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RESULTS OF THE APPLICATION OF SAS FOR FRAUD IDENTIFICATION IN PUBLIC ADMINISTRATION OF BRAZIL

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#SASGF

RESULTS OF THE APPLICATION OF SAS FOR FRAUD IDENTIFICATION IN PUBLIC ADMINISTRATION OF BRAZIL

Sérgio Côrtes; Aline Emidio; Leonardo Aguirre; Leda Salles

Maxtera Tecnologia Ltda

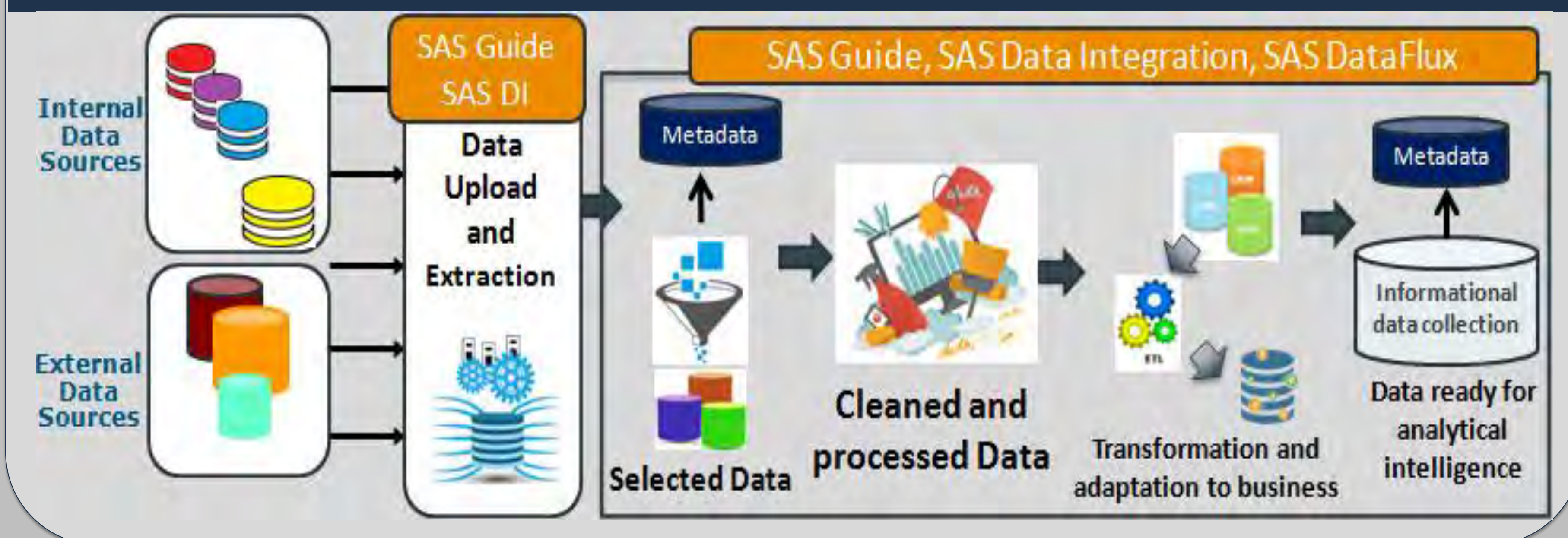## ABOUT THE AFFILIATION: MAXTERA/CDS

Maxtera, a member of the CDS group, received in 2016 the SAS Channel Partner award, besides the national awards in 2018 of Sales Results and Number of Customers Reference.

ABSTRACT

In Brazil, in a period when there is a lot of discussion about losses and consequences due fraudulent acts and cases of corruption, the identification and fight against theses actions have been prominent. With innovative initiatives in the Data Analysis area, the elaborated works guarantee to the various publics institutions in Brazil the knowledge necessary to combat fraud and irregularities.

For this purpose the SAS tools associated with analytical and predictive techniques were used in several sectors, focusing on the recovery of revenues, benefits payments, government purchases, health, public safety, among many others business areas.

METHODS

METHODS

The processes that involve the identification and prevention of fraud has many stages, starting with obtaining the data, which may come from internal source of each institution, and through agreements that facilitate access to external data.

Subsequently, a long tasks begins which involves cleaning, selecting and transforming the available data until it is stored in a repository and ready to be used in the step that includes the analysis and publication of the obtained insights.

Among the analyzes responsible for discovering patterns and obtaining valuable information, we highlight initial explorations, data mining, text mining, creation of relationship networks and, finally, the disclosure of theses results.

For each step in this process a different SAS tool was used, according to its characteristics and purposes.

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METHODS CONTINUED

Business Rules

Anomalies

Social Network

Predict Models

Unstructured data

Risk Score

In what concerns the identification of frauds, it was used what is known as "*Hybrid Approach*". In this approach several methodologies are employed in order to optimize the identification of irregularities.

The **Business Rules** intended to identify the nonconformities with Brazilian legislation.

Through the **Anomalies** we search for entities that have very different behaviors from those observed among their equals.

The **Social Network** analysis brings the benefits of being able to track inappropriate relationships and monitor the connections of entities that are already under suspicion.

The **Predict Models** bring the differential of identifying behavioral patterns undetected so far and which are prevalent among fraudsters.

Unstructured Data analysis provides the advantage of using previously discarded data in face of the complexity of extracting value from text type information.

All resources are jointly used to assign to the entity a **Risk Score** where, the higher the score, the more evidence of irregularity identified, thus prioritizing the most critical cases and facilitating the audit work.

RESULTS

Work focused on identifying frauds in the payment of social security benefits.
Over 3,000 indicators were created automatically and approximately 1 trillion deviations were calculated.

Benefits with high probability of fraud cost $900 millions

Identification of frauds in the payment of taxes to the State of Mato Grosso. Several indicators created based on 5 styles of fraud recognized by auditors..

A loss of $ 23 million was avoided in three months

Using social networks it was possible to identify government employees with more than one position (illegal) and to identify relationships between companies that participate in government procurement processes.

