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Decision support in the budget management of a public institution: a constructivist multicriteria model

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Abstract: The need for having controls that provide support for decision-making and the improvement of management techniques encourages managers to seek greater efficiency in the use of public resources. Utilizing tools that allow for a more in-depth evaluation and analysis, using clearly defined and transparent criteria encompassing the public budget, assists in decision support and enhancing the budgeting process. By defining criteria for each context, those responsible gain the means to support their decisions, backed by consistent and measurable information. In this way, this study aimed to construct a multicriteria performance evaluation model to support the budget management of a public institution, based on the needs and perceptions of its budget manager. To do this, the MCDA-C methodology was adopted as the methodological procedure. This instrument allowed for the identification of 34 descriptors considered relevant by the decision-maker, an understanding of the impact of their decisions, and the recommendation of improvement actions. Furthermore, the study compared the criteria identified in the literature, directed toward performance evaluation and public budget, with the descriptors highlighted in the model. It was found that some concerns of the decision-maker, listed in the model, are not present in the criteria identified in the literature, resulting from a constructivist bias. As a contribution, the model provides a new tool to support the manager in making decisions regarding the use of public resources, as well as serving as a reference for other institutions and in the development of further research.

Keywords: performance evaluation, decision, public budget, MCDA-C.

JEL: H50, H61

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Introduction

The pursuit of greater efficiency in the allocation of public resources fosters the need for managers to implement managerial control tools that provide support for decision-making and contribute to the improvement of their management practices (Coelho & Quintana, 2008; Budimir, Lutilsky, & Vasicek, 2021). With the advent of the New Public Management - NGP, which requires more efficiency and effectiveness in the application of resources and in the quality of the services provided, led these entities to realize that performance evaluation systems can generate information that supports their activities (Pedersini & Ensslin, 2020).

Organizations need to be more agile, flexible, and responsive to changes to continuously improve their processes, and it is essential to have integrated, dynamic, accessible, and visible performance information (Rengel & Ensslin, 2020). Performance evaluation assists in the management of public resources, accountability, and governance by providing useful elements for decision-making and discussions with stakeholders (Ensslin, Dutra, Ensslin, Graziano, & Longaray, 2022).

In this sense, public agencies should evaluate performance in all areas to effectively manage resources and achieve their objectives (Ensslin et al., 2022). Its use is justified to learn about what is or isn't working and to enhance organizational performance based on the knowledge available to improve (Behn, 2003; Vieira & Bortoluzzi, 2020).

Considering that the capacity of taxes to finance public services is limited and their needs continue to grow, Boueri, Rocha, and Rodopoulos (2015) suggest that the solution to address this reality lies in the rationalization and prioritization of public spending. Increasing demands from society compel public managers to implement more visible criteria for resource allocation, aiming to expand dialogue, transparency, and social control (Jordão, Gonçalves, & Moraes, 2021).

The budget is one of the key components to designing and identifying the path forward in the face of an endless array of opportunities and needs, therefore, planning what, where, and how to allocate public resources should be one of the initial actions that public managers (Deon, Macêdo, Zanin, & Moura, 2021).

With the expansion of the number of available slots without a corresponding allocation of budgetary, human, and structural resources, public university managers have been required to seek other forms of management. In this context, performance evaluation configures yourself as a tool that provides information to support them in this activity (Valmorbida, Ensslin, Ensslin, & Ripoll-Feliu, 2014).

Martins and Ensslin (2020) found a low incidence of models and evaluation systems specifically constructed to meet the needs of each organization from the perspective of the manager decision-maker. To meet this need, the Constructivist Multicriteria Decision Support Methodology (MCDA-C) allows for the construction of models and performance evaluation systems for each context, capable of handling various types of information, highlight the managers' objectives, facilitate a reflection on

their priorities and preferences, and identify aspects that compromise the organization's efficiency (Jordão et al., 2021, Cera et al., 2020).
In light of the need for efficient and effective allocation of increasingly scarce budgetary resources, which are sometimes affected by contingencies that compromise their execution, and the need for a performance evaluation model for public budgeting to support decision-making, the following research question arises: What criteria should be taken into account in the budget management process of a public university to support decision-making for the proper use of public resources?
To answer the research question of this study, the work was guided by the general objective, which aimed to construct a constructivist multicriteria performance evaluation model to support the budget management of a public institution, based on the needs and perceptions of the budget manager. The study aims to develop a tool that assists in decision-making for the management of the financial resources of the researched institution and also contributes to the literature by demonstrating the application of the MCDA-C methodology, its results, and the identification of criteria related to performance evaluation and public budget.

