. In other words, some sort of a score-card matrix was used. Numbers and colors according to its value represented the score. The highest values (a maximum of 1000) indicate a high probability of an irregular benefit.

It is understood that this methodology will enable SecexPrevidência to perform in a selective way

on the benefits with greater possibility of error/fraud, on the vulnerability of transactional systems, on the decrease of false-positives, on the monitoring of deliberations, on the performance of more accurate diagnosis, on the identification of opportunities that may contribute to the delivery of best services to citizens. The methodology will also enable the automation of some data-crossing procedures, which may be periodically performed at a low operational cost. In short, the implementation of this type of methodology will contribute to the improvement of techniques of fraud detection, risks evaluation and transparency dissemination currently used in the Audit Department.

Given the materiality and complex of social security systems regimes, benefits of Unemployment Insurance and Special Salary Raise of the Ministry of Labor, and of the actions of income transference of the Ministry of Social Development and Fight against Hunger, the need of implementing actions involving the use and analysis of a great database is reinforced.

Therefore, the challenges faced by SecexPrevidência in this action strategy involving data analysis in an integrated way require changes in the work processes of the unit as well as in the articulation with other areas of the Court, especially in the area responsible for the training and information technology.

In relation to the support to the IT area, a new way of integration among and within teams of the Court is necessary, evolving to the mass use of IT in the integration of bases, quality increase and development of solid and useful analyses for the responsible areas of the Court. That requires training, integration among teams of different areas and an adequate software for data mining for information crossing.

The conjunction of several actions is necessary to achieve the desired performance scenario. The first and most important is training auditors that already perform in the SecexPrevidência in areas of new challenges knowledge. In addition, it is proposed that a group of auditors from the Audit Department become responsible for the interaction with other areas, especially from the IT, and for the information support that may become necessary for control actions of the unit. This group would aim at contributing, through analyses and database alignment, to a greater effectiveness and efficiency of the resources allocated in the Audit Department while guiding the actions to benefits and transactional systems that present a greater risk. The action would improve the quality and the results of the works, for a diagnosis performed in 2014, supported

by Seplan, identified a significant and repetitive investment of time on data analyses that could be part of a previously structure routine, providing the auditors with more accurate and continuous information bases.

However, based on a diagnosis previously performed, it was identified that the implementation of a strategy in SecexPrevidência that enables the use of data in a broad manner may increase efficiency in the performance. For that purpose, a modification in the processes of internal works, of personnel allocation, IT support and technicians training will be necessary.

In addition to present the systematic of integrated analysis in a context of great databases being developed in SecexPrevidência, the present article aims at drawing attention to the opportunity of developing similar strategies in other areas of the Court, as in Health, Education, Personnel, Works and Bids, once they all work with broad databases.

## NOTE

- 1 MACIÇA – payroll from the benefits operated by the NISS; CNIS – National Registry of Social Information– registration of those covered by the NISS; CadÚnico – Social Information Registration – registration of social assistance beneficiaries of the Ministry of Social Development (MDS); CAGED – General Employed and Unemployed Register; Folha PBF – Bolsa Família Programme Payroll – under the responsibility of the MDS; RAIS – Annual Listing of Employees and Salaries from 2009 to 2012; SIAPE – Human Resources Management Integrated System; CPF – Issuance of Individual Taxpayer Registry; SISOBÍ – Obituary Control System of the Ministry of Social Security, CENSOSuas – Single System of Social Assistance census.

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