Journal URL: https://scholarsjournal.net/index.php/ijbm
DOI: https://doi.org/10.31686/ijbm.vol1.iss1.4166

Development of a Business Intelligence Solution for Performance Evaluation in Brazilian Courts of Auditors

Saulo Coelho Lima[1] and Kleber Bittencourt Oliveira[2]
[1] Postgraduate Program in Process Engineering – PPGEP/ITEC, Federal University of Pará, Brazil.
saulo.c.lima@gmail.com
[2] Postgraduate Program in Process Engineering – PPGEP/ITEC, Federal University of Pará, Brazil.
https://orcid.org/0000-0002-5998-5129

Abstract
In a context of raised demand for public services, shortage of resources and increasing complexity of controlling these public resources within a perspective that considers the evolution of public administration, with the incorporation of concepts of governance, planning and social engagement, it is imperative to pursuit improvement of ours institutions through the perception of their actions. Performance evaluations are essential management tools that allow us to monitor the achievement of goals, identify advances, correct problems and the need to make changes. Aiming at the optimization proposal in the indicators evaluation process that establishes the measurement of performance, quality and agility of Court of Auditors' activities (established by ATRICON), applying a Business Intelligence tool that helps in the consolidation of the measurement of indicators and allows the registration and monitoring of the evolution of institution's performance submitted to evaluation based on the framework Performance Measurement Milestone (MMD-QATC). To accomplish this task, the MySQL database management system was used in conjunction with HeidiSQL, the SQL Power Architect modeling tool, the Python programming language, the Pentaho Data Integration, part of the suite for BI solutions Pentaho in its Community Edition version, and the Microsoft Power BI Desktop. Thus, resulting in a more practical and scalable platform for consolidating the data.

Keywords: business intelligence; performance indicators; court of auditors;

1. Introduction

Societies have shown an interest and need to know and control public spending throughout their existence. Historical evidence goes back to the papyrus of the Pharaoh Menés (3000 BC), through the *hellenotomiai* (treasurers of the Goddess Athens, responsible for analyzing and judging the accounts of public managers in Ancient Greece) and also, in the Brazilian context, by the institution of the "Erario Régio", on the part of Portugal, already at the Consulate of the Marquês de Pombal - considered by many to be the origin cell of the Courts of Auditors (TCs) - and several other events (GARCIA, 2015) point to concrete efforts to create mechanisms that allow a real control over the pecuniary actions of public managers.

The formal establishment of the first Court of Auditors in Brazil, the Federal one, took place on the initiative of Rui Barbosa (Minister of Finance, at the time) through Decree no. 966-A of November 7, 1890.

BORALI (2018), presents what he considers pillars of institutional strengthening of the Courts of Auditors: the creation of laws on fiscal responsibility and access to information; creation of institutions such as the Association of Members of the Audit Courts of Brazil (ATRICON) and the Rui Barbosa Institute (IRB), at the national level, and the International Organization of Higher Audit Institutions (INTOSAI) and the Latin American and Caribbean Organization of Supreme Audit Institutions (OLACEF), at the international level; in addition to the creation of the Program for the Modernization of the External Control System of Brazilian States, Federal District and Municipalities (PROMOEX), made possible through an agreement with the Inter-American Development Bank (IDB). Such initiatives raised its status, expanded its scope of action and began to demand greater openness, publicity and accountability.

LUZ (2018), makes a historical overview of the evolution of TCs and, not only that, but he also discusses factors that contributed to what he called the resignification of TCs, citing actions such as the street demonstrations of 2013, the "Operação Lava- Jato" by the Brazilian Public Ministry and Federal Police, the recommendation of disapproval of the accounts of the Presidency of the Republic in judgment by the Federal Audit Court (TCU), in 2015.

ATRICON decided to regulate guidelines for the Courts of Accounts, which ended up culminating in the "Performance Measurement Framework – Quality and Agility of the Courts of Accounts in Brazil" (MMD-QATC), which incorporates the ATRICON guidelines and is strongly based on international standards accepted by Supreme Audit Institutions. BORALI (2018) points out the MMD-QATC among the works that encourage the standardization of control institutions (along with other IRB, OLACEFS and INTOSAI initiatives), reinforcing the importance and relevance of this initiative.

We live in a time of increased demand for public services, scarcity of resources and an increase in the complexity of controlling these public resources within a context that considers the evolution of public administration, with the incorporation of concepts of governance, planning and greater social engagement, which makes it imperative to seek the improvement of institutions through the perception and evaluation of their actions.

Performance evaluations are essential management tools that allow monitoring the achievement of goals, identifying advances, quality improvements, correcting problems and the need to make changes.

This study has as its main objective the development of a Business Intelligence solution that optimizes and helps in the consolidation and evaluation of performance in Brazilian Courts of Auditors based on the criteria defined by ATRICON in its Performance Measurement Framework - Quality and Agility of the Courts of Auditors, allowing evolutionary monitoring of these institutions.

2. Methodology and Structure of the MMD-TC

The Supreme Audit Institutions – Performance Measurement Framework – SAI PMF, from INTOSAI, served as an inspiration for the methodology used in the MMD-TC which, in turn, incorporated the Atricon guidelines, the Brazilian Public Sector Auditing Standards (NBASP) and the International Standards of

Supreme Audit Institutions (ISSAIs), constituting the main assessment instrument of the Brazilian Courts of Auditors (ATRICON, 2019).

The MMD-TC aims to:

- Assess the performance of the Audit Courts;
- Identify strengths and weaknesses,
- Improve management and governance;
- Emphasize transparency, accountability and performance;
- Monitor, over time, the implementation of improvements;
- Evaluate and disseminate good control and management practices; and
- Stimulating social participation through the production of knowledge for the benefit of society and public authorities in a wide way.

Seeking to cover processes related to final activities of external control and governance and management processes, the Framework was structured as shown in Figure 1.

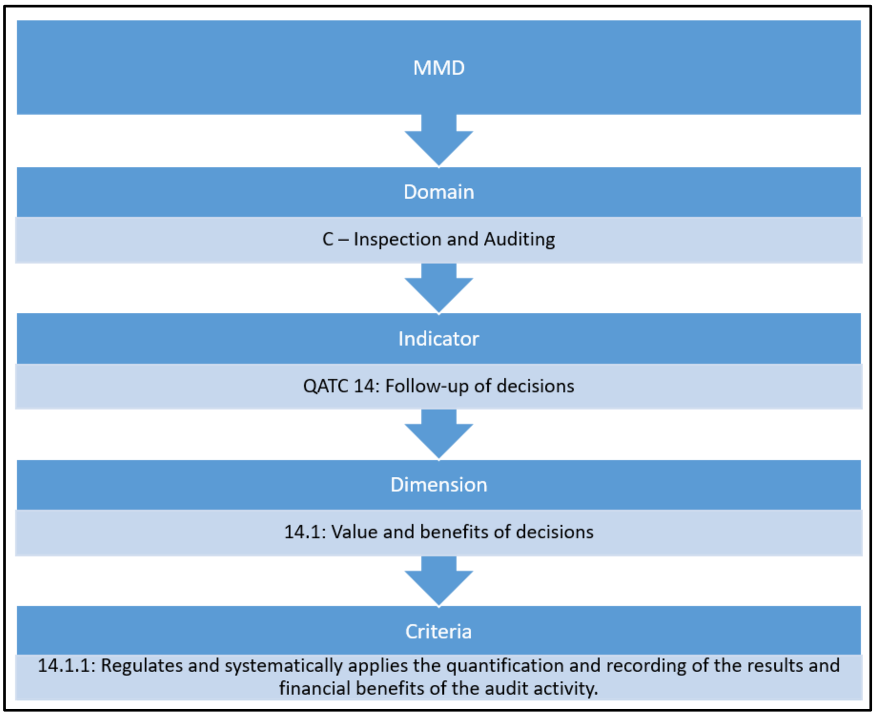

Figure 1 - MMD-TC's Structure.

