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Multi-Criteria Decision Analysis Applied To External Control Of Agreements Signed With The Brazilian Public Sector

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Abstract:
Based On The Need To Rationalize Public Resources To Improve The Quality Of Inspection And Reduce Corruption And Fraud In Agreements Signed Between The Public Sector And Private Partners, This Research Is Presented, Which Takes Place In Partnership With The Court Of Auditors Of The State Of Ceará. In This Research, The Multicriteria Decision Analysis Is Used To Order A List Of Agreements According To The Degree Of Risk To Fraud Based On Certain Indicators. The PROMETHEE II And ELECTRE III Multicriteria Analysis Methods Were Applied, Using A Set Of Fraud Risk Typologies As Criteria For Prioritization. Finally, The Degree Of Similarity Of The Results Is Analyzed Under Two Different Coefficients And The Intersection Of The Main Results Is Calculated To Assess The Degree Of Risk Of Common Agreements.

Key Word*: Fraud; Multicriteria Methods; Agreements; Court Of Auditors Of The State Of Ceará; Operational Research.*

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I. INTRODUCTION

Corruption at the government level is a problem that directly affects the well-being of society by reducing the resources that reach the population and exacerbating social inequality by diverting resources from priority government programs from a social and economic point of view. economic (AVRITZER and FILGUEIRA, 2011). Voluntary Transfers are financial resources passed on by one federated entity to another or to non-profit private entities, because of the execution of a specific instrument, for the performance of works and/or services of common interest and that do not originate from a constitutional determination or legal or intended for the Health Unic System (SISTEMA ÚNICO DE SAÚDE - SUS). As, in most cases, the transfer of resources takes place before the execution of the object, such an instrument provides the emergence of possible evidence of fraud and increases the probability that the resources are not correctly allocated.

In Brazil, the inspection process of the application of public resources towards society within the scope of the Union, States and municipalities is carried out by the Courts of Auditors. The Court of Auditors of the State of Ceará (TRIBUNAL DE CONTAS DO ESTADO DO CEARÁ -TCE/CE) has a constitutional and legal obligation to supervise transactions involving funds from the public coffers of the State of Ceará and the 184 municipalities of Ceará. However, if all instruments were inspected, approximately 47 processes would be distributed to each server, a completely unfeasible scenario. Thus, the need to rationalize the use of TCE-CE resources to carry out inspections of voluntary transfers is evident, optimizing the choice of objects to be inspected.

The e-Parcerias system (CONTROLADORIA E OUVIDORIA GERAL DO ESTADO DO CEARÁ, 2022) made it possible to provide a set of information that helps in the analysis of accountability for society in Ceará, providing elements for the agents involved in this audit process to have greater subsidies to carry out their tasks. Another positive effect was the increase in transparency and control of the application of public resources, as it allowed the creation of a vast repository of data referring, mainly, to the physical and financial execution phase of the partnerships.

Anti-fraud inspection is understood as a practical problem, but one that goes beyond the context of the situation, forming a set of generalizable types of problems, and which ends up gathering useful devices for taking actions, that is, a class of problem under the paradigm of Design Science Research – DSR. The application of multicriteria methods can give a satisfactory answer to the problem in this specific context, and this generated

knowledge can be reapplied in similar situations in other contexts, configuring an instantiation of a method, according to the DSR classification (DRESCH et al, 2013).

The objective of this work is, therefore, to establish a method for prioritizing agreements that are especially susceptible to fraud, aiming at selective and targeted auditing based on the use of multicriteria analysis within the TCE-CE. The specific objectives include evaluating the similarity of the results of different methods and the elaboration of weights and other parameters, by the specialists, consistent with the reality of the TCE-CE to improve the results. In this way, a better allocation of public resources can be favored by controlling expenditures. Thus, the success of this initiative can become an instrument to support citizenship, as more effective risk and fraud detection techniques are implemented by audits and the benefits subsequently passed on to society.

II. THEORETICAL BACKGROUND

The following sections describe the multi-criteria methods used in this work, as well as the criteria, weights and methods employed.

MCDA methods

The MCDA (Multi-Criteria Decision Analysis) methods seek to reduce the subjectivity of the decision-making process of a multicriteria problem, not representing an "optimal decision" or "ideal decision", but rather decisions that best meet the profile of the analyst or manager to be analyzed. starting from the choice of a method, the elaboration of a set of criteria and the weights attributed to them (DAUGAVIETIS et al., 2022). They can be used to solve three types of problems: choice, prioritization, and classification (ZOUPOUNIDIS et al., 2002). The result of its application is the selection of a subset of the most suitable alternatives from a set of candidate alternatives, given various levels of uncertainty (OPABOLA and GALASSO, 2022).