1. Literature review

1.1. Decision-making process

The decision-making process has been a central theme in organizational studies, where different approaches, theories, and methods are employed to understand the complexity involved in this process (Santos & Bulgacov, 2021). Decision-making is characterized as a fundamental task of human behavior, present in both everyday life and managerial and organizational decisions (Santos & Clementino, 2022).
In organizations, decisions are influenced by the hierarchical system, its characteristics, the interrelationship between people, and the flow of information (Andrade, 2021). To achieve the desired results, there are many challenges because making an effective decision requires information that truly represents the organization (Oliveira, 2007).
In this area of decision support and decision-making, there are approaches that have a set of assumptions that influence how management processes are understood, developed, and executed, classified as normative, descriptive, prescriptive, and constructivist (Dias & Tsoukias, 2003; Ensslin, Dutra, Ensslin, Kruger, & Gavazani, 2017).
The constructivist approach argues that the variables that make up the evaluation model and their scales should come from the decision-maker when contextualizing the problem and possible solutions within the researched context (Ensslin et al., 2017).
This approach seeks to develop in the decision-maker a body of knowledge that allows them to understand the consequences of their decisions, taking into account the aspects they consider relevant (Azevedo, Ensslin, Lacerda, França, Ibarra González, Jungles, & Ensslin, 2011). Constructivist models do not assume that

preferences already exist but allow the decision-maker to develop their own value system as it is being constructed and validated in the end (Dias & Tsoukias, 2003).

1.2. Performance evaluation and public budget

Performance evaluation is a management tool aimed at building, establishing, and disseminating knowledge, allowing the monitoring and improvement of the environment in which the manager intends to carry out their management (Rosa, Ensslin, Petri & Ensslin, 2015). In the public sector, performance evaluations are complex because they are related to organizational structure, bureaucracy, legislation, culture, stakeholders, and other characteristics that give them a unique identity (Martins & Ensslin, 2020; Pedersini & Ensslin, 2020).

Performance evaluation systems are crucial to prevent the improper use of financial resources, as their use enhances organizational efficiency and can assist public agents in budget allocation (Behn, 2003; Veledar & Gadzo, 2020; Androniceanu et al., 2022). Budgeting is one of the stages in an organization's strategic planning because it aims to estimate and define the best connection between expected results and necessary expenses (Suave, Lunkes, Rosa & Soares, 2013).

It represents a commitment between society and the government, as the collected resources are allocated to actions that meet the needs of the population (Deon et al., 2021). It is a process of resource allocation, which, given its limitation in meeting all demands, makes it complex (Antunes, 2018).

In times of economic and fiscal scarcity, ensuring efficiency and effectiveness in the public sector is relevant, and managing the performance of these organizations presents itself as a solution to this challenge (Bornholt, Baekgaard & Houlberg, 2016; Androniceanu et al., 2019). For this to be possible, public managers need measures that define the efficiency of various activities, which, when formalized, can be used to allocate resources appropriately (Behn, 2003).

2. Research methodology

2.1. Research outline

This study is characterized as both qualitative and quantitative. The qualitative approach is used during the development of the decision support model, particularly in identifying the context surrounding the decision-making process within the institution. The quantitative approach is applied during the evaluation phase of the MCDA-C methodology since it involves the development of measurement scales for descriptors and the definition of substitution rates for inclusion in the model.

In terms of research design, this study is described as both descriptive and exploratory. It is descriptive in the sense that it aims to provide a clearer definition of the problem, describe behaviors of phenomena, and elucidate and classify facts and variables. Regarding its objectives, the research is classified as exploratory since it seeks to understand specific details of the decision-making context within the budget management unit.

The research is further described as applied since it aims to address a real-world problem within the specific context of the decision-maker. In terms of research methods, it is a case study and documentary research. The intervention tool used is the Constructivist Multicriteria Decision Support Methodology (MCDA-C) for the development of the decision support model.