Source: Adapted from ATRICON (2019).

2.1 Domain

- ATRICON (2019) defines, in the context of the MMD-TC, the "Domain" level as the title given to the grouping of indicators with related themes, with no aggregation of scores at this level. The structure comprises a total of 6 domains, namely:
- Domain A: independence and legal framework;
- Domain B: internal governance;

- Domain C: inspection and auditing;
- Domain D: inspection of infrastructure and environment;
- Domain E: inspection and auditing of social public policies; and
- Domain F: inspection and audit of fiscal management, internal control, information technology, transparency and ombudsman.

2.2 Indicator

ATRICON (2019) defines, in the context of the MMD-TC, the "Indicator" level as the title given to the grouping of dimensions with related themes, having as a score the conversion of the scores of the dimensions that are linked to it and will objectively indicate the level of performance of the Court of Auditors in the respective key areas.

There are a total of 25 indicators mapped and distributed among the six domains, as follows: Domain A with one (1) indicator; Domain B with six (6) indicators; Domain C with eight (8) indicators; Domain D with three (3) indicators; Domain E with four (4) indicators; and Domain F with three (3) indicators. Appendix A presents which indicators are worked on.

2.3 Dimension

ATRICON (2019) defines, in the context of the MMD-TC, the level "Dimension" as the title given to the grouping of criteria with themes. The score for each dimension will be defined depending on whether or not the criteria linked to them are met. Each indicator has up to four (4) dimensions, reaching, in the end, a total of seventy-nine (79).

2.4 Criteria

ATRICON (2019) defines, in the context of the MMD-TC, the "Criteria" level as a set of requirements used as a reference for the evaluation of TCs, prepared based on laws, regulations, guidelines, standards, best practices, etc.

2.5 Performance level

ATRICON (2019) defines, in the context of the MMD-TC, the "Level of Performance" as a measurable result based on the final score of each indicator, which may vary, on the MMD-TC measurement scale, from 0 to 4 points.

Figure 2 presents such a scale, where higher scores demonstrate higher levels of maturity of an indicator. Where: level 0 indicates that the evaluated practice does not exist; at level 1 the practice exists, but with unsatisfactory aspects; level 2 that the practice exists at an unsatisfactory level, but with clear signs of improvement; level 3 that the practice exists at a satisfactory level and being performed as provided for in the Atricon Resolutions and the NBASP; and finally, at level 4, the practice follows all established standards and the Tribunal implements the activities in a way that allows it to constantly evaluate and improve its performance.

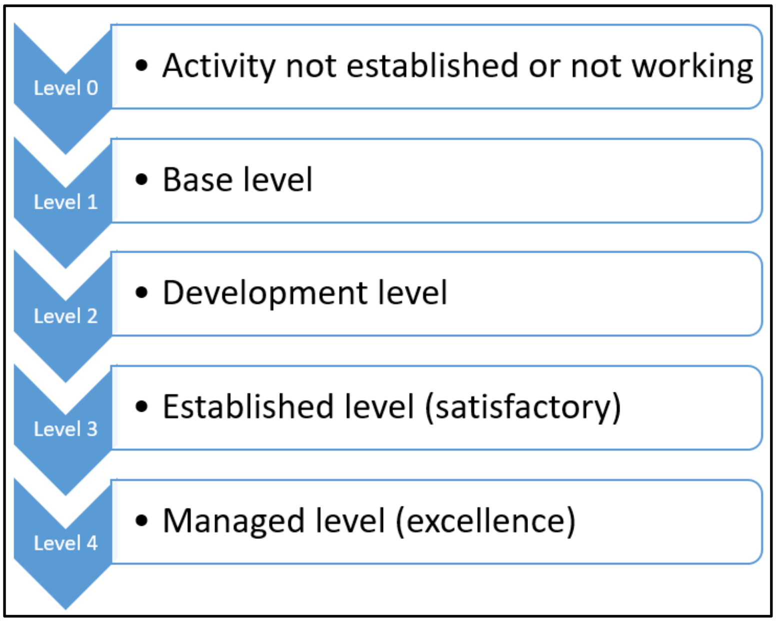

Figure 2 – Performance levels scale.
Source: Adapted from ATRICON (2019).

3. Business Intelligence

TURBAN et al. (2009) state that Business intelligence (BI) is an “umbrella” term that includes architectures, tools, databases, applications and methodologies. It can vary in meaning from person to person, which is caused by the flood of acronyms and buzzwords associated with it and its tools.

According to SABHERWAL and BECERRA-FERNANDEZ (2011), Business Intelligence (BI) is highly important for organizations from the most different branches of the industry, which have obtained significant benefits through the careful use of this resource, because when decisions are based on knowledge, it becomes more reliable than those taken simply based on data. However, they point to the need to distinguish three important concepts: data, information and knowledge.

The data would be raw numbers or statements and therefore may be devoid of meaning, context or intent. The information would be a subset of data, including only data that has context, relevance, and purpose, typically involving the manipulation of that raw data to obtain a more meaningful indication of trends or patterns in the data. And finally, knowledge would differ from information in that it is not simply a set of facts in greater detail, but a justified belief about relationships between concepts relevant to that particular area.

POPOVIČ et al. (2010) add other less tangible factors to this discussion: they emphasize the importance of the human factor within a BI solution and that it would not exist without people interpreting the meaning and relevance of the information and acting according to the knowledge acquired. And even though, the quality of the solution depends on the specific knowledge of the specialists (in order to fill the gap between the information technology and business areas), on adequate organizational structure and culture that allow improvements in the business process through identification of the “right questions” and how they can lead to this improvement.

So, BI can be defined as providing valuable information and knowledge to decision-makers, using a variety of data sources, internal or external to the organization, whether the data is structured or not, and can be qualitative or quantitative (SABHERWAL 2007, 2008).

TURBAN et al. (2009) corroborate this thought by stating that the BI process is based on transforming data into information, then into decisions and finally into actions.

A definition, which we believe to be more complete and which encompasses the aspects reported above, was given by FOLEY and GUILLEMETTE (2010), who proposed BI as a combination of processes, policy, culture, and technologies to collect, manipulate, store and analyze data collected from internal and external sources in order to communicate information, create knowledge and aid decision making. BI helps report business performance, discover new opportunities and make better decisions about competitors, suppliers, customers, financial and strategic issues, products and services.

Regarding the adoption of BI in organizations of different sizes, HORAKOVA and SKALSKA (2013) point out that although it can be used effectively in companies of all sizes, the use of BI in small and medium-sized companies is lower than in large companies, as they seem too complex or expensive for small business needs. As an alternative to this point, the authors suggest the adoption of cloud BI solutions, which can offer lower implementation costs and ease of use, or the use of open source tools and applications. In the study in question, the authors used a mixed solution taking advantage of both commercial and open-source software to build a BI to analyze the costs and the profits of a small company.

All these work processes and technologies need to be organized in an architecture in order to allow interoperability between their components. NEGASH and GRAY (2008) understand that a typical BI solution consists of 4 levels of components and metadata management, namely:

- Operating system level: the operating systems of the business are mainly the Online Transaction Processing (OLTP) systems that support the day-to-day operations of the company.
- Data acquisition level: here the ETL process of the data extracted from OLTP systems to the DW takes place. At this level, data is processed and transformed according to established rules.
- Data storage level: here resides the data processed and stored by the ETL in the DW base, which is normally implemented using traditional database management systems (DBMSs). Star schema and snowflake schema are the most popular schemas adopted for building data warehouse schemas.
- Analytical level: at this level, data is presented through the most diverse types of analytical tools, report generators and online analytical processing (OLAP), which allow efficient navigation of data from different analysis dimensions.
- Metadata Management: metadata is data about other data, such as access authorizations, business rules, etc. They are crucial for the accuracy and consistency of information and system maintenance.