De Loreto et al. (2022) used the Hierarchical Analysis Method proposed by Saaty (2008) to identify the most suitable areas for implantation of irrigation systems in the Midwest portion of the Tocantins Araguaia Basin. The same criterion was used by De Araújo et al. (2022) to establish a spatially explicit model that presents the aptitudes of the areas belonging to the surroundings of the Rio Doce State Park for the implementation of agroforestry systems, to locate and define the size of areas suitable for agroforestry aimed at environmental preservation and for income generation. The method of the Elimination et Choix Traduisant la Realité (ELECTRE) II family was used for the selection of sewage treatment systems for the Rio Pardo watershed. The results showed that the imposition of standards for effluents led to the selection of variations of the activated sludge process, mainly for denser population centers (REIS et al., 2022).

Taira et al. (2022), investigated renewable alternatives in Uiramutã, Roraima, replacing diesel oil thermoelectric plants and identified that photovoltaic solar energy proved to be the most promising among the alternatives selected by the Preference Ranking Organization Method for Enrichment Evaluation" (PROMETHEE). Costa et al. (2022) used PROMETHEE II to rank the performance indicators of the hospital at the Federal University of Vale do São Francisco (HU- UNIVASF), which provided greater flexibility in the choice of Key Performance Indicators (KPIs) based on the perspectives of the most relevant Balanced Scorecard (BSC).

Costa Pereira et al. (2019) used PROMETHEE II to choose sugar suppliers for purchasing management at a large food company. PROMETHEE II was used by Santos Júnior et al. (2022) to evaluate the elaboration and implementation process of Agenda 21, idealized at the Rio 92 Conference to mitigate the effects of global warming, which allowed identifying limitations in its elaboration and application. In Miranda et al. (2022) the PROMETHEE GDSS the combination of strategic planning tools, BSC and MCDA allowed to bring a more careful evaluation of the monitoring indicators, reinforcing the idea of having few Key Performance Indicators that guide the organization in favor of the institutional vision and mission.

Polatidis et al. (2015) compared the use of the ELECTRE III and PROMETHEE II methods in a case study in the context of investment in the field of geothermal energy, evidencing the important degree of subjectivity of these in carrying out the complete planning. Balali et al. (2014) presented a case study of the selection of structural systems for buildings that launches a hybrid MCDA methodology. Salabun et al. (2020a) performed a benchmarking of different methods (COPRAS, VIKOR, PROMETHEE, TOPSIS) and presented a convergence analysis of the results with different correlation coefficients, explaining the degree of similarity of the methods found in the test. Daugavietis et al (2022) carried out a numerical robustness test and sensitivity analysis with different methods (WSM, DEA, TOPSIS, ELECTRE and PROMETHEE) in a context of the sustainability of a public heating network.

Criteria

The criteria represent a grouped set of information that makes it possible to compare alternatives according to technical axes that are particularly significant for the decision-making problem, and must be clear and unambiguous; relevant to the nature of the problem, since they significantly influence the selection of the most appropriate alternatives; in sufficient and moderate quantity; in addition to seeking independence from each

other to reduce the redundancy of the model, simplifying it (DAUGAVIETIS, 2022). They are expressed through indicators that seek to be maximized or minimized by the methods according to their classification between benefit or cost criteria. A criterion is classified as a benefit criterion if an increase in the corresponding indicator (or performance measure) results in a potential gain. In contrast, a criterion is classified as a cost criterion if an increase in the corresponding performance measure results in a possible loss and vice versa (OPABOLA et al., 2022).

Weights

The weights are non-negative numbers that represent the importance of a criterion in relation to another in the amplification or de-amplification of the classification of each alternative, and consequently in the selection of the most adequate alternative. In their simplest form, and with a detrimental effect on the quality of the results, they can be attributed equally to all criteria (SALABUN and URBANIAK, 2020a; DAUGAVIETIS, 2022). Its attribution is not a trivial task, as it involves the subjective perceptions and prioritization of managers and analysts, generally requiring expert judgment and available information about the objectives and scope of the research, as well as the potential use of the data. Therefore, the weights of the criteria may vary for each instance of the method if the objectives or the potential use of their data are different (OPABOLA et al, 2022; BALALI et al, 2014).

Methods

Despite the apparent universality of MCDA methods, different methods can result in different solutions to the same problem, even exhibiting contradictory results. The reasons for this problem reside, in part, in the different algorithms of the methods themselves, and other adjustments and procedures inherent to the particularities of each method (SALABUN and URBANIAK, 2020). As a fundamental part of the process of choosing the MCDA methods, it is possible to carry out an exploratory stage with an informal pre-selection approach, based on heuristics, aiming to explain the individual characteristics that may best suit the characteristics of the decision-making problem in question. (SALABUN et al, 2020).