2.2. Intervention instrument - MCDA-C methodology

The MCDA-C methodology has its remote origins dating back more than two centuries; however, its consolidation as a scientific management tool only occurred in the 1980s, as documented by Landry (1995), Skinner (1986), Keeney (1992), Bana e Costa (1999), and Roy (2006), as described by Ensslin et al. (2011).
MCDA-C allows the decision-maker to expand their understanding of a specific problem within a particular context, enhancing their perception of crucial factors to consider when assessing performance. It acknowledges that decisions made affect both the decision-maker themselves and others involved in the process (Ensslin et al., 2022). The method comprises three phases: structuring phase, evaluation phase, and recommendation phase (Ensslin, Dutra, & Ensslin, 2000).
The structuring phase seeks to understand the context and begins with knowledge generation, identifying and explaining what is essential, necessary, and sufficient for the evaluating manager, ensuring their preferences are considered in model construction (Valmorbida, Ensslin, Ensslin, & Ripoll-Feliu, 2015; Araújo, Matos, & Ensslin, 2021).
In the evaluation phase, the goal is to translate the decision-maker's perception into a mathematical model (Rosa et al., 2010). The focus is on transforming ordinal (qualitative) scales into cardinal (quantitative) scales, requiring the identification of differences in attractiveness between their levels (Bana e Costa, De Corte, & Vansnick, 2005). This phase includes the following steps: (i) analysis of preferential independence; (ii) construction of value functions; (iii) identification of compensation rates; (iv) identification of the impact profile of alternatives; and (v) sensitivity analysis (Lacerda, Ensslin, & Ensslin, 2011).
Finally, the recommendation phase assists the decision-maker in identifying ways to improve the performance of the object under analysis. If implemented, these actions are reflected in their strategic objectives (Ensslin, Giffhorn, Ensslin, Petri, & Vianna, 2010). These recommendations do not intend to provide specific instructions but rather support the decision-maker in exploring alternatives, understanding their consequences, and identifying aspects that permeate the organization at different levels (Longaray, Ensslin, Dutra, Ensslin, Brasil, & Munhoz, 2019).

3. Research results and discussions

The research was conducted at a federal institution of higher education located in the city of Foz do Iguaçu, in the state of Paraná, Brazil. The institution's mission is to educate human resources capable of contributing to Latin American integration,

regional development, and cultural, scientific, and educational exchange in Latin America, especially within Mercosur (Unila, 2022).
To conduct this study, it was necessary to have the support of the individual responsible for the Office of Planning, Budget, and Finance (PROPLAN). This manager reports that the institution's budget has been significantly affected by a shortage of resources, resulting in reduced funding for the maintenance of administrative and academic activities. They emphasize that budget execution becomes even more complex, particularly during periods of resource contingencies. The absence of criteria for resource allocation significantly contributes to this outcome, often requiring highly subjective decision-making, which, in the manager's opinion, should be more well-founded, transparent, and discussed with stakeholders. In response to this problem, a case study was conducted involving PROPLAN and its Vice-Chancellor in the role of the decision-maker, using the MCDA-C methodology to assist in this work.

3.1. MCDA-C structuring phase

3.1.1. Actors, label, and primary evaluation elements

In this stage, the problem was structured and organized, with the decision-maker establishing its label, which sought to best represent what was being sought to resolve, defined as: "Decision Support Model in the Budget Management of a Public Higher Education Institution." Upon defining the label, the actors of the model were identified, as described in Table 1.

Table 1. Actors of the decision support model

Actors	
Decision-Maker	Pro-Rector of PRO PLAN
Intervenes	Rector and Vice-Rector, Pro-Rectors of Macro-Units and Servers crowded in the Department of Programming and Budgetary Control
Facilitator	Author of the work
Affected	Students, Servers, Outsourced, Academic community, Society and Suppliers