This simple and functional architecture, which served as the basis for the development of this study, is presented in Figure 3 through a diagram demonstrating the organization and connection of these levels, as well as examples of components internal to each part. In it, we can identify the path that the data takes from the source databases and systems until they are made available to the end-user.

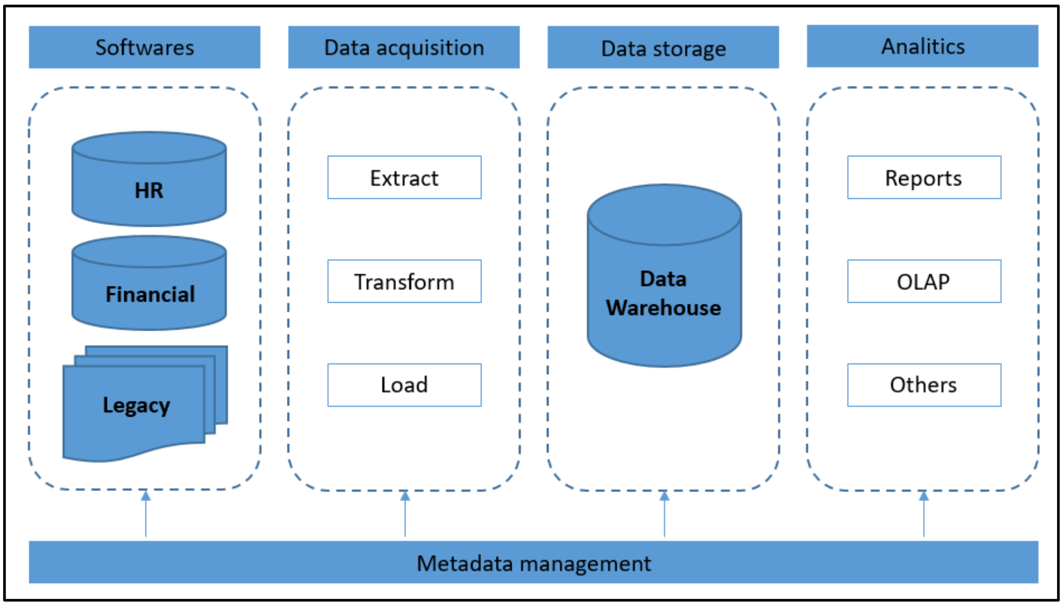

Figure 3 – General architecture of a traditional BI system.
Source: Adapted from NEGASH and GRAY (2008).

4. Materials and Methods

4.1 Technologies and Resources Used

The development of a BI solution necessarily requires the use of a set of tools that together will form an infrastructure, of hardware and software, which will support and allow the execution of the necessary actions.

4.1.1 Hardware Infrastructure

- Three different computers were used, for specific functions, interconnected in a network, according to the specifications below:
- Database server: responsible for hosting the database service. This equipment houses the data warehouse and data mart databases managed by MySQL. The equipment runs a Windows Professional Edition operating system and has a 64bit Intel Core i7 processor, 16GB of RAM and a 512GB solid-state drive (SSD) for storage.
- ETL Server: responsible for the ETL service, interacting with the database and source data repository services. The equipment runs a Windows Professional Edition operating system and has a 64-bit Intel Core i7 processor, 16GB of RAM and a traditional 1TB hard disk (HDD) for storage.
- Client computer: in this context, this equipment was responsible for the functions of source data repository (which in this case are files in XLSX format) and execution of the analysis and dashboard visualization tool. The equipment runs the Windows Home Edition operating system and has a 64bit Intel Core i5 processor, 8GB of RAM and a traditional 1TB hard disk (HDD) for storage.
- Router: asset responsible for networking other equipment, allowing point-to-point communication between them. Equipment with Gigabit speed technology was used.

4.1.2 Software Infrastructure

Different softwares were used to meet the expected needs, according to the specifications below:

- MySQL: used as a data repository for the data warehouse and data mart databases.
- HeidiSQL: SQL client used to interact with MySQL.
- SQL Power Architect: used to perform data modeling and to generate SQL commands to create objects in databases.
- Python programming language: used to write the algorithm that reads data from spreadsheets and persists in the data warehouse database.
- Pentaho Data Integration (PDI): used for ETL process from data warehouse base to data mart base.
- Power BI Desktop: used to build BI reports.

4.2 Methodology

Some steps were followed for the proposed solution to be developed:

- Identify the origin and describe data structure: it was identified that each Court of Accounts responds to a questionnaire and sends the data in spreadsheets in ".XLSX" format to ATRICON.
- Identify and relate facts and dimensions: the events that we wanted to analyze (facts) and from which perspective (dimension) we would like to analyze them were identified, from the point of view of managerial expectations.
- Generate test data mass: unfortunately, ATRICON, which has the real data of all participating Courts of Auditors, does not make them publicly available. For this reason, files were generated with values assigned randomly, following the range of possible response values and the correct structure of the standard files.
- Create data warehouse: the data warehouse (DW) database was modeled and the creation script resulting from this process was executed.
- Create ETL data warehouse: an algorithm was developed to extract data from the source (".XLSX" files) and persist them in the DW database.
- Create datamart: the datamart database (DM) was modeled and the creation script resulting from this process was executed.
- Create ETL datamart: the processes necessary for extracting data from the source (DW database) and persisting them in the DM database were modeled in Pentaho Data Integration.
- Create analyzes and dashboards: Analyzes were developed in Power BI Desktop using data from the data mart and then these analyzes were organized into dashboards.

5. Results and discussion

Figure 4 presents the diagram with the components of the architecture of the BI solution developed.

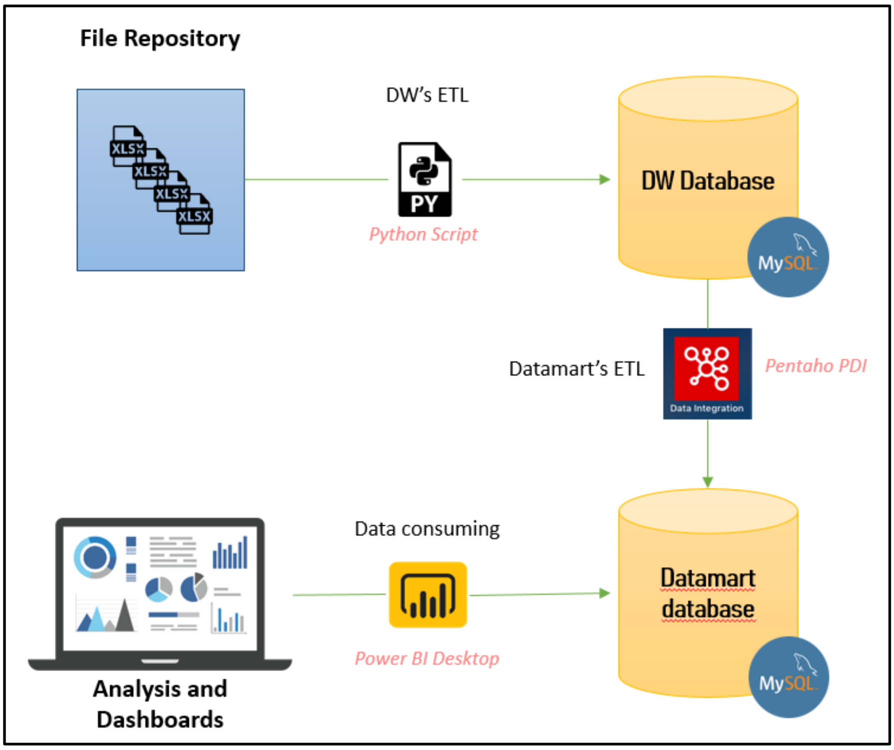

Figure 4 – Diagram of the proposed solution's architecture.