Among the branches of the MCDA family of methods, there are those from the European School of Decision Support, based on the use of relational models, which determine the prioritization relationship (outranking) between pairs of actions in a problem (SALABUN et al., 2020a). The two main methods of this school are the Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE), developed by (BRANS and VINCKE, 1985; BRANS et al., 1986), and ELECTRE (ROY et al., 1986; ROY, 1991). The outranking relation is based on the use of binary relations between the different alternatives, which return the preferred alternative of the pair according to all the criteria. Considering "A" the total number of alternatives of the multicriteria problem, a distance matrix with A x A elements is used to store all possible relations (ZOPOUNIDIS, 2002).

PROMETHEE II

The PROMETHEE II method, developed by Brans et al. (1986), produces a complete ordering of a finite set of alternatives from an aggregated preference index calculated for all of them. Its application is considered one of the easiest and simplest, requiring the analyst to assign general function types to the problem criteria, which, in most cases, requires the insertion of additional parameters, which can make selection difficult when not if each criterion is sufficiently known (BALALI, 2014; POLATIDIS et al., 2015). The limitations of the method are its inability to include disagreements in the outranking relationship, although the concept of disagreement is one of the reasons for the existence of outranking methods, as well as not having the ability to veto (BALALI, 2014).

As it is a method based on the outranking relation, where α and b are two alternatives belonging to a set of alternatives "A", the aggregate preference index π(α,b) expresses the degree to which alternative α is preferred to the detriment of b considering the sum of the products between the criteria, mediated by preference functions Pj and any additional parameters, and the weights wj assigned to them. Each pair of shares (α,b) is also evaluated in the opposite direction (b,a) being calculated according to:

$$\pi(a,b) = \sum_{j=1}^{k} P_j(a,b)W_j$$

Being P = kj, Fj(α,b) a number between 0 and 1.

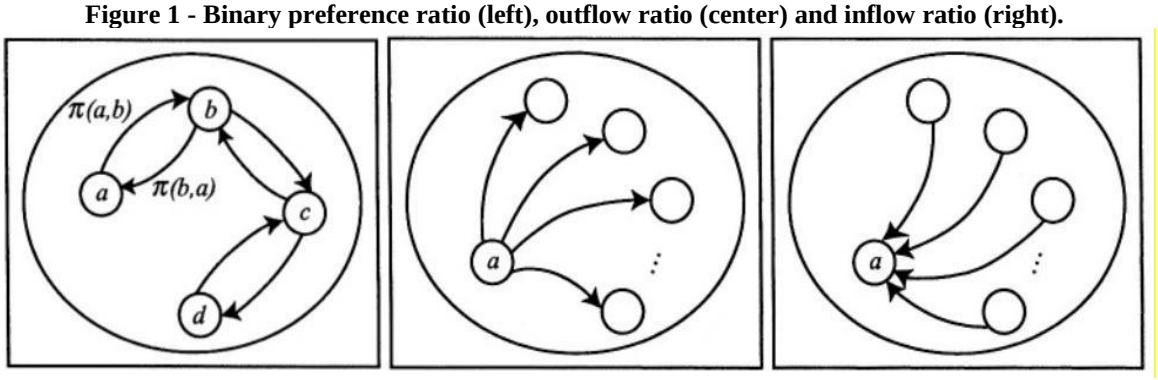
The degree of preference is used in the calculation both for the outflow π(α, b) and for the inflow π(b,α) (Fig 1 the first image), which in turn is applied in the calculation of the flow of net preference, which represents the relation of preference with all the other alternatives, as placed in the equations Xb and Xc and presented in figure 2, in the second and third images, serving as an index for the complete prioritization (BRANS et al, 1986; SALABUN et al, 2022).

ϕ-(α) = π(b,α) (inflow)

ϕ+(α) = π(α,b) (outflow)

$\phi(\alpha) = \phi^+(\alpha) - \phi^-(\alpha)$ (liquid flow)

Figure 1 - Binary preference ratio (left), outflow ratio (center) and inflow ratio (right).



Source: Adapted from Brans (1986)

ELECTRE

The ELECTRE family of methods, from the French school, emerged in the 1960s. The outranking method uses pairwise comparison, which was initially developed for choice problems, based on the construction of an "S" classification relation that incorporates the preferences established by the decision maker. ELECTRE III (ROY, 1978) aims to solve complex ordering problems using pseudo-criteria. This method is based on three main steps: ordering the options, aggregating the criteria and selecting the final option. Thus, with the inclusion of pseudo-criteria, strict preference (P), weak preference (Q) and indifference (I), preference and indifference thresholds are defined, creating a hesitation range (Figure 2) as defined below:

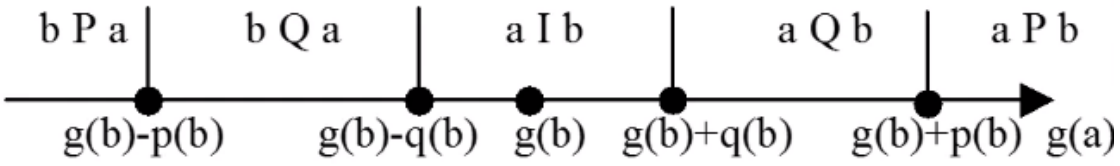
$a\ P\ b$ (a has strong preference to b) $\Leftrightarrow\ g(a)\ -\ g(b)\ >\ p$

$a\ Q\ b$ (a has weak preference to b) $\Leftrightarrow\ q\ <\ g(a)\ -\ g(b)\ \leq\ p$

$a\ I\ b$ (a is indifferent to b, and b is indifferent to a) $\Leftrightarrow |g(a)\ -\ g(b)|\ \leq\ q$

$$\forall\ a,\ b\ \in\ A \qquad a\ P\ b\ sse\ g(a)\ >\ g(b)\ +\ p[g(b)]$$
$$a\ Q\ b\ sse\ g(b)\ +\ p[g(b)]\ \geq g(a)\ >\ g(b)$$
$$a\ I\ b\ sse\ \vdash_{g(a)\ +\ q[g(a)]\ \geq\ g(b)}^{g(b)\ +\ q[g(b)]\ \geq\ g(a)}$$

Figure 2 – ELECTRE method pseudo criteria.



Source: Roy (1978)

For each pair of alternatives (a, b), there is a measure of agreement and a measure of disagreement, ending in the combination of these two measures and producing the degree of classification, being a credibility index that evaluates the strength of the statement that "a is at least as good as b" (ALMEIDA, 2013), according to the following equations:

Concordance index $\boldsymbol{C\ a,\ b}$:

$$c_i\ (a,\ b)\ =\ \begin{matrix} 1,\ se\ g_i(a)\ +\ q_i\ \geq\ g_i(b) \\ 0,\ se\ g_i(a)\ +\ p_i\ \leq\ g_i(b) \\ \frac{p_i\ +\ g_i(a)\ -\ g_i(b)}{p_i\ -\ q_i},\ \text{otherwise} \end{matrix}$$

Discordance index S $\boldsymbol{a,\ b}$:

$$d_i(a,\ b)\ =\ \begin{matrix} 0,\ se\ g_i(a)\ +\ p_i\ \geq\ g_i(b) \\ 1,\ se\ g_i(a)\ +\ v_i\ \leq\ g_i(b) \\ \frac{g_i(b)\ -\ g_i(a)\ -\ p_i}{v_i\ -\ p_i},\ \text{otherwise} \end{matrix}$$

Credibility degree S $\boldsymbol{a,\ b}$:

$$S(a,\ b)\ =\ C(a,\ b) \times \prod_{i:d_i(a,\ b) > C(a,\ b)} \frac{1 - d_I\ (a,\ b)}{1 - C(a,\ b)} \qquad \begin{matrix} C\ (a,\ b),\ se\ d_i\ \leq\ C(a,\ b),\ \forall_i \end{matrix}$$

III. METHODOLOGY

Next, the methodology used to achieve the proposed objectives is presented. Initially, the procedures for data collection are reported. Afterwards, the criteria used in the application of the MCDA technique are described, followed by the definition of the adopted weights. Finally, the instantiation of the methods and the techniques used to compare the results produced by the PROMETHEE II and ELECTRE III methods are presented.

Data Collection Procedures

For the elaboration of the proposal presented in this work, information from the tables related to the e-Partnerships database (CONTROLADORIA E OUVIDORIA GERAL DO ESTADO DO CEARÁ, 2022), a system developed by the Comptroller and Ombudsman General of the State of Ceará (CGE) was used. to serve as a repository of information relating to voluntary financial transfers from the State of Ceará. Partnerships - legal relationships between the Public Administration and its partners - considered in the system are agreements, similar instruments, collaboration term, development term and cooperation agreement. The e-parcerias database is organized into tables that store system information. In this case, to calculate the seven typologies presented in this work, the following tables were used:

- pessoa: has the identification of a certain entity.
- pessoa_juridica: describes a legal entity with information such as CNPJ, corporate name and opening date, for example.
- parceiro: has information regarding the partner or covenant, that is, an individual or legal entity that has a formalized partnership with the State.
- instrumento: describes the term that formalizes the existing partnership, informing the date of its celebration and the values used, for example.
- contratacao_fornecedor_parceiro: displays information regarding the act of contracting between partner and supplier.
- historico_situacao_parceiro: has a historical record of situations of regularity, validation and payment of partnerships already entered into.
- ordem_bancaria: gathers information about each Bank Transfer Order (OBT) with all the bank movements of the partnership's specific account.
- inadimplencia: describes the registered defaults.