Source: Author's contribution

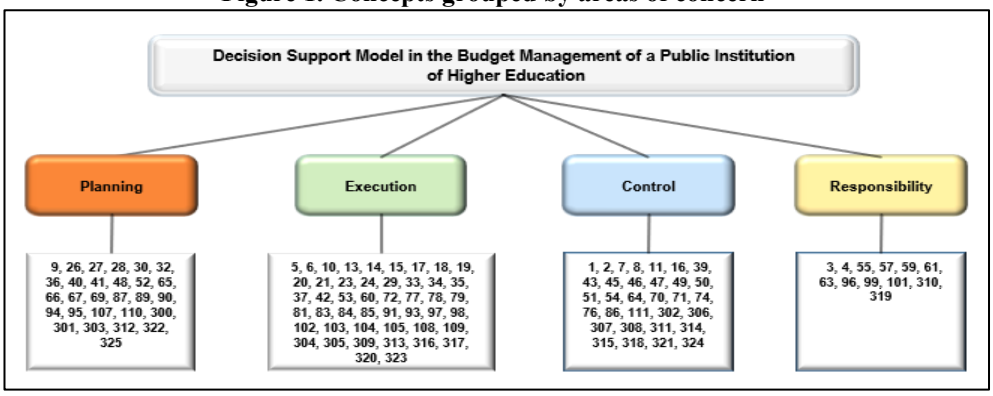
The next step was to identify the Primary Evaluation Elements (PEEs), which represent the characteristics or properties of the context that, according to the decision-maker's judgment, impact their values in the decision-making process (Nobrega Junior, Petri, & Ensslin, 2021). These data were obtained through interviews, which contributed to the development of 111 PEEs, numbered from 1 to 111. In Table 2, five of them are presented randomly as illustrative examples.

3.1.2. Concepts and family of viewpoints

After obtaining the PEEs, it is necessary to enhance their understanding by converting them into concepts geared towards action, thereby providing a better

understanding of the decision-maker's concerns and defining their preferred direction (Reina, Ensslin, Ensslin, & Reina, 2012; Vieira & Bortoluzzi, 2020). To develop the concepts, interviews were conducted where the decision-maker described the action that best represented each PEE.
Once the concepts are identified, the construction of the Family of Viewpoints (FV) begins, aiming to demonstrate the strategic objectives that should be considered when evaluating the decision-making context. To form an FV, it is necessary to group these concepts in a way that characterizes the areas representing what the decision-maker considers important. Therefore, four areas of concern were established, as shown in Figure 1: planning, execution, control, and responsibility.

Figure 1. Concepts grouped by areas of concern



Source: Author's contribution

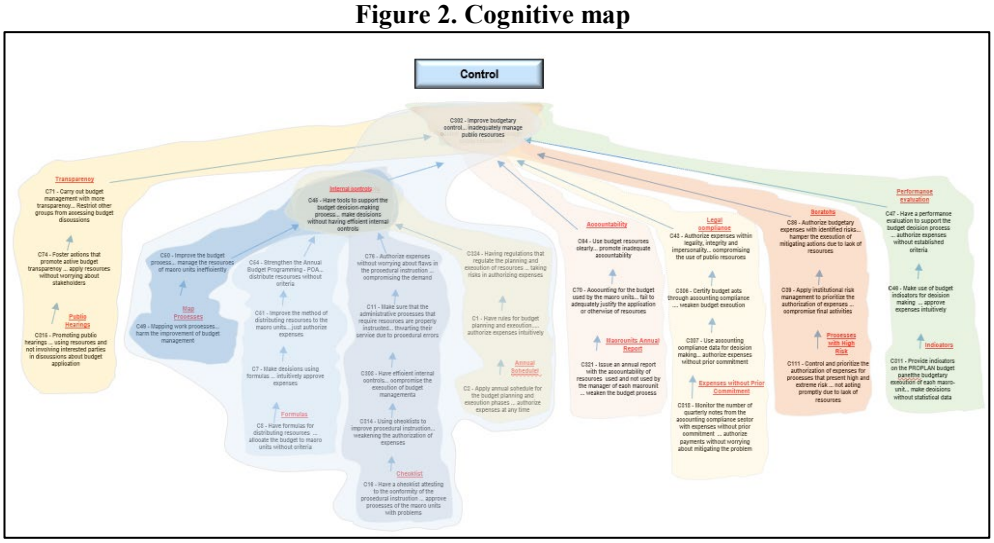
During the identification of concepts for each PEE, they are initially presented randomly, without convergence toward a single objective. To achieve this alignment, the decision-maker, with the support of the facilitator, identified and guided the linking of all concepts to the four areas of concern, which, in their view, would be sufficient to allocate all of them.