Saves almost $ 1 million per month

Identifying improper use of tax benefits for small businesses, and the composition of collusions - illegal agreements between companies for their own benefits - harming the government procurement process..

Public purchases with signs of irregularities result in more than $1.2 billion

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RESULTS CONTINUED

Building Predictive Models using Text Mining, Dimension Reduction, and Supervised Learning techniques to identify laundering money crimes (corruption) and evidences of terrorism.

Reduced audit time to less than one quarter.

COAF

Creation of several indicators based on three types of fraud and use of networks to identify criminal networks. Creation of indexes to identify the chances of debt liquidation by taxpayers.

Almost $74 millions identified as frauds in the first three months

PREFEITURA MUNICIPAL DE CAMAÇARI

Creation of a DataMart and application of Association Rules techniques to identify irregularities in bids. Use of relationship networks to map links between people and companies and the accumulation of public positions.

Information to investigate fraud is available in less than 1 minute

TCDF

Creation of a DW with automatic data loading, discovery of new patterns of fraud, construction of a predictive model to detect suspicious transaction and analysis of social networks.

Increase in the number of transactions analyzed in a shorter time
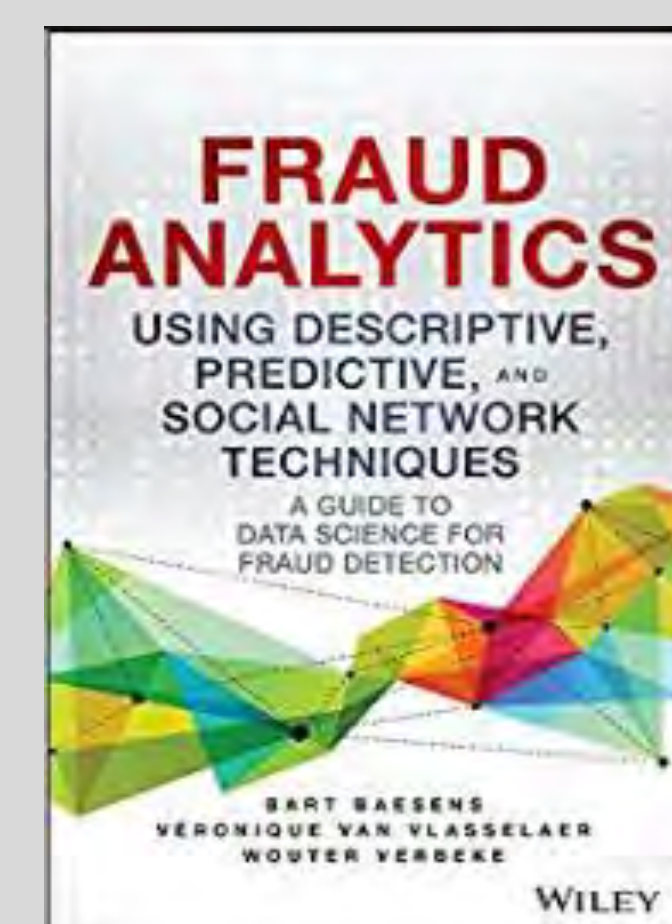
BNB

CONCLUSIONS

The results presented in this e-poster demonstrate how different applications of analytical intelligence can support the discovery and prevention of fraud in various sectors of public administration. Each work used one or more methodology among the five existing in the Hybrid Approach, obtaining diverse financial results.

Institutions that would like to combat tax fraud used the relationship networks to, after identifying a fraudulent company, track the others that somehow were linked and thus act making the means of tax evasion unfeasible.
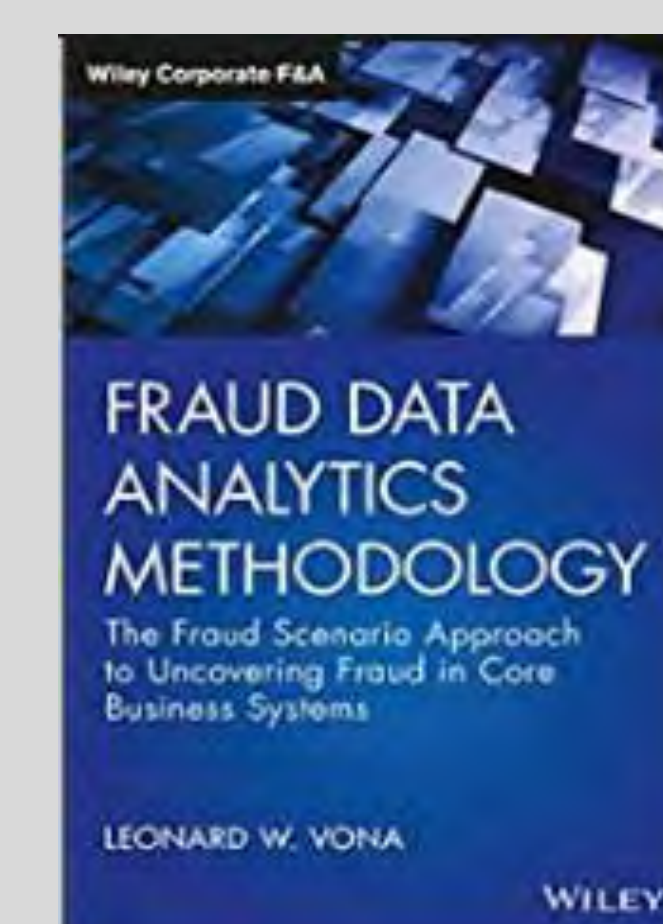
Other government procurement control institutions focused their efforts on identifying prohibited association among participants in the procurement process who acted in this manner to spoil the bidding.

In addition, predictive models that use data mining techniques were applied to classify an event between a legitimate action and a fraudulent action.

REFERENCES

Baesens, B., Van Vlasselaer, V., & Verbeke, W. (2015). *Fraud analytics using descriptive, predictive, and social network techniques: a guide to data science for fraud detection*. John Wiley & Sons.