MCDA criteria

He criteria for ordering the agreements were elaborated from the typologies of fraud risk indicators (RAMALHO, 2019), deriving a set of real criteria and pseudo criteria, these synthesized from the original data to assist the use of the MCDA, as description in Table 1.

Table 1 - Criteria applied to MCDA methods.

Ranking	Name	Type	Max/Min
0	Total value of the agreement, in BRL	Real value	Maximize
1	Default value of the agreement, in BRL	Real value	Maximize
2	Indicator of the number of times a given entity acted as a partner	Binary	Maximize
3	Was the resource fully released to a single company in a single Bank Transfer Order (OBT)?	Binary	Maximize
4	Percentage of the resource value of the agreements that was released to a given partner	Real value	Maximize
5	Sum of partner entities that have the highest history of failure	Real value	Maximize
6	Is the prevented partner supplier receiving transfer indirectly?	Binary	Maximize
7	Does the defaulting company have a current contract?	Binary	Maximize

Source: Authors' tabulations

Weights

With the participation of a specialist from the TCE-CE, weights were assigned to the established criteria, which are shown in Table 2.

Table 2 - Weights assigned to criteria for MCDA methods.

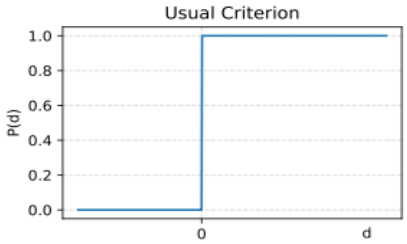
Ranking	Name	Weights
0	Total value of the agreement	3
1	Default value of the agreement	4
2	Indicator of the number of times a given entity acted as a partner	1
3	Resource was fully released to a single company in a single OBT	2
4	Percentage of the resource value of the agreements that was released to a given partner	1
5	Sum of partner entities that have the highest history of failure	3
6	Is the prevented partner supplier receiving transfer indirectly?	4
7	Does the defaulting company have a current contract?	5

Source: Authors' tabulations

Instantiation of methods

In instantiating the PROMETHEE II method, only the usual criterion was used (Figure 3), in which preference is given when, for a given criterion, the value of one share exceeds the value of another. The choice is explained by the simplicity and robustness of the criterion, especially in relation to binary criteria, not requiring additional parameters.

Figure 3: Usual type general criterion



$$P(d) = \begin{cases} 0 & d \leq 0 \\ 1 & d > 0 \end{cases}$$

Source: Adapted from Brans (1986)

Comparison of methods

To verify the degree of similarity between the results of the applied MCDA methods, the Rank Biased Overlap and the Rank Similarity Coefficient were used as direct comparison measurement coefficients. Both assess the degree of convergence and divergence, assigning greater weight to the elements at the top of the list, being suitable for MCDA due to their use value in prioritizing alternatives.

Rank Biased Overlap - RBO

Coefficient in the range of [0,1] which, based on the intersection between two infinite orders S and T, performs a weighting biased by the depth of the top common elements from a parameter p, so that the infinite tail does not dominate numerically the result. A result of 0 means completely disjoint sets, and 1 means identical sets (WEBBER, et al., 2010).

$$RBO(S,T,p) = (1-p)\sum_{d=1}^{\infty} p^{d-1} \cdot A_d$$

com $0 < p < 1$

The RBO additionally requires an assignment of a secondary coefficient p, which defines a percentage of weight to the first N elements. In this work, the first 33 alternatives were selected because they represent 10% of the total number of agreements, receiving, in sequence, a weight of 85%, 50% and 20%.

Rank Similarity Coefficient

Coefficient of similarity between rankings that is strongly related to the differences found mainly at the top. It is asymmetric, that is, the weight of a given comparison is determined from its position in the first list (SALABUN and URBANIAK, 2020).

$$WS = 1 - \sum_{n=1}^{\infty} \left(2^{-R_{xi}} \cdot \frac{|R_{xi} - R_{yi}}{\max\{|1 - R_{xi}|, |N - R_{xi}|\}} \right)$$

IV. DISCUSSION

The MCDA methods return, as a common value, the indexes of the agreements in the dataset with each series sorted according to the results of each method. Table 3 presents the results and their respective indexes, representing the agreements that are more susceptible to fraud (columns 2 and 3).

Table 3 - Top twenty results of prioritization of MCDA methods.