3.1.3. Cognitive map, clusters, subclusters, and hierarchical value structure

With the linking of concepts to the areas of concern, cognitive maps were constructed that reflect the decision-maker's discourse regarding a specific objective (Ensslin, Montibeller, & Noronha, 2001). The concepts were placed on the respective maps with the assistance of the decision-maker, using the following questions: "How can a final concept be achieved?" and "Why is the middle concept important?" (Perez et al., 2022).
The positive pole and the opposite psychological pole were established, both initiated by an infinitive verb, to determine the possible performances of PEE and their levels of acceptance (Ensslin et al., 2010; Nobrega Júnior et al., 2021). The ellipsis symbol (...) along with the concepts, in Figure 2, should be interpreted as "is

preferable to" or "instead of," assigning meaning to the described information (Reina et al., 2012; Perez, Longaray, Tondolo, Ensslin, & Dutra, 2022).
This action allowed for the organization of all concepts on cognitive maps and indicated the need to create 25 new concepts while excluding 8. This situation arose during the construction of middle-end relationships. Exclusion was necessary because some concepts showed certain similarities among them or became less relevant in light of a broader understanding.
The inclusions and exclusions demonstrate that knowledge is continually generated in the decision-maker when using MCDA-C. With the concepts organized on cognitive maps, in a cause-and-effect relationship, it was possible to group them by affinity areas that seek to represent the best meaning for the context, referred to as clusters and subclusters (Ensslin et al., 2001).
In this stage, four maps were generated, with Figure 2 showing the cognitive map of the "Control" area of concern and its clusters, including transparency, internal controls, accountability, legal compliance, risks, and performance evaluation. Among these, only the "Internal Controls" cluster contains subclusters.

Figure 2. Cognitive map



Source: Author's contribution

After completing the middle-end relationship maps, the next step in MCDA-C is to transform the influence relationship into a Hierarchical Value Structure (HVS), which aims to establish a mechanism for decision-making by incorporating the decision-maker's preference judgments in the model (Ensslin et al., 2010; Perez et al., 2022).
Each Fundamental Point of View (PVF) should be decomposed by the decision-maker until a lower-level viewpoint can be measured ordinally. The result of this process led to the construction of the HVS, partially shown in Figure 6. The next step was to develop descriptors for each EPV, which will be addressed in the next subsection.

3.1.4. Descriptors, reference levels and status quo

With the formalization of the HVS, the development of descriptors begins. To do this, through an interactive process, the decision-maker was encouraged to define a scale that demonstrates the intensity and order of attributes for each Elementary Point of View (EPV) in the model. During the scale structuring, impact levels were defined, and reference levels were established.
For the descriptors, two anchoring levels were determined: the upper level is referred to as "Good," and the lower level is "Neutral" (Ensslin, Souza, & Ensslin, 2012). For an action that falls below the "Neutral" level, its performance is considered "Compromising"; if it falls between the "Neutral" and "Good" levels, it is classified as "Competitive" or "Market"; and if it is above the "Good" level, it is considered "Excellent" (Ensslin et al., 2022).
The HVS enabled the development of 34 descriptors aligned with the EPVs of the model. The construction of knowledge contributed to identifying ordinal (qualitative) scales, allowing the measurement of the performance of each EPV. With the descriptors, ordinal scales, and reference levels, it was possible to demonstrate their current situation, referred to as the Status Quo (SQ). The descriptors constructed for the Control EPV are presented in Figure 7, along with the results of the next phase of the research.
The construction of descriptors in the HVS concludes the MCDA structuring phase. The knowledge gained helped identify, from the decision-maker's perspective, what is essential to support decision-making but does not allow for the integration between descriptors to obtain an overall evaluation of the model (Ensslin et al., 2022). This action was carried out in the evaluation phase, as discussed in the next section.