In it we can observe the origin of the data, which resides in a repository in the file system, being organized in files in the .XLSX format and serving as input for the "ETL of the DW" process.

Then, a script for extracting the data at the source and inserting it into the target database is triggered by executing a command line. This step occurs every time you want to process new incoming files. After extracting the data from the files and making them available in a database, we perform the Datamart ETL.

Using Pentaho Data Integration (PDI), we implemented seven (7) data loading processes that have the DW base as the source and the Datamart base as the destination. Figures 5, 6 and 7 present the result of this modeling in the software.

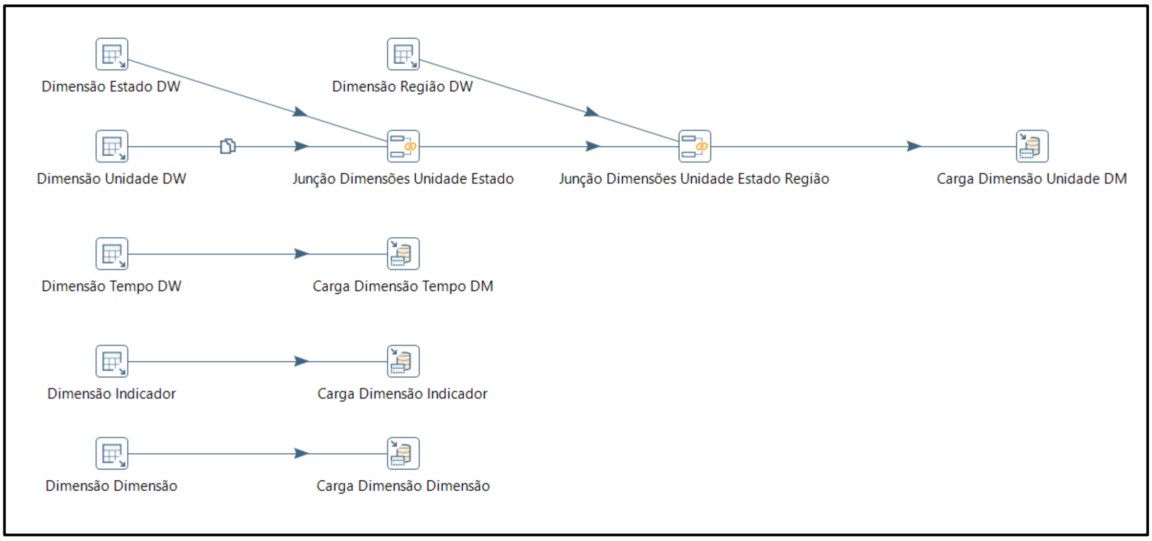

Figure 5 – Modeling of loading processes of dimensions in general

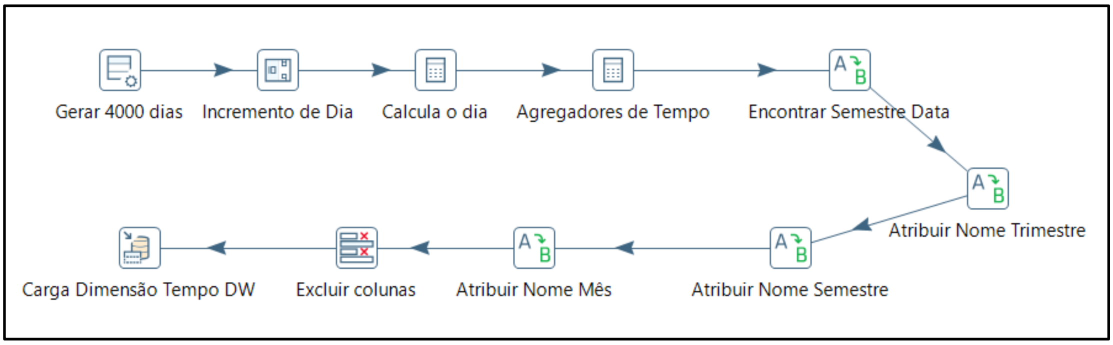

Figure 6 – Modeling of the loading process of the time dimension.

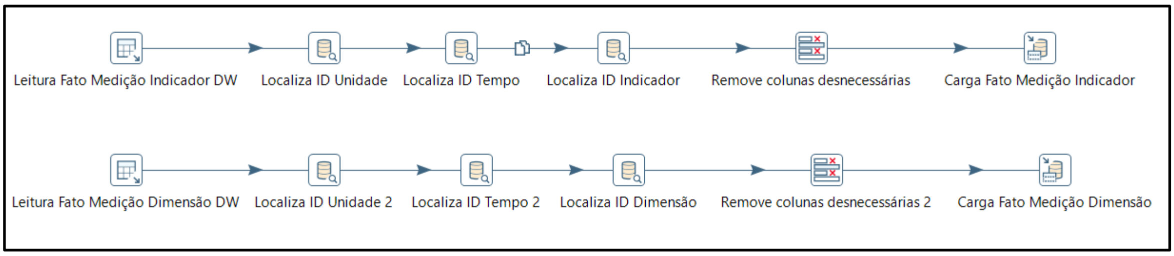

Figure 7 – Modeling of loading processes of facts.

The Datamart ETL process closed the structural steps of the proposed architecture, in which the data is processed so that it is available in a practical way for consumption in the analyzes and dashboards implemented in Power BI Desktop.

At this stage, of data consumption, it was intended to provide views that allowed observing, among others:

- The values of each of the indicators per unit.
- An evolutionary view of the indicator scores per unit.
- The values of each of the dimensions of the indicators per unit
- An evolutionary view of dimension scores per unit.

– The average value of the indicators by region.

– The average value of the dimensions of the indicators by region.

As a final result, we obtained several views, organized into nine (9) different dashboards, which are described below and displayed in the appendix. It is important to point out that the values that appear expressed in the panels are test data, since ATRICON does not provide the real data.

5.1 Dashboard "Units, Indicators and Dimensions"

This panel presents the set of Units, State and Municipal Courts of Accounts existing in Brazil, in two different views: one in a table format, organized by Region and State; and another in a pie chart format, where it is possible to intuitively observe the quantitative distribution of these units in the different regions of the country. You can see the final look of this dashboard in Figure 8.