Classification	PROMETHEE II	ELECTRE III
0	3015	1449
1	3013	1455
2	3012	1447
3	3014	1439
4	1358	1441
5	3017	1443
6	3016	1453
7	868	1445
8	867	1451
9	1774	1457
10	1773	1459
11	1355	2247
12	1770	2248
13	1769	3013
14	1354	3015
15	1776	3017
16	1775	2252
17	870	2250
18	928	2550
19	869	3012

Source: Authors' tabulations

Based on the arranged agreements, the similarity of the methods was calculated from the ordering of the number of agreements with the application of the correlation coefficients for the two series, as shown in Table 4. As for the RBO coefficient, three variations were calculated that attribute the priority weight to the first 33 elements of the ordination, representing 10% of the total number of agreements. These were assigned, in series, 85% of the weight, 50% of the weight and 20% of the weight, and the respective values of the secondary p coefficient, necessary to obtain the final correlation value, were also calculated.

Table 4 - Results of correlation coefficients

Coefficient	Correlation	Coefficient (RBO)
Rank Biased Overlap $_{85/33}$	0.183	0.9699
Rank Biased Overlap $_{50/33}$	0.3224	0.99190
Rank Biased Overlap $_{20/33}$	0.4795	0.998
Rank Similarity Coefficient	0.5201344819985776	

Source: Authors' tabulations

The coefficients return values with a positive correlation between weak and moderate, indicating convergence of results due to the greater weight attributed to the similarity of the first values of the series. In the case of the RBO, the smaller the share of the priority weight of the agreements that are within the top 10% margin, the higher the index. The result reveals a greater similarity in the prioritization result when the priority weight is extended to the alternatives that are below the most prioritized ones. In the RSC, the position similarity coefficient returns the highest correlation value found, confirming that, based on the PROMETHEE II results, the ELECTRE III result presents a moderate correlation.

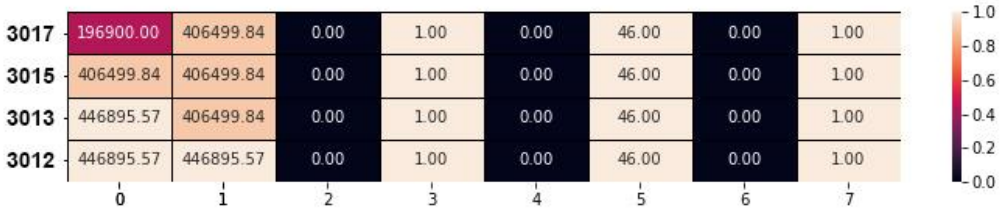
Intersection of prioritized agreements

To quantitatively observe the original values of the criteria in the health insurances prioritized by both methods, an intersection of the first 20 elements of each set of results is carried out, with the presentation of their values presented in figure 5. A coloring was applied that represents the normalized result for each criterion from

all dataset entries, that is, when the value is the maximum found, the light color corresponding to the value 1.0 is applied, and when it is the minimum value, the dark color corresponding to the value 0.0.

$$PII20 \cap EIII20 = \{3017, 3015, 3013, 3012\}$$

Figure 4 - Heatmap containing the criteria on the x-axis, and the identifier of each agreement on the y-axis



Source: Authors' tabulations

V. CONCLUSION

This article is the result of actions developed in the Project: Combating and Preventing Risks and Frauds in the Public Sector, which aims to improve mechanisms for combating and preventing risks and fraud that already exist in the TCE/CE, through the development of new tools and with its systematization. Within the scope of the project and based on data analysis and integration techniques, in proprietary, public and/or custodial databases, descriptive/predictive computational models are used, as well as analysis of social networks aimed at promoting, through the exchange of knowledge and opportunity to practical application of the scientific production of the researchers appointed by the Cearense Foundation for Scientific and Technological Development (FUNCAP) and by the Court of Auditors of the State of Ceará.

The instantiation of PROMETHEE II and ELECTRE III as MCDA methods for prioritizing a list of agreements based on fraud indicators returned a positive convergence in the results, demonstrating its usefulness for the organization's objective. This ordered list, therefore, can be used as a selection criterion in audits of voluntary transfers, thus maximizing the probability of acting on those objects with a higher risk of fraud.

REFERENCES

[1]. AVRITZER, Leonardo; FILGUEIRAS, Fernando. Corrupção E Controles Democráticos No Brasil. Brasília, DF: CEPAL. Escritório No Brasil/IPEA, 2011. (Textos Para Discussão Cepal-Ipea N. 32). Disponível Em: Https://Mpra.Ub.Uni-Muenchen.De/1818/1/MPRA_Paper_1818.Pdf. Acesso Em: 03 Maio De 2023.

[2]. BALALI, Vahid; ZAHRAIE, Banafsheh; ROOZBAHANI, Abbas. Integration Of ELECTRE III And PROMETHEE II Decision-Making Methods With An Interval Approach: Application In Selection Of Appropriate Structural Systems. Journal Of Computing In Civil Engineering, V. 28, N. 2, P. 297-314, 2014.