3.2. Evaluation Phase

After completing the structuring phase, which provides qualitative knowledge to the decision-maker, the evaluation phase begins. The goal is to enhance this process by creating cardinal scales and substitution rates, thus reflecting local and global preferences (Reina et al., 2012; Ensslin et al., 2022). In this phase, the following actions were carried out: cardinal preferential independence analysis; construction of value functions; identification of compensation rates; and identification of the impact profile of alternatives (Ensslin et al., 2022).

3.2.1. Cardinal preferential independence analysis

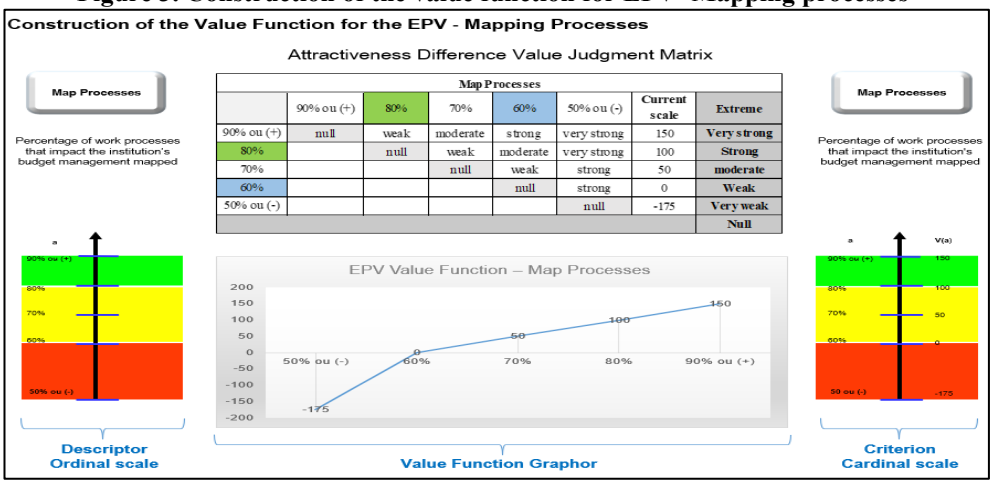
The MCDA-C methodology employs a compensatory model to integrate the components and create a global model; therefore, compensation rates must be constant, requiring measurements for the resulting range to be preferably cardinal-independent (Ensslin et al., 2010; Schlickmann & Bortoluzzi, 2023). This analysis aims to determine the isolability of viewpoints and ensure that all descriptors can be evaluated independently of the performance of other descriptors (Longaray et al.,

2019). In this stage, the analysis was limited to the "GOOD" and "NEUTRAL" performance levels.
All the criteria of the model were tested, involving four performance situations, through the application of three tests where questions were posed to the decision-maker. The result indicated that the attractiveness difference between levels in a given descriptor is not affected by the performance of another descriptor. Since they were demonstrated to be cardinal-independent, the next step was to begin constructing the value functions.

3.2.2. Construction of value functions

This stage aims to transform the ordinal scale into a cardinal scale using a semantic evaluation method to determine the attractiveness difference between different levels of descriptors with the assistance of the M-MACBETH software (Longaray et al., 2019). Interviews were conducted with the decision-maker to identify the attractiveness difference for all model descriptors.
After introducing the impact levels and anchoring in the software, the procedure for constructing the value functions (cardinal scales) began. The value functions were delimited by the Good (upper) and Neutral (lower) reference levels, with the former corresponding to one hundred points and the latter to zero points (Bortoluzzi, Ensslin, Lyrio, & Ensslin, 2009).
The decision-maker was asked to indicate the attractiveness difference between all alternatives by comparing them in pairs and then choosing one of the semantic categories. Based on the judgments made by the decision-maker, the responses were recorded in the M-MACBETH software, which assigned scores to each level of the descriptor, allowing for the identification of value functions.
Figure 3 illustrates the structure of the process of transforming the ordinal scale into a cardinal scale for the "Process Mapping" descriptor.

Figure 3. Construction of the value function for EPV -Mapping processes



Source: Author's contribution

The joint analysis of the ordinal and cardinal scales for the EPV "Process Mapping" demonstrated that the loss of attractiveness when moving from the neutral level a(60%) = Va(0) to the compromising level a(50% or (-)) = Va(-175) is slightly greater than moving from the good level a(80) = Va(100) to the excellent level a(90% or (+)) = Va(150).
The decision-maker justifies this difference in attractiveness by explaining that in the initial stage of process mapping, it is necessary to prioritize the most relevant processes, leaving the simpler ones or those with fewer issues for another time. With the value functions developed, the MCDA-C methodology allowed the manager to measure cardinal values for each operational aspect presented in the model.