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Results of the application of SAS® for fraud identification in public administration of Brazil

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Maxtera Tecnologia, Sistemas e Comércio LTDA

ABSTRACT

Several public institutions in Brazil, on federal, state and municipality levels, with the partnership of CDS / Maxtera, apply SAS® tools in their businesses in order to identify signs of irregularities (or fraud). Revenue recovery, benefit payments, government purchases, education, public safety, amongst so many other areas of business.

In less than two years, more than 100 million dollars have already been recovered or prevented from migrating to several different people, aswell as criminal organizations. This experience has aroused the interest of many government entities, and CDS / Maxtera has made use of SAS® solutions and tools contributing to the success of these projects, applying methodologies and procedures for data analysis and analytical intelligence.

This paper, therefore, proposes the presentation of methodology employed and consolidated results for the work carried out in several public institutions in Brazil, which aimed primarily the identification, control, fraud prevention and monitoring in the most diverse levels to which it was directed.

INTRODUCTION

In 2016, Maxtera, affiliated to CDS group, started several works focused specifically on fraud identification and prevention in the public sector. For the work started that year, the company won the 2016 SAS Channel Partner Award. Several institutions of control, enforcement and tax collection, among others, started anti-fraud projects, taking advantage of SAS® Fraud Framework tools and the expertise of the company in works of the same area, thus making knowledge dissemination easier.

In order to add value to data inherent to each institution, and retrieve essential information with the best possible degree of assertiveness in fraud detection, in different ways, a holistic approach has been adopted. This approach, called "Hybrid Approach", deals with a combination of methods that are used together, providing a complete view of the business, assessing the possible occurrence of fraud through various perspectives. Each method has different levels of application difficulty, ranging from simple database queries to the application of sophisticated text and data mining techniques. Currently, each project has some of the features of the hybrid approach, linking different elements that were necessary to the business concerned.

In this paper, the hybrid approach and its aspects and advantages will be presented, as well as the choice of each institution for the methodology to be used in their projects, in addition to the efforts and techniques used in each project. Also shown are the benefits arising from the application of the approach, which are not limited to financial benefits, but also to increase accuracy and assertiveness, and to reduce the time elapsed in the analyses.

THE METHODOLOGY USED

The methodology used in the works that will be presented assumes an end-to-end work, which includes access to the data stored in database, selection of attributes, registry selection, cleansing and imposition of quality, and finally the loading of tables in "*sas7bdat*" format. The final tables of this process are used in the following step: the Hybrid Approach.
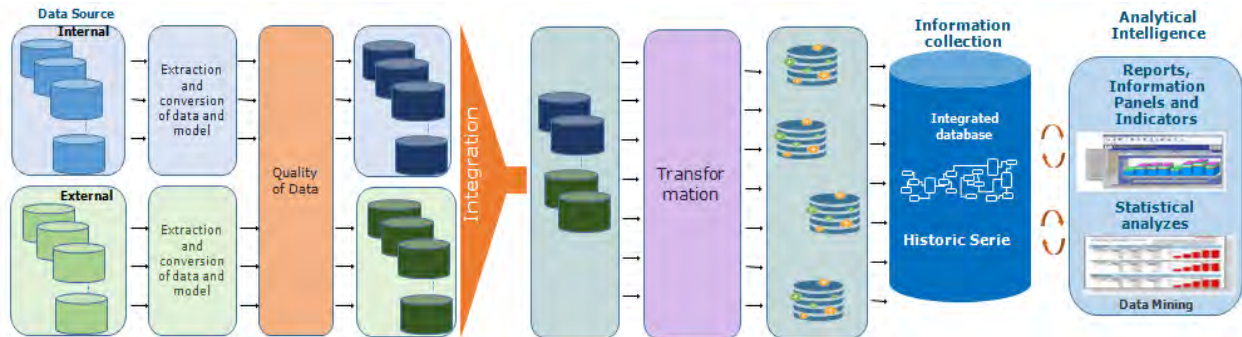

Figure 1. Description of the stages of the Analytical Intelligence process for fraud detection

Each institution has its own internal data collection in a given data model and chooses whether to make agreements with public or private companies in order to obtain data from external sources. For this reason, the step including the transformation of raw data into data prompt to analytical intelligence application must be customized and has different representations within each project.

In spite of being a necessary and very important step in the projects, the processes involved in it are not often mentioned, for the reason that, although indispensable for any Data Mining work, they are not responsible for the generation of knowledge of the data. However, given its importance in all projects, and the representativeness that this stage may achieve, the methodology is mentioned in a generic way, excluding the peculiarities of each work developed.
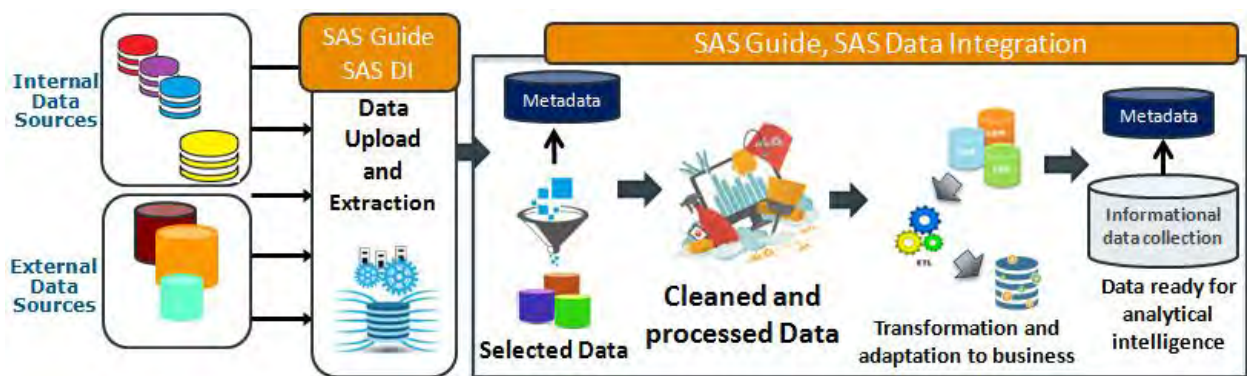

Figure 2. Description of the steps in the Analytical Intelligence process for fraud detection by positioning SAS® tools used in each step

The first step involves the connection to the databases in which information is stored, as well as importing files such as ".txt" and ".csv". These data go through a process of imposing quality and integration in which the various sources are consolidated in an integrated database. From then on, tasks inherent to attribute and observation selection, cleansing of incompatible data, grouping, creation of derived attributes, sorting, among many others, are started until the final data is ready to be used in analytical

intelligence. To perform the tasks presented above, SAS Base®, SAS Enterprise Guide® and especially SAS Data Integration® tools were used due to their design oriented to these tasks.