[3]. BRANS, Jean-Pierre; VINCKE, Ph; MARESCHAL, Bertrand. How To Select And How To Rank Projects: The PROMETHEE Method. European Journal Of Operational Research, V. 24, N. 2, P. 228-238, 1986.

[4]. BRASIL. TRIBUNAL DE CONTAS DO ESTADO DO CEARÁ. PARCERIAS. Disponível Em: Https://E-Parcerias.Cge.Ce.Gov.Br/E-Parcerias-Web/Arquivostemporarios/AEEFE645E6779EC9EA011D95FED1C045.Localhost/2835982.Pdf/?Nomearquivo=Pergutasfrequenteseparcerias.Pdf. Acesso Em: 04 Maio De 2023.

[5]. CONTROLADORIA E OUVIDORIA GERAL DO ESTADO DO CEARÁ. E-Parcerias. Disponível Em Https://E-Parcerias.Cge.Ce.Gov.Br/E-Parcerias-Web/Arquivostemporarios/AEEFE645E6779EC9EA011D95FED1C045.Localhost/2835982.Pdf/?Nomearquivo=Pergutasfrequenteseparcerias.Pdf. Acesso Em: 20 De Março De 2023.

[6]. COSTA PEREIRA, Maria Carolina Feitosa Et Al. Modelo De Apoio À Decisão Multicritério Na Seleção De Fornecedores: Um Estudo De Caso Em Uma Empresa Do Ramo Alimentício. In: ENCONTRO NACIONAL DE ENGENHARIA DE PRODUÇÃO, 39., Santos, São Paulo, Brasil, 15 A 18 De Outubro De 2019.

[7]. COSTA, João Paulo Vieira Et Al. Método PROMETHEE II Para Gerenciamento Do Risco De Modelo Em Instituições Financeiras PROMETHEE II Method For Model Risk Management In Financial Institutions. Brazilian Journal Of Development, V. 8, N. 2, P. 9291-9308, 2022.

[8]. CUNHA, George Henrique De Moura; HOLANDA FILHO, Raimir. (Org.). Riscos E Fraudes No Setor Público: Ensaios E Estudos De Casos Para O Estado Do Ceará. 1. Ed. Fortaleza: Edições IPC, 2022. V. 1. 250p.

[9]. DAUGAVIETIS, Janis Edmunds Et Al. A Comparison Of Multi-Criteria Decision Analysis Methods For Sustainability Assessment Of District Heating Systems. Energies, V. 15, N. 7, P. 2411, 2022. Https://Doi.Org/10.3390/En15072411. Acesso Em: 06 De Maio De 2023.

[10]. DE ARAÚJO, Wagner Junqueira; GOMES, Tamara Aureliano. Avaliação De Sistemas De Gerenciamento De Processos De Negócios (BPMS): Análise Multicritério Dos Softwares Bizagi E Bonita. RDBCI: Revista Digital De Biblioteconomia E Ciência Da Informação, V. 20, P. E022023-E022023, 2022.

[11]. DE LORETO, Maria Das Dores Saraiva Et Al. Análise Multicritério Para Identificação De Áreas Prioritárias Para Irrigação, Por Meio De Indicadores Socioeconômicos, No Contexto Da Bacia Tocantins-Araguaia, Região Centro-Oeste Do Brasil. Interações (Campo Grande), P. 927-943, 2022.