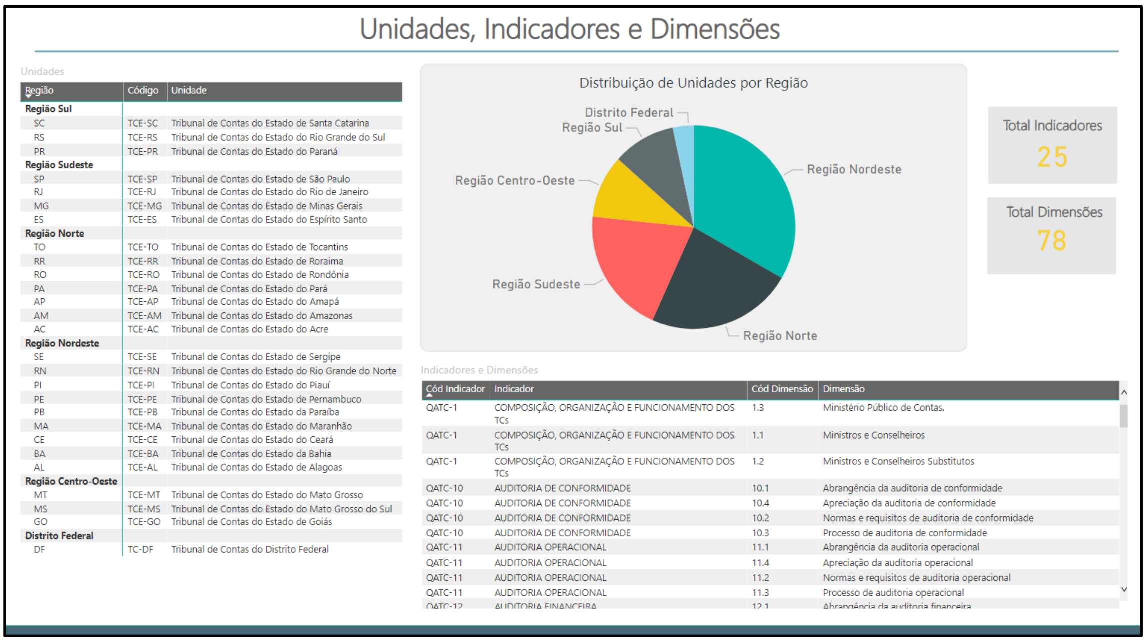

Figure 8 - Dashboard "Units, Indicators e Dimensions".

5.2 Dashboard "Deliveries"

This panel presents different views of the deliveries of the processed questionnaires, allowing even a concomitant follow-up. In a table on the left, the Units that had the questionnaire processed are presented, along with the date on which the event occurred and the total score obtained based on the scores of the indicators. In the center, in a donut chart, it is possible to observe the distribution by region of these deliveries up to the time of consultation. You can see the final look of this dashboard in Figure 9.

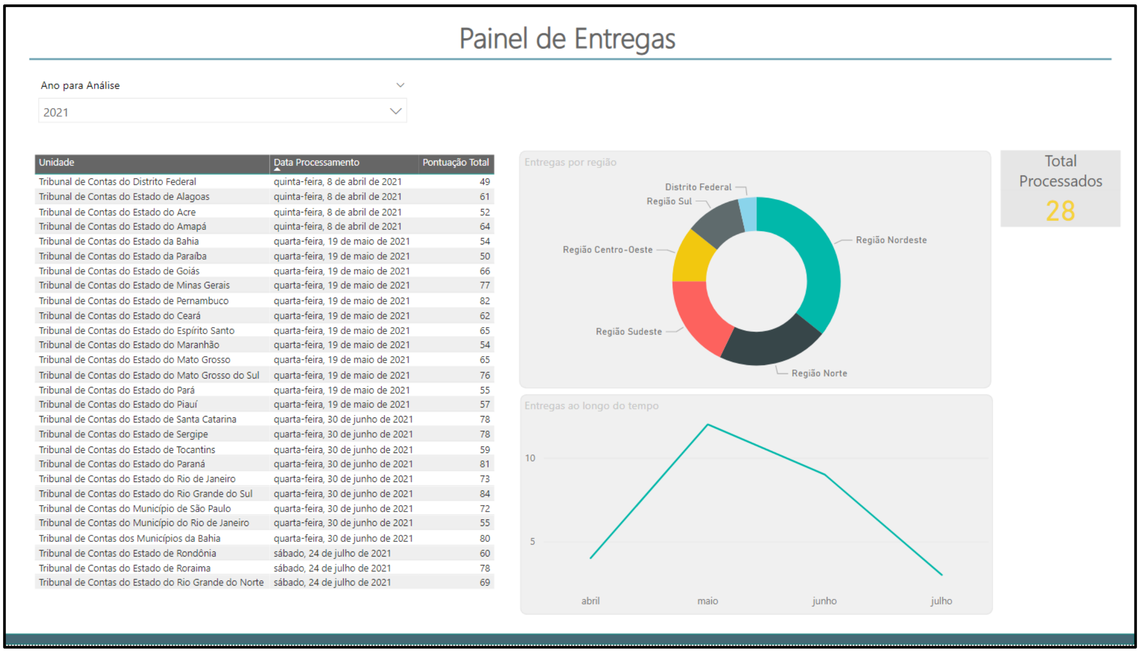

Figure 9 - Dashboard "***Deliveries***".

5.3 Dashboard "Indicators per Unit"

This panel presents different views of the indicator notes for a given unit. In a table on the left side, the indicator codes, the grades assigned by the CCQ (commission of the corresponding unit) and by the CGQ (which represents the definitive grade for that item, assigned by the Atricon commission) are presented. In the center, in a graph with bars that indicate the "size" of the note for each of the indicators, it is possible to observe if there is uniformity between the indicators or if there is a discrepancy that may indicate some imbalance. The colors of the bars adapt according to the note they represent. You can see the final look of this dashboard in Figure 10.

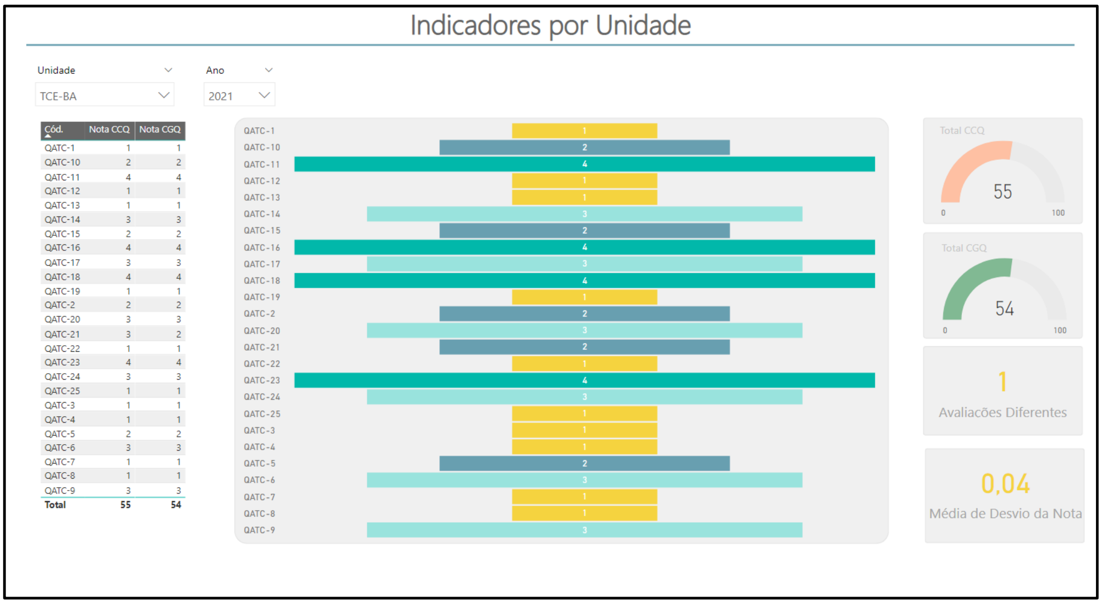

Figure 10 - Dashboard "Indicators per Unit".

5.4 Dashboard "Evolution of Indicators per Unit"

This panel displays the final values of indicators for a given unit over time. In a table on the left, the indicator codes and the scores assigned for each of the years processed are presented. In the center, a horizontal bar chart makes a visual comparison of these scores between the different years for each indicator. You can see the final look of this dashboard in Figure 11.