3.2.3. Identification of compensation rates

After transforming ordinal scales into cardinal ones, the MCDA-C methodology suggests integration through the identification of compensation rates. In the previous stage, value functions were developed, but it was still not possible to measure performance and compare the strategic or tactical objectives of the HVS. To perform a global evaluation of the model, taking into account all viewpoints, it is necessary to identify the compensation rates for each FPV and EPV. To achieve this, the compensation rates were identified, followed by the additive aggregation of the model.
In this stage, with the help of the ranking matrix (Roberts, 1979) and the M-MACBETH software, alternatives were arranged according to the decision-maker's preferences, who ranked the EPVs in an order of overall attractiveness, creating the necessary conditions to obtain a cardinal scale. Thus, if one EPV was preferable to another, a "1" was assigned to it and a "0" to the other.
After comparing the EPVs among themselves, the result for each EPV was obtained, determining the preference order of the alternatives. The next step was to quantify the differences in attractiveness between the EPVs. Therefore, the decision-maker was asked to project these differences using the semantic categories associated with the MACBETH methodology.
Guided by the responses, the facilitator filled out the judgment matrix, demonstrating the scores for each EPV, as shown in Figure 4. This action helped determine the compensation rates for all EPVs directly related to the central objective of this study.
The hierarchical value structure was evaluated, starting from the lower hierarchical levels up to the higher ones, enabling the execution of the global model evaluation, as described in the next subsection. This action helped determine the compensation rates for all FPVs directly related to the central objective of this work.

3.2.4. Identification of the impact profile of alternatives

Once the value functions and substitution rates of the descriptors have been identified, it is possible to determine the potential action's impact on each FPV and calculate the overall model assessment by applying a mathematical equation for

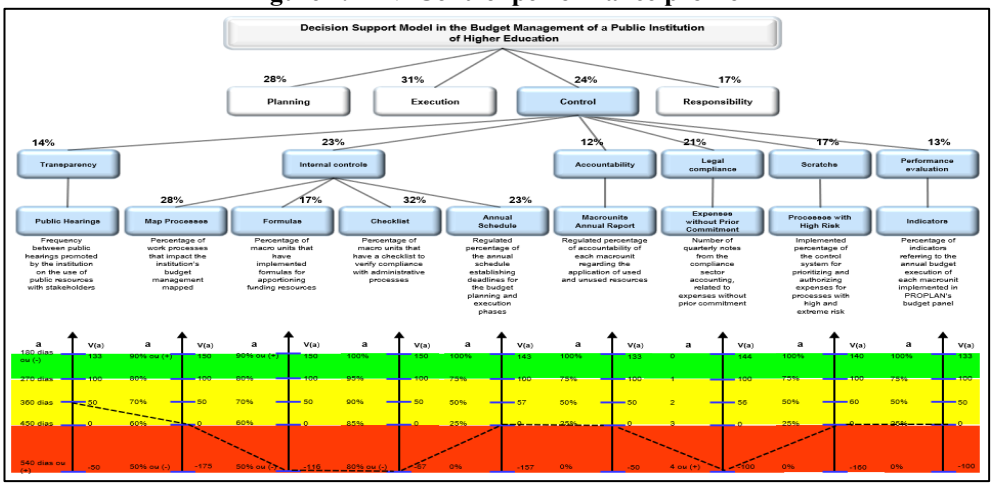
additive aggregation (Reina et al., 2012; Ensslin, Mussi, Dutra, Ensslin, & Demetrio, 2020).

First, performance assessments were developed for each FPV, as their results make up the formula for identifying the overall model performance. To identify the global model equation, which encompasses all FPVs and their compensation rates, the following formula was used:

$$VMADGOIPES(a)=0{,}028*VFPV-planning(a)+0{,}031*VFPV-execution(a)+0{,}024*VFPV-control(a)+0{,}017*VFPV-responsibility(a)$$

The equation yielded a negative result (-1.94), below the value established for the neutral level, which is zero. This result indicates that the model is in a compromising situation due to the high number of descriptors with low levels of performance. Figure 4 illustrates the performance profile of the FPV "Control" that is part of the equation.