Once data is processed and ready for analytical application, it is given start to the construction of processes involving the Hybrid Approach. This approach has its name based on the fact that it is composed of five dimensions (or analytical pillars) that must be used together in order to prioritize cases for investigation due to the high risk of irregularities.

Figure 3. Description of the Hybrid approach for fraud detection

- **Business Rules:** Business Rules are database queries aimed to identify events mapped by the business team. Among the rules, we search, for instance, events that are not in compliance with Brazilian legislation, thus incurring irregularity, or other events that, according to experts in the areas, involve suspect behavior already identified. In this dimension, no predictive analysis is used, making it a less complex technique for identifying frauds. For this reason, many of the institutions start their fraud identification work with this dimension, since great results can be achieved in a short time. In general, when the negotiation rule searches for a nonconformity concerning the law, it is usually attributed to events that incur a high score in the rule, so that these may have priority in the analysis due to irregularity already identified.

- **Anomalies**: Anomalies make use of the search for behavior patterns, or even events that are much different from others. In this dimension of analysis, the distribution of events is observed, determining the central measure of the events and the dispersion of data. Given certain limits, events that are outside the determined range of acceptance (around 2 to 5 standard deviations above or below average) are identified as anomalous events. It is important to note that such comparisons should only be performed by observing similar events among each other, especially when a significant difference in metrics is observed compared between different groups. For example, in order to determine the acceptance limits of the sales value for a given product, the distribution of these values by city must be observed, since there is variation in the average value of the item in different cities. In this dimension, the lowest risk score is usually attributed, since no irregularity was seriously detected, only abnormal patterns were noted, but they should be recorded in order to compose the consolidated analysis of the findings.

- **Social Network:** Relationship networks stand out as a differential in the identification of frauds. This is because, by identifying some entities that incur in frauds, it is possible to trace other entities that also act in fraudulent ways. Traceability occurs by means of relationships between entities. A relation already configured as problematic can be used for expansion and identification of the other entities that are part of that group. Thus, even if only a few fraudulent events are identified in the other dimensions, the relationship network allows them to visualize new events previously unnoticed but which should be under analysis. In addition, other types of relationships given as improper can be viewed in the relationship network. Some examples applied to the works that will be exposed in this paper include relations of kinship between companies that compete in bids, or yet, the occupation of multiple positions in government institutions by the same public servant. Scores assigned through discovery in relationship networks may vary, based on the understanding of the business team.

- **Predict Models**: Predictive models fulfill one of the most enriching functions of the fraud recognition process, which is the discovery of unknown patterns. In this domain, several data mining techniques are used, among which we mention, market analysis, cluster analysis, logistic models, decision trees, random forest, MCMC, among others. As an example, these techniques can be used, once knowing the entities that act in fraudulent ways, to perceive their characteristics and similar actions, and thus, when identifying a new entity that, although not being marked as fraud, may present patterns (characteristics and actions) very similar to those of the fraudulent entities, mark it as such. Thus, in a deterministic analysis of the facts, one can imagine being faced with a classification error of the model, when in fact, it may be a discovery of a pattern not yet mapped by the business area. Predictive models can give each case a score proportional to the probability of dealing with a fraud.

- **Unstructured Data:** Unstructured data can be used in a series of ways to add value to the business. These data, not long ago, were disregarded from the analyzes because of the greater difficulty inherent to manipulation and analysis. However, much relevant information can be obtained from this source. Sometimes inconsistencies in filling certain fields in a record, for instance, are pointed out when checking the content described in another field. Or, information related to a perception, and that due to its specificity are not registered in a structured way, may be the most relevant and enlightening in a fraud identification process. In this way, investigations in which no proceeds can be obtained from unstructured data are rare. Again, the scores attributed through discovery in unstructured data may vary, based on the understanding of the business team

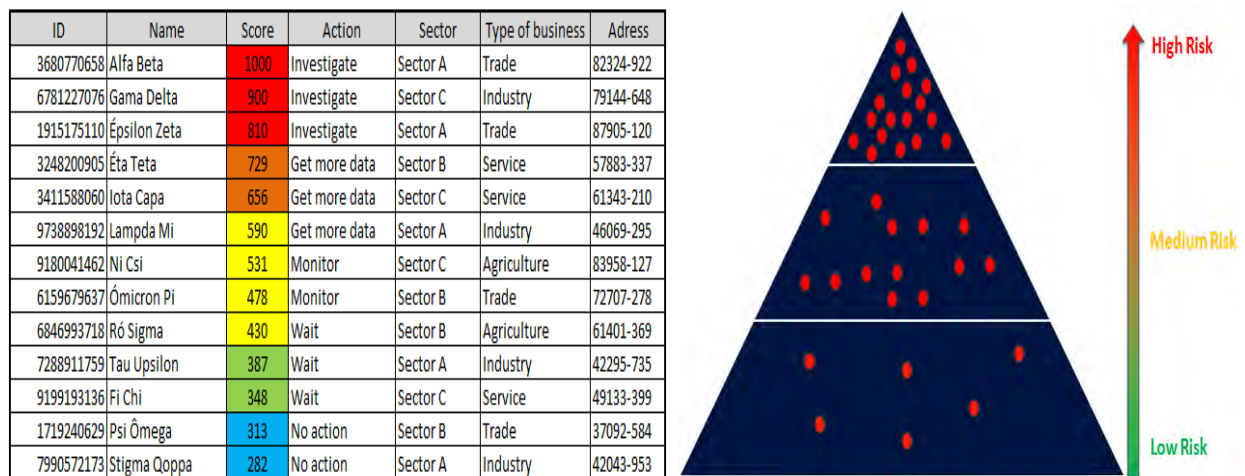| ID	Name	Score	Action	Sector	Type of business	Adress
3680770658	Alfa Beta	1000	Investigate	Sector A	Trade	82324-922
6781227076	Gama Delta	900	Investigate	Sector C	Industry	79144-648
1915175110	Épsilon Zeta	810	Investigate	Sector A	Trade	87905-120
3248200905	Éta Teta	729	Get more data	Sector B	Service	57883-337
3411588060	Iota Capa	656	Get more data	Sector C	Service	61343-210
9738898192	Lampda Mi	590	Get more data	Sector A	Industry	46069-295
9180041462	Ni Csi	531	Monitor	Sector C	Agriculture	83958-127
6159679637	Ómicron Pi	478	Monitor	Sector B	Trade	72707-278
6846993718	Ró Sigma	430	Wait	Sector B	Agriculture	61401-369
7288911759	Tau Upsilon	387	Wait	Sector A	Industry	42295-735
9199193136	Fi Chi	348	Wait	Sector C	Service	49133-399
1719240629	Psi Ômega	313	No action	Sector B	Trade	37092-584
7990572173	Stigma Qoppa	282	No action	Sector A	Industry	42043-953