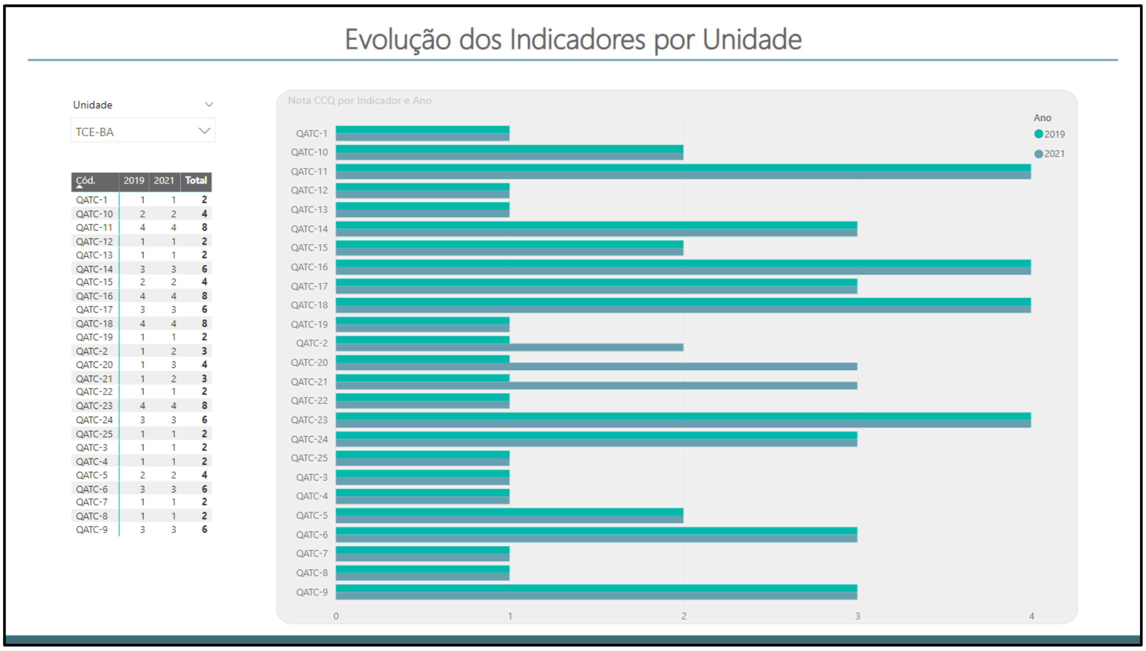

Figure 11 - Dashboard "Evolution of Indicators per Unit".

5.5 Dashboard "Indicators per Region"

This panel presents the indicators of the different units with a focus on the geographic aspect. In a table on the left side, the accumulated totals of the indicator scores and the average score per indicator of each of the units are presented, organized by region and state. At the center, plotted on the map of Brazil, at the location referring to each unit, circles represent the scores obtained. The appearance of the circles varies in size and color, with larger values being represented by larger circles and tending more toward green, while smaller notes are represented by smaller circles and towards redder. On the right side, six (6) cards are presented with the average total score of the units for each of the Brazilian regions and for the Federal District. You can see the final look of this dashboard in Figure 12.

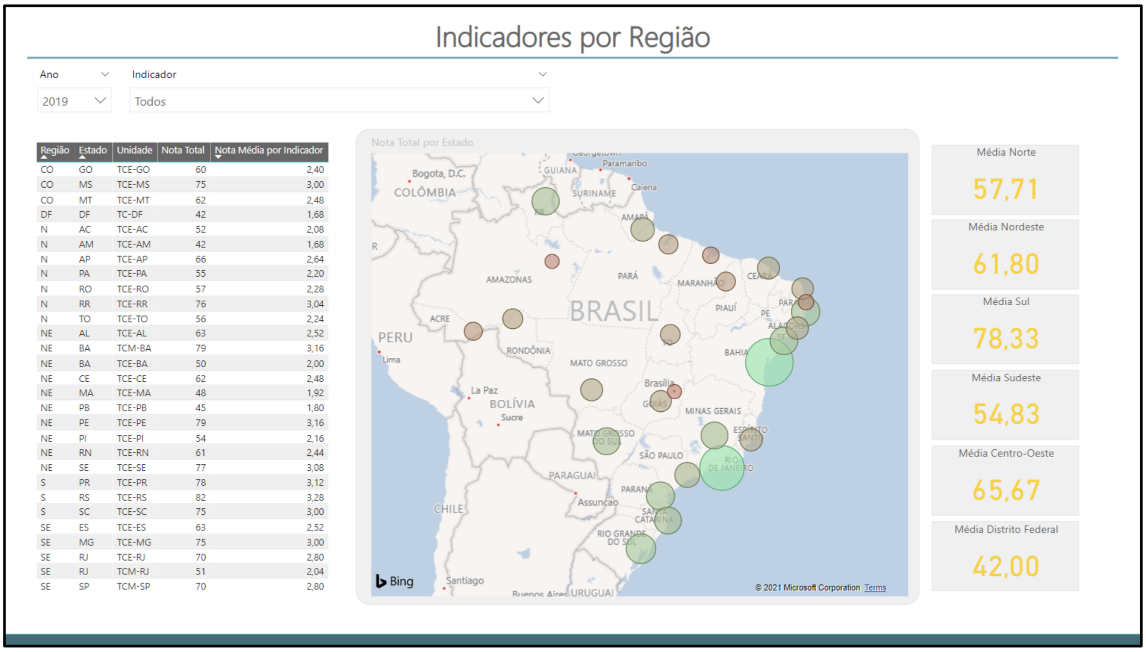

Figure 12 – Dashboard “Indicators per Region”.

5.6 Dashboard “Unit Performance per Indicator”

This panel allows the individual analysis of a specific indicator between units. The indicator description is centrally highlighted and, just below it, we find two charts. On the left, a vertical bar chart shows the rating of each of the units for the selected indicator. On the right, a donut chart shows the distribution of these units according to the level reached on the scoring scale. When hovering the mouse pointer over the second graph, the tool displays a breakdown indicating the number of units and the percentage in relation to the whole that is classified under that level. You can see the final look of this dashboard in Figure 13.

Figure 13 – Dashboard “Unit Performance per Indicator”.

5.7 Dashboard "Units by Level of Development"

This panel allows the analysis of the units based on the average of the scores of the indicators, classifying them according to the level reached in the scoring scale. In a table on the left, the code and name of the unit are presented, together with the total score (sum) of the indicators and the average of the scores assigned by the CGQ. On the right, a pie chart shows the distribution of these units according to the level reached on the scoring scale, with the total number of levels shown in the form of cards above this chart. You can see the final look of this dashboard in Figure 14.