[12]. DE PAULA, Natália Oliveira Barbosa, Et Al. "Strategic Support For The Distribution Of Vaccines Against Covid-19 To Brazilian Remote Areas: A Multicriteria Approach In The Light Of The ELECTRE-Mor Method." Procedia Computer Science 199, P. 40-47, 2022. Disponível Em: Https://Doi.Org/10.1016/J.Procs.2022.01.006 . Acesso Em: 06 De Março De 2023.
[13]. FILHO, Jaime De Jesus; MATOS, Paulo R. F; LIMA, Sarah Mesquita; SOUSA, Matheus. Diagnóstico Geral De Práticas Desenvolvidas E Benchmarking. In: CUNHA, G. H. M.; HOLANDA FILHO, R. (Org.). Riscos E Fraudes No Setor Público: Ensaios E Estudos De Casos Para O Estado Do Ceará. 1. Ed. Fortaleza: Edições IPC, 2022
[14]. HO, William. Integrated Analytic Hierarchy Process And Its Applications–A Literature Review. European Journal Of Operational Research, V. 186, N. 1, P. 211-228, 2008. Disponivel Em Https://Doi.Org/211-228. 10.1016/J.Ejor.2007.01.004. Acesso Em: 22 De Abril De 2023.
[15]. L'ASTORINA, Humberto Carlos; BORENSTEIN, Denis. Planejamento Anticorrupção Em Obras Públicas E A Teoria Do Triângulo Das Fraudes. 2011. Disponível Em: Http://Www.Ibraop.Org.Br/Acervo/XIV_Sinaop/Docs/Humbertolastorina.Pdf . Acesso Em: 12 De Abril De 2023.
[16]. LIMA, S. M.; BRITO, R.W; MATOS, P. R. F.; DE JESUS FILHO, J.; HOLANDA FILHO, R. Modelagem Do Gasto Eficiente Com Medicamentos: Um Estudo De Caso Para O Estado Do Ceará: 2006 A 2019. Razão Contábil E Finanças, V. 12, N. 2, 2021.
[17]. LIMA, S. M.; BRITO, R.W; MATOS, P. R. F; DE JESUS FILHO, J.; HOLANDA FILHO, R.; CUNHA, G. H. Prevenção De Fraudes Na Aquisição De Combustível: Um Estudo De Caso No Estado Do Ceará. Razão Contábil E Finanças, V. 12, N. 2, 2021.
[18]. MIRANDA, Vítor Silva Et Al. Avaliação De Indicadores Hospitalares Sob O Enfoque Da Análise De Decisão Multicritério. Research, Society And Development, V. 11, N. 16, P. E97111637550-E97111637550, 2022.
[19]. OPABOLA, Eyitayo A.; GALASSO, Carmine. "Multicriteria Decision Making For Selecting An Optimal Survey Approach For Large Building Portfolios.International Journal Of Disaster Risk Reduction, V. 76, 15 Jun. 2022, 102985. Disponível Em: Https://Doi.Org/10.1016/J.Ijdrr.2022.102985. Acesso Em: 20 Abril De 2023.
[20]. POLATIDIS, Heracles; HARALAMBIDOU, Kyriaki; HARALAMBOPOULOS, Dias. Multi-Criteria Decision Analysis For Geothermal Energy: A Comparison Between The ELECTRE III And The PROMETHEE II Methods. Energy Sources, Part B: Economics, Planning, And Policy, V. 10, N. 3, P. 241-249, 2015.
[21]. REIS, José Antônio Tosta Dos Et Al. Seleção De Sistemas De Tratamento De Esgotos Com O Emprego Da Análise Multicritério-Avaliação Do Emprego De Diferentes Estruturas De Preferências. Engenharia Sanitaria E Ambiental, V. 27, P. 761-771, 2022.
[22]. ROY, B. ELECTRE III: Un Alghoritme De Methode De Classements Fonde Sur Une Representation Floue Des Préférences En Presence De Critères Multiples. Cahieres De CERO, V. 20, N. 1, P. 3-24. 1978.
[23]. SAATY, Thomas L. Decision Making With The Analytic Hierarchy Process. International Journal Of Services Sciences, V. 1, N. 1, P. 83-98, 2008.
[24]. SALABUN, W.; URBANIAK, K. A New Coefficient Of Rankings Similarity In Decision-Making Problems. In: Springer Nature Switzerland AG 2020 V. V. Krzhizhanovskaya Et Al. (Eds.): ICCS 2020, LNCS 12138, P. 632–645, 2020a. Https://Doi.Org/10.1007/978-3-030-50417-5_47. Acesso Em: 14 Março De 2023.
[25]. SAŁABUN, Wojciech; WĄTRÓBSKI, Jarosław; SHEKHOVTSOV, Andrii. Are Mcda Methods Benchmarkable? A Comparative Study Of Topsis, Vikor, Copras, And Promethee Ii Methods. Symmetry, V. 12, N. 9, P. 1549, 2020b.
[26]. SANTOS JUNIOR, Gilvan Mota Dos Et Al. Modelo Para Priorização De Projetos Sustentáveis: O Caso Da Agenda 21 Do Município De Caruaru, Pernambuco, Nordeste Do Brasil. Revista Brasileira De Gestão Ambiental E Sustentabilidade, V. 9, N. 22, P. 637-650, 2022.
[27]. SUPRI, Zikra; RURA, Yohanis; PONTOH, Grace T. Detection Of Fraudulent Financial Statements With Fraud Diamond. Journal Of Research In Business And Management, V. 6, N. 5, P. 39-45, 2018.
[28]. TAIRA, Daniela Et Al. Análise Multicritério Para Seleção De Alternativas Renováveis Para Geração De Energia Elétrica Em Roraima (Brasil). Sustentabilidade: Diálogos Interdisciplinares, V. 3, P. 1-16, 2022.
[29]. TAVARES, L. V.; ARRUDA, P. A Multicriteria Model To Select Candidates For Public Contracting Using The OPTIONCARDS Method, Automation In Construction 136 (2022): 104162. Disponível Em: Https://Doi.Org/10.1016/J.Autcon.2022.104162. Acesso Em: 14 Julho De 2023.