Figure 4. Selection of cases for analysis after application of the hybrid approach

After the attribution of the scores due to all the checkouts carried out in the five analytical pillars of the hybrid approach, the sum of the points obtained per entity is made. In this way, the entities that obtain higher scores are those in which more evidence of irregularity or more serious signs of irregularity were identified, which is why they require a more urgent analysis from the investigator. Thus, although the scope of events to be investigated may be high, the investigator needs to focus his efforts primarily on the events with higher scores, since there will be a greater concentration of cases of irregularities in this group. Therefore, the hybrid approach is able not only to reduce the investigator's efforts, but also to improve his productivity, since a greater number of frauds can be verified in a reduced time of analysis.

DEVELOPED PROJECTS

Next, some cases of public institutions in Brazil will be presented, in which the methodology described above was applied in order to detect and prevent fraud, obtaining relevant results.

FEDERAL COURT OF AUDIT IN BRAZIL - TCU

The Brazilian Federal Court of Audit (TCU - Tribunal de Contas da União) is responsible for auditing the accounts of public administrators and other individuals responsible for money, assets and federal public securities, as well as the accounts of any person who causes injuries, financial loss or other irregularity resulting in prejudice to the National Treasure[1]. For this reason, it is particularly necessary to carry out works in order to control public expenditure. In this Court, two works involving the use of the tool framework of SAS® solutions associated to analytical intelligence techniques will be presented.

In December 2016, Social Security of Brazil had about 33.6 million active benefits in its records, of which 83.9% were of a social security nature. Pension benefits accounted for approximately $ 11.3 billion in December / 2016. It should be noted that, in addition to being expressive values, social security expenditures in Brazil show a remarkable increase over the last years[2].

This scenario is propitious to carry out studies aimed at identifying and blocking the payment of benefits that are in situation of irregularity, whether due to fraud or errors.

Front 1: Identification of fraud in the payment of social security benefits

In order to identify benefits with evidence of irregularities, two approaches were developed:

- Creation of 14 Business Rules aimed at identifying, among other issues, compliance with the limits of benefit values and minimum ages for each type of benefit, accumulation of benefits for the same retiree/beneficiary, a check on the record situation of retired/beneficiary, checking on external bases for counting time of service of retirees, checking of death registries within the country, among others.

- Creation of a predictive model for identifying frauds in the payment of benefits, to perform the adjustment of several classificatory algorithms, using a history of irregularities in the payment databases, concession and other external data source, to assign to each benefit a probability of fraud. From then on, a cut line was stipulated and the benefits analyzed were classified as fraudulent or not.

On this front, we highlight the use of 3 domains of the hybrid approach: business rules, anomalies and predictive modeling.

Front 2: Percentage Estimation of Irregularities on the payment of benefits

This front was aimed at obtaining point and interval estimates for the percentage (and amounts) of the benefits with some kind of irregularity (fraud or error) in order to follow up and monitor irregularities.

Although this number could be obtained by the application of sampling techniques folllowed by the audit of benefits, this methodology was discarded due to its high operational cost. For this reason, a survey was conducted by means of a questionnaire applied to a group of experts in which the perception of the amount of fraud was addressed.

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[1] http://portal.tcu.gov.br/institucional/conheca-o-tcu/funcionamento/
[2] http://www.previdencia.gov.br/dados-abertos/dados-abertos-previdencia-social/

Based on the answers of the experts, several analyzes were conducted, such as analysis of the differences in perceptions between geographic regions, between the institution in which the specialist works, and above all, the sampling performed from simulations of probability distributions using Markov Chains (MCMC techniques). The application of such techniques allowed an average and interval estimate to be obtained from the specialists' specific answers.
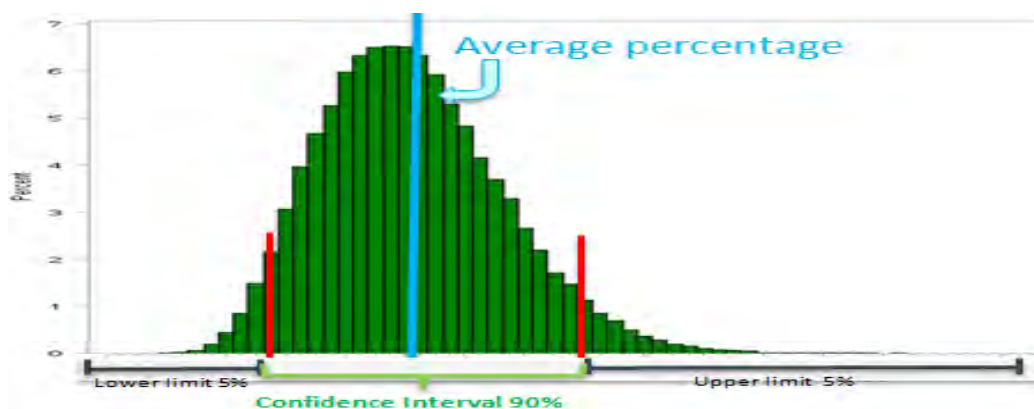
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Figure 5. Percentage distribution for irregularities in social security in Brazil

SECRETARY OF FINANCE OF THE STATE OF MATO GROSSO - SEFAZ-MT

The Secretary of Finance of the State of Mato Grosso (Secretaria de Fazenda do Estado do Mato Grosso – SEFAZ-MT) is the institution responsible for ensuring public revenue and control of the application of public spending, with fiscal justice, contributing to the economic and social sustainability of the State of Mato Grosso[3]. In spite of being a very rich Brazilian state, irregularities resulting from possible omissions, tax fraud and other irregular actions from taxpayers reduce the State's financial revenue, resulting in the lack of financial resources to foster the development of the region and meet the needs of the state's population.