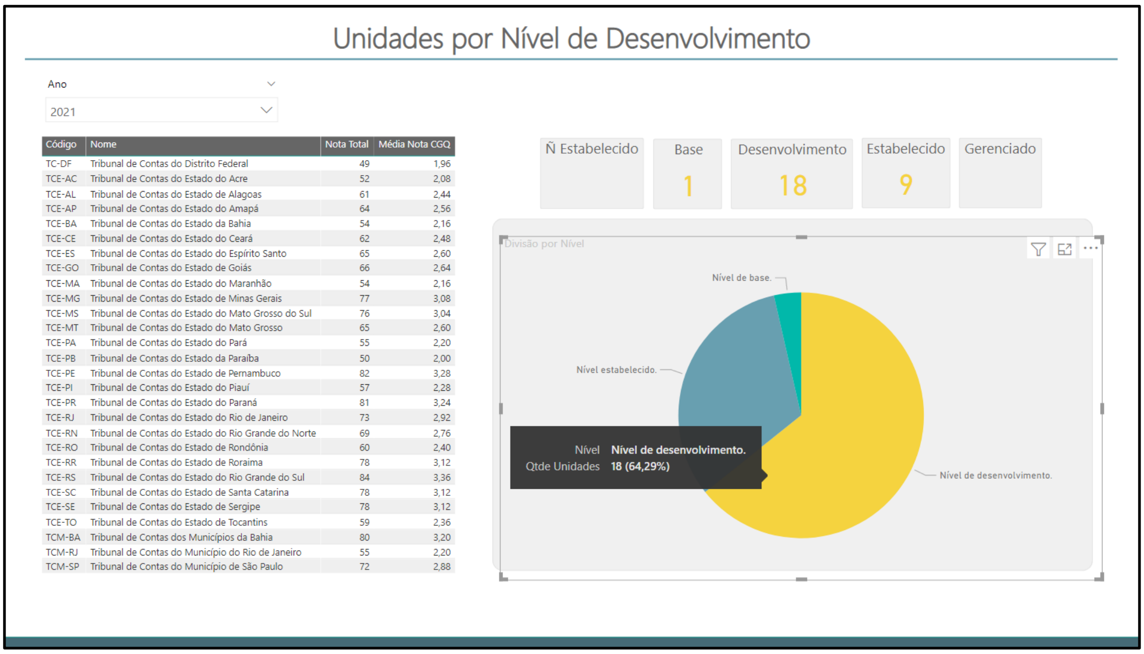

Figure 14 – Dashboard "Units by Level of Development".

5.8 Dashboard "Indicators/Dimensions"

This panel allows the analysis of indicators in view of the dimensions that compose them. The indicator description is centrally highlighted and, just below it, we find two charts. On the left, a horizontal bar chart shows the average of the final grade for each of the indicator dimensions and selected units. On the right, a donut chart shows the distribution of these units according to the level reached on the scoring scale. You can see the final look of this dashboard in Figure 15.

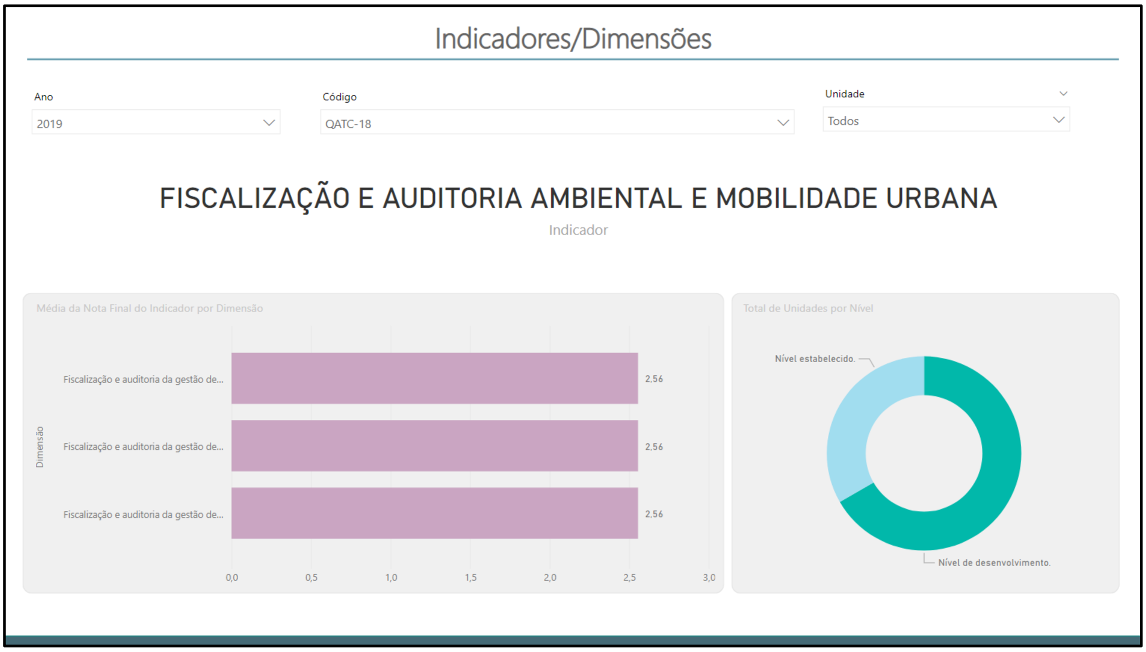

Figure 15 – Dashboard "Indicators/Dimensions".

5.9 Dashboard "Indicators/Dimensions - General"

As a complement to the panel presented above, it allows the analysis of indicators and dimensions in a broader way. On the left, a horizontal bar graph displays the dimensions ordered in descending order by the average of the dimension's final grade. On the right, a table displays the dimensions, grouped by gauge, with final grade averages by gauge and by dimension. You can see the final look of this dashboard in Figure 16.

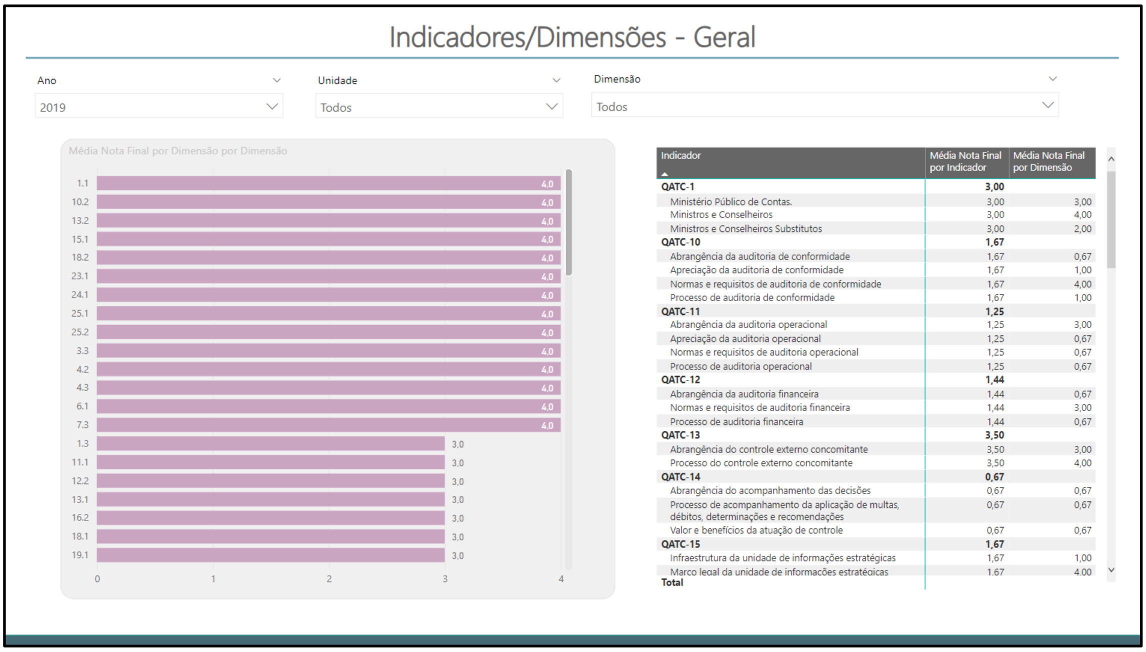

Figure 16 – Dashboard "Indicators/Dimensions - General".

5. Conclusion

BI techniques and tools were studied and applied in the construction of the solution that would allow the consolidation of the measurement of twenty-five (25) indicators and seventy-nine (79) dimensions, as established by the MMD-QATC, for several units subject to evaluation.

Based on the identification of the origin and organization of the data, the solution included the creation of an algorithm capable of locating and extracting from the spreadsheets, the file format established by the MMD-TC Procedures Manual, the values of the assigned grades and other pertinent information. As a final part of the processing of this algorithm, these data are stored in a DBMS.

Such data, which before would be pulverized in several files and, therefore, requiring a greater effort to manipulate them, from the execution of the algorithm, are now stored in a structured way at a single point, thus facilitating their handling. These were still worked on by processes mapped in Pentaho Data Integration in order to make them ready for final consumption in the different views presented in the built dashboards. These dashboards presented different possibilities of data observation, in addition to the obvious "variable/value".

With the adoption of this solution, the performance evaluation process in Brazilian Courts of Auditors would be simplified (from the moment in which there would no longer be the need to manually consolidate the various data files sent by the TCs) and previously defined analyzes would be generated and presented in an automated way, helping the process of generating knowledge and potential decision-making in the definition of various policies aimed at the continuous evolution of these bodies, thus directly bringing benefits to the country and the population.

6. Acknowledgement

The author acknowledge the Federal University of Pará (UFPA); and Galileo Institute of Technology and Education (ITEGAM)

7. References

Atricon, Associação dos Membros dos Tribunais de Contas do Brasil. Apresentação. Disponível em: <http://www.atricon.org.br/institucional/ apresentacao/>. Acesso em: 15 de setembro de 2020, 23h.

Atricon, Associação dos Membros dos Tribunais de Contas do Brasil. Marco de Medição do Desempenho – Qualidade e Agilidade dos Tribunais de Contas do Brasil (MMD-QATC). Brasília. 2014. Disponível em: <http://www.atricon.org.br/wp-content/uploads/2015/03/QATC2_VersaoFinalPublicada.pdf>. Acesso em: 15 de setembro de 2020, 23h50.

Atricon, Associação dos Membros dos Tribunais de Contas do Brasil. Marco de Medição do Desempenho dos Tribunais de Contas MMD-TC (Versão 2017). Brasília. 2017. Disponível em: <http://qatc.atricon.org.br/wp-content/uploads/2019/03/MMD-TC-DocumentoBase-2017-vers%C3%A3o-publicada. pdf >. Acesso em: 16 de setembro 2020, 23h.

Atricon, Associação dos Membros dos Tribunais de Contas do Brasil. Manual de Procedimentos do MMD-TC. Brasília. 2019. Disponível em: < http://qatc.atricon.org.br/wp-content/uploads/2019/03/2.-Manual-de-Procedimentos-MM D-TC-v.1.pdf >. Acesso em: 05 de março de 2020, 18h.

Atricon, Associação dos Membros dos Tribunais de Contas do Brasil. Regulamento ATRICON Nº 01/2013. Disponível em:<http://www.atricon.org.br/wp-content/uploads/2013/07/REGULAMENTO_PARAMETROS_AGILIDADE_QUALIDADE.pdf>. Acesso em: 16 de setembro de 2020, 23h.

Borali, M. N. Capacidade Estatal e Tribunais de Contas no Brasil: Uma análise sobre seus recursos humanos e informacionais. 2018. Dissertação (Mestrado em Administração Pública e Governo) – Escola de Administração de Empresas da Fundação Getúlio Vargas. São Paulo. 2018.

Castaldelli, M. E. Divulgação de desempenho de órgãos públicos: uma Análise de Conteúdo dos relatórios de gestão do Tribunal de Contas da União. 2010. Dissertação (Programa de Pós-Graduação em Controladoria e Contabilidade). Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto da Universidade de São Paulo. Ribeirão Preto, 2010.

Date, C. J. Introdução a Sistemas de Bancos de Dados. 8. ed. Rio de Janeiro: Elsevier, 2003.

Elmasri, R., Navache, S. B. Sistemas de banco de dados. 6. ed. São Paulo: Pearson Addison Wesley, 2011.

Foley, É.; Guillemette, M. G. What is Business Intelligence? International Journal of Business Intelligence Research, v. 1, n. 4, pp. 1-28, October-December, 2010.

Franck, K. M., Pereira, R. F., Filho, J. V. D. Diagrama Entidade-Relacionamento: uma ferramenta para modelagem de dados conceituais em Engenharia de Software. Research, Society and Development, v. 10, n. 8, pp. 1-12, 2021.

Davenport, T. H., Harris, J. G. Automated Decision Making Comes of Age.

Sloan Management Review, v. 46, n. 4, pp. 83-89. 2005.

Garcia, E. Tribunal de Contas do Estado do Amazonas - Sessenta e Cinco Anos. 2. ed. Manaus: Norma Editora, 2015.

Gespública, Programa Nacional de Gestão Pública e Desburocratização. Produto 4: guia referencial para medição de desempenho e manual para construção de indicadores. Secretaria de Gestão. Ministério do Planejamento. Brasília, 2009. Disponível em: <http://www.gespublica.gov.br/sites/default/files/documentos/guia_indicadores_jun2010.pdf>. Acesso em: 09 de março de 2020, 20h30.

Ghisi, A. P. Desempenho das Entidades Fiscalizadoras Superiores e Indicadores de Rendimento. Revista do TCU, v. 31, n. 86, out/dez, pp. 327-337, 2000.

Heuser, C. A. Projeto de banco de dados. 6. ed. Porto Alegre: Bookman, 2009.

Horakova, M., SKALSKA, H. Business Intelligence and Implementation in a Small Enterprise. Journal of Systems Integration, v. 4, n. 2, pp. 50-61, 2013.

Luz, M. B. B. de C. Da Legalidade à Legitimidade: Vozes em torno da reforma dos Tribunais de Contas Brasileiros no período de 2000 a 2017. 2018. Dissertação (Mestrado em Administração) - Faculdade de Administração, Ciências Contábeis e Economia da Universidade Federal de Goiás. Goiânia, 2018.

Negash, S., Gray, P. "Business Intelligence". In: Burstein, F., Holsapple, C. W. (eds.), Handbook on Decision Support Systems 2: Variations, 1st. ed., chapter 2, Berlin, German, Springer-Verlag, 2008.

Ocde, Organização para a Cooperação e Desenvolvimento Econômico. Internal Control and Internal Audit: Ensuring Public Setor Integrity and Accountability. Report 47638204, OECD Conference Centre, Paris, France, 2011.

Popovič, A., Turk, T., Jaklič, J. Conceptual model of business value of business intelligence systems. Management, v. 15, n. 1, pp. 5-30, 2010.

Reis, G. V. dos; Colauto, R. D., Pinheiro, L. E. T. Proposta de adaptação do Balanced Scorecard para Órgãos Públicos: um enfoque na secretaria Geral de Administração (SEGEDAM) do Tribunal de Contas da União. XIV Congresso Brasileiro de Custos, João Pessoa, Brasil, 05-07 de dezembro, 2007.

Sabherwal, R., Becerra-Fernandez, I. Business intelligence: Practices, Technologies, and Management. 1st. ed., USA: John Wiley & Sons, INC, 2011.

Sabherwal, R. Succeeding with Business Intelligence: Some Insights and Recommendations. Cutter Benchmark Review, v.7, n. 9, pp. 5-15, 2007.

Sabherwal, R. KM and Bl: From Mutual Isolation to Complementarity and Synergy. Cutter Consortium

Executive Report, v.8, n. 8, pp. 1-18, 2008.

Silva, I. L. da; Drumond, R. B. A Necessidade da Utilização de Sistema de Custos e de Indicadores de Desempenho na Administração Pública. 4º Congresso USP de Controladoria e Contabilidade, São Paulo, Brasil, 07-08 de outubro, 2004.

Turban, E. *et al.* Business Intelligence – Um enfoque gerencial para a Inteligência do Negócio. 1. ed. Porto Alegre: Bookman, 2009.