In order to previously identify and suspend the activities of companies that act irregularly, a work was carried out at SEFAZ-MT, which consisted of the implementation of five Business Tracks, composed by several business rules aimed to identify fraud in the payment of taxes due to the State. Among several fraudulent transactions are the issuance of non-value invoices as well as the practice of underbilling by means of the reduction of the tax base.

In addition to the implementation of Business Track, relationship networks were created connecting companies and people via society, telephone, e-mail and IP of the computer issuing the invoice. In this way, when identifying a fraudulent company, in case it had multiple relationships, or problematic relationships with other companies, these two will be connected and presented.

Thus, all the invoices issued daily are assessed for the five business tracks and for each irregularity found a certain score is attributed to the invoice. At the end of the process, the sum of the points obtains is made and the invoices with higher scores are brought to light.

In this way, on a daily basis, SEFAZ-MT auditors view screens presented by SAS Stored Process[®] and SAS Social Network Analysis (SNA)[®] that lead to analyzes ranging from the number of frauds identified, to the type of fraud, the list of invoices with indications, the details of the company issuing the invoice, the network of relationships, among other relevant information.
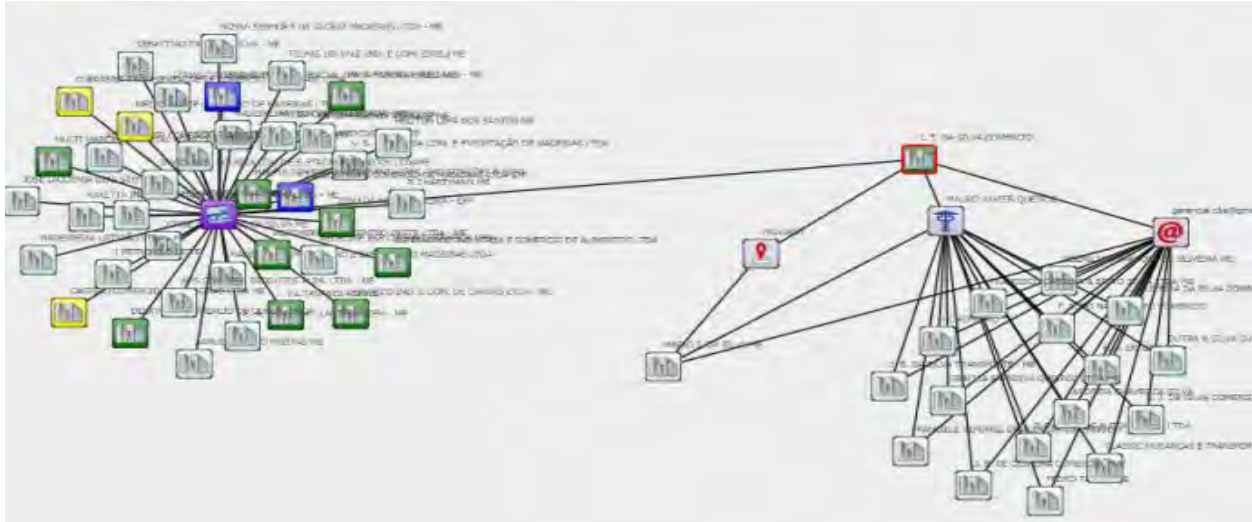
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[3] http://www5.sefaz.mt.gov.br/identidade-organizacional

Figure 6. Network created to connect people and companies in Mato Grosso

COURT OF AUDIT OF CEARÁ - TCE-CE

The State Audit Court (Tribunal de Contas do Estado do Ceará) is the public institution responsible for the control of state public assets and resources, promoting ethics in public management in order to guarantee the full exercise of citizenship for the population of the state of Ceará[4].

Brazilian legislation, in general, does not allow the accumulation of public positions. However, this rule has been constantly disobeyed and several public servants are accumulating positions in public or private institutions, with a workload higher than what is permitted law, which brings prejudice to the provision of public services to society.

By crossing databases, a scan was performed on the data sources available to the Court of Audits, and all the servants with more than one function were brought to light. Next, the constitutionality of such accumulation was checked, and cases of undue accumulation were reported.

MINISTRY OF PLANNING, DEVELOPMENT AND MANAGEMENT - MPDG

The Ministry of Planning, Development and Management (Ministério do Planejamento, Desenvolvimento e Gestão) is a Brazilian institution whose mission is to plan and coordinate federal public administration management policies in order to strengthen the state's capacity to promote sustainable development and improve the delivery of results to citizens[5].

Between 2015 and 2017, public purchases made by public administration entities in Brazil that use SIASG (a system used to facilitate and expedite the purchase and acquisition of government materials and services) summed approximately $ 80.5 billion dollars associated to 530,179 processes[6].

Due to the volume of transactions to be evaluated in the Ministry of Planning, it was necessary to use the analytical approach to identify frauds in public purchases considering the various ways in which this may

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[4] https://www.tce.ce.gov.br/institucional/apresentacao
[5] http://www.planejamento.gov.br/acesso-a-informacao/institucional
[6] paineldecompras.planejamento.gov.br

occur, as well as the use of SAS Base®, SAS Enterprise Guide® and SAS Enterprise Miner®. At the end of the process, three fronts were constructed:

- In some of the electronic processes called "trading sessions" companies compete by bidding in order to provide certain items or services to the public administration. One of the criteria mostly used to determine the winner of the process is the bidder who offers the lowest price. However, it was noted that some companies had a "robot" capable of bidding much more often than human capacity would allow, harming the fairness of the process. Thus the identification for the use of "robots" occurred through business rules and perception of anomalies implemented, through which were listed the electronic biddings with use of robots, the estimated percentage of bids that used this resource, and the impacts caused by such practice.

- In Brazil, small companies (Micro Empresa-ME and Empresa de Pequeno Porte - EPP) have some advantages in the bidding process. However, the use of the benefits was unduly exploited by companies that do not fall into the category of small businesses. This scan is made considering the limit of the billing legislation of small companies and confronting this limit to the sum of the values committed in public purchases by each company that used the benefit. The monitoring of committed values and a list of irregular companies are regularly presented .

- One of the common forms of fraud in the bidding process is through collusion. In this type of fraud, companies that should act independently act together to undermine the bidding process. In order to obtain personal advantages, one of the companies, called "motivator", starts the bidding process with prices much lower than expected, discouraging licit companies to bid again, while the other company involved in collusion tries to guarantee the second best price. When the winner is called to deliver documentations for the process, it does not meet the requirements and is therefore eliminated from the process, while the company that won in 2nd place is then called, being able to practice the given price, which, in general, is higher than would have been expected had there been no demotivation of competitors. To identify this type of fraud, an analysis called market basket analysis was carried out to identify the association of companies. After identifying the association of bidders, analyzes are performed to verify the percentage of attendance to the requirements of the process by the company that won first place. If this company frequently does not meet the requirements, it is evidenced the formation of collusions for its own benefits.
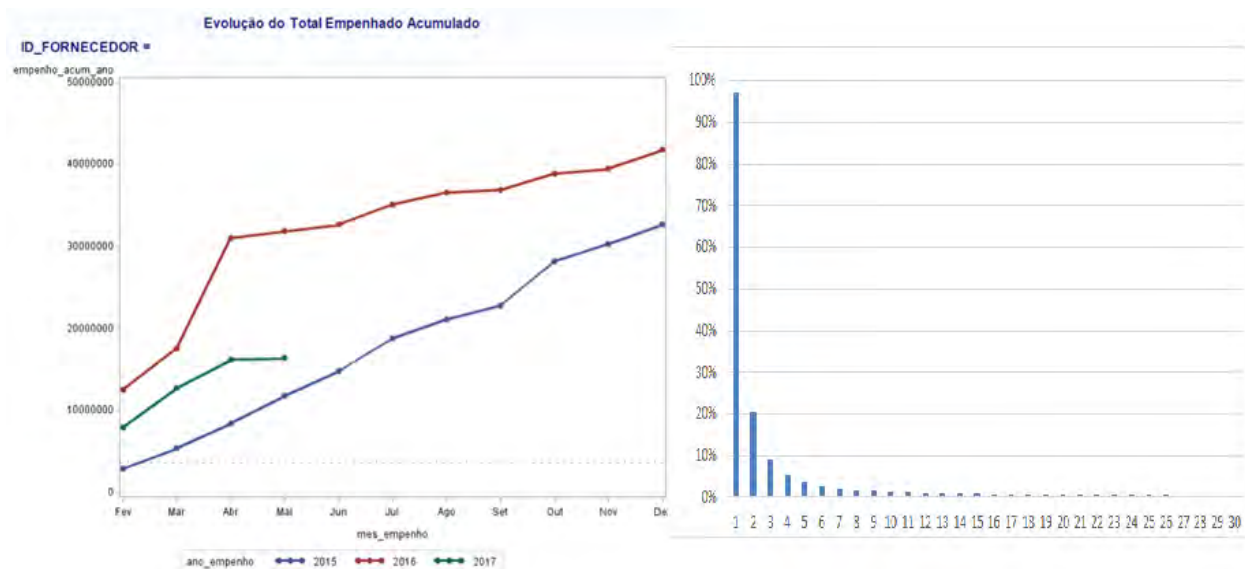

Figure 7. Informational graphs for identifying frauds in benefits of small business and the practice of collusion

FINANCIAL ACTIVITIES CONTROL COUNCIL - COAF

The Financial Activities Control Council - COAF (Conselho de Controle de Atividades Financeiras) works by producing Financial Intelligence and promoting the protection of economic sectors against "money laundering" and terrorist financing[7].

In order to support this work, some institutions are obliged by the current legislation to report via communication certain types of activities that are considered suspicious or that may be used for illegitimate purposes. COAF is the institution responsible for receiving and analyzing the communication, concluding on the need to conduct a more detailed investigation, and giving the other institutions reports on the conclusions obtained.

Due to the volume of communication received, COAF's team of analysts worked on the construction of a predictive model that should analyze the table fields containing the communication sent, including the field of free description and, aware of the decision pattern of the analysts concerning opening or not an investigation, decide whether the communication under analysis should follow for further investigation.

Due to the sensitivity of the topic in question, several data mining and text methodologies had to be employed with the help of the SAS Enterprise Miner® tools, in order to obtain a more assertive predictive model, among which we mentioned the use of n-grams, association measures, logistic regression models, decision trees, random forest, neural networks, among others.

Thus, communication received is regularly evaluated by the predictive model that assigns a probability to the possible opening of a case for investigation. The greater the likelihood, the greater the chances of being faced with communication that may refer to a case of money laundering or terrorist financing, which is why the modeling recommends the analysts to the need of relating the case for further investigation.

SECRETARY OF FINANCE OF THE MUNICIPALITY OF CAMAÇARI / BA

The Treasury Department - SEFAZ of the municipality of Camaçari - Bahia (SEFAZ-Camaçari/BA) has the purpose of promoting, planning, supervising, executing and evaluating foment actions, with the purpose of increasing municipal collection, managing tax collection, financial, taxpayer and of information management[8].

To achieve the goals of planning and inspection, the Treasury Department of Camaçari initiated two fronts of action:

1. Creation and implementation of Business Rules aimed at comparing information related to registration and invoices, including the descriptive field, with several sources of external data, as well as verifying compliance with current legislation, in order to recognize companies that may be acting in irregular ways at the time of payment of municipal taxes (Tax on Services - ISS and Inspection Fee for Operation - TFF).

2. Creation of an index to represent the chances that a property (commercial or residential) may have its debt refered to the IPTU - Urban and Territorial Property Tax paid out by its owner. The higher the index, the greater the chance of discharge. In this way, when collecting the debt, the municipality may focus its efforts on property owners with greater chances of making out the payment.

Information generated through SAS Enterprise Guide® and SAS Enterprise Miner® are presented through SAS Social Network Analysis® and SAS Visual Analytics® tools.

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[7] http://www.coaf.fazenda.gov.br/acesso-a-informacao/Institucional/missao-visao-e-valores.
[8] http://sefaz.camacari.ba.gov.br/portal/funcao.php?url=secretaria.php

Figure 8. Management panels help identify locations that have the greatest chances of recovering debts

COURT OF ACCOUNTS OF THE FEDERAL DISTRICT - TCDF

The Federal District Court of Audit (Tribunal de Contas do Distrito Federal) has the mission of carrying out external control over the administration of public resources of the Federal District of Brazil ensuring the maintenance and preservation of the public patrimony, and the effective and regular application of public money for the benefit of the Federal District population. It has the constitutional duty to supervise and judge the good and regular application of the public resources by the administrators and other people responsible for them[9].

For this purpose, three analyzes were performed using databases from the Federal District Court of Audit :

- As done with the Court of Audit of Ceará – TCE-CE, it was sought to check public servants who accumulated more than one position in situations that violate the dictates of Brazilian legislation.

- A number of principles must be respected in public procurement, including impersonality. That is, those involved in a public procurement process should be impersonal, ensuring that the public interest is respected. In order to ensure this principle, a work was generated in order to create relationship networks to identify links between people (physical, legal and governmental) in actions involving the Government of the Federal District. In this way, the auditor receives a direction for supervision based on the assessment of compliance with the mentioned principle.

- The third analysis consisted of using the Market Basket Analysis technique (as performed in the Ministry of Planning, Development and Management of Brazil) to identify the association between companies in collusions that act in order to obtain their own benefits by limiting the desired economy by means of a bidding for public purchases.

SAS Enterprise Guide® and SAS Enterprise Miner® tools were used to construct the analyzes and the SAS Social Network Analysis® tool was used to present the results.
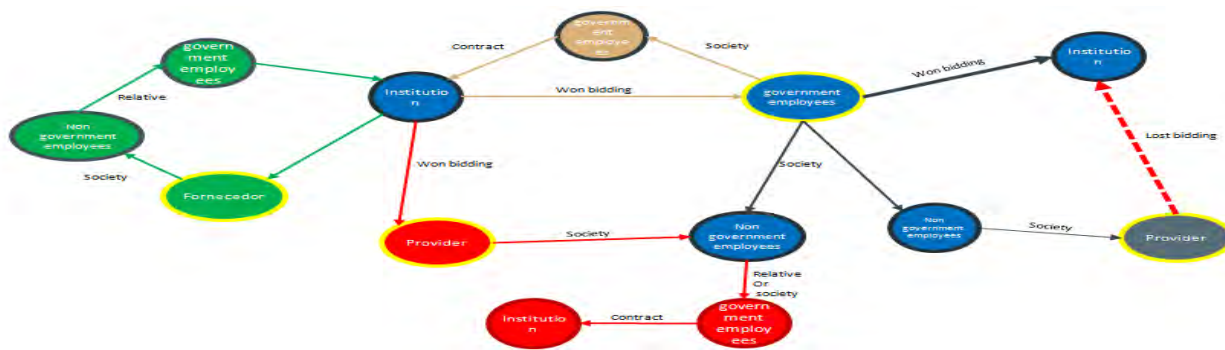
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[9] http://www.tc.df.gov.br/web/tcdf1/conheca-o-tcdf

Figure 9. Illustrating the relationship networks to identify undue relationships between those involved in public purchases in the Federal District

CONCLUSION

This paper aims to explain how a unique methodology was able to support works of institutions in the federal, state and municipal scopes, in their most diverse needs.

As we presented, all projects involved massive data processing stages for integration and preparation, and this information being available for future consultations aimed at extracting knowledge from the data. From the existing methodologies to extract knowledge and add value to data, with a focus on fraud identification and prevention, the Hybrid Approach stands out as a holistic methodology for understanding the methods and means by which fraud occurs in the country's public administration.

As shown in this paper, all institutions whose works were presented in a syntactic way took advantage of the use of one or more domains of the hybrid approach towards their processes, proving the usefulness and benefits of the methodology employed. In this way, the use of a methodological framework for analytical intelligence associated to the most suitable SAS® tools for each process and idealized to support the identification of frauds have made possible such significant results in the Brazilian public administration.

Worthy of note is the fact that the significant results are not limited to financial results alone, which are responsible for recovering and preventing the public resources from the evasion of amounts that exceeded the sum of 100 million dollars, and only by themselves would be sufficient to justify the adoption of analytical intelligence projects, but also generate operational results for the optimization of processes, since they contributed to a better productivity of the areas, which, supported by the results achieved, act in a more efficient and assertive way.

Thus, by identifying frauds in the different contexts and scopes of public administration in Brazil, the methodologies applied here may support a series of benefits for the Brazilian State.

Considering the momentum of economy, and the demand of the Brazilian population for a better allocation of public resources, involving actions towards inhibiting corruption and any fraudulent acts, besides recovering losses incurred by these practices, this work contributes to the widespread of knowledge concerning methodologies capable of achieving these goals.

In addition to the operational benefits obtained through the identification and prevention of fraud, one of the gains from the work introduced here is raising debates about the improvement of processes and systems used by the public administration, such as government purchases, personnel management, tax collection, among others.

Therefore, works of this nature contribute to the development of the country by solving problems related to fraud and waste of public resources, encouraging other entities to apply analytical intelligence methodologies in their processes, besides demonstrating the need for continuous improvement of methods and systems used in public administration in Brazil.

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