Figure 4. FPV-Control performance profile



Source: Author's contribution

The developed model allowed for the identification of 34 descriptors, of which, 16 are at a compromising level, 12 are at a neutral level, and only 4 are at higher levels. A negative result is a cause for concern, as it indicates that the budgeting process of the institution needs improvement. This information enables the decision-maker to identify areas for improvement and take action to enhance the institution's budget management.

3.3. Recommendations phase

After completing the phase of identifying the impact profile, there is a need to propose actions that can impact the model's performance, especially in the case of descriptors that are at a compromising level. In this phase, the facilitator, with the support of the decision-maker, suggests measures to improve the budgeting process,

guided by the knowledge acquired about the analyzed context and the data generated by the model.
As observed in the previous section, all FPVs are in a critical situation. This scenario is the result of the decision-maker's attractiveness judgment when constructing the value functions for each elementary viewpoint. When identifying the attractiveness difference, the decision-maker applied the highest levels of attractiveness (strong, very strong, and extreme) in all judgment matrices.
This behavior may be a result of the decision-maker's care for the proper use of public resources. They may revisit their judgment and make adjustments if necessary, which can influence the overall value of the model.
To improve budget management, the decision-maker suggested that, given the high number of EPVs and the efforts required for their implementation, initially, 50% of them should be selected for the recommendations phase. As a result, eight recommendations were issued.
After implementing these recommendations, the manager can monitor the descriptors and measure their performance, thus establishing a performance management process (Ensslin et al., 2022). The proposed actions can be reviewed by the decision-maker to meet the needs for effective budget management.

3.4. Criteria Alignment

To verify whether the criteria described in the literature related to performance evaluation and public budgeting are reflected in the model developed in this study, bibliographic research was conducted, resulting in the identification of 46 criteria, with 19 from national sources and 27 from international sources. These criteria were compared with the EPVs (Performance Evaluation Variables) and descriptors associated with the respective areas of concern in the model.
The alignment process revealed that 8 EPVs, as listed in Table 2, were not directly associated with the criteria from the literature, due to the lack of a clear alignment with their purposes. These perspectives express the decision maker's concerns related to forecasting future expenditures, seeking alternative sources of funding, addressing unplanned expenses, and establishing technical reserves of resources, especially for investment-related expenses.

Table 2. EPVs of the model not associated with the criteria identified in the literature

EPV	Descriptor
Costing	Annual percentage of the amounts requested by the macro-units, for funding expenses in the Annual Budget Piece - POA, which contains a forecast of expenses for the next 3 years
Investments	Annual percentage of amounts requested by macro units, for investment expenses in the Annual Budget Piece - POA, which contains expenditure forecasts for the next 5 years

EPV	Descriptor
Term of decentralized execution	Percentage of resources received, through Decentralized Execution Term, in relation to the total requested for other bodies
Parliamentary amendments	Number of parliamentary amendments received by the institution annually
Payments	Annual percentage of discretionary budget used to pay extraordinary expenses
Mitigate usage with overheads	Annual percentage of the technical reserve used to pay general expenses
Allocate more resources	Percentage of the amount allocated to the technical reserve in relation to the budget approved in the Annual Budget Piece - POA
Tendered processes	Implemented percentage of the control of tendered processes, and under commitment conditions, referring to works and equipment

Source: Author's contribution

The variations between the criteria found in the literature and the concerns mentioned by the decision-maker are results of the constructivist approach of MCDA-C (Multi-Criteria Decision Analysis for Constructivist), as the constructed model is personalized for a specific context, taking into account the relevant aspects of the decision-maker (Cardoso, Ensslin & Dias, 2016; Ensslin et al., 2020). On the other hand, it was observed that five criteria from the literature, as listed in Table 3, are not present in the decision-maker's concerns and, therefore, were not incorporated into the model. Faced with this situation, the decision-maker was questioned about these criteria, and they indicated that they would consider them in the decision-making process.

Table 3. Literature criteria not associated with the model

Criteria	Authors
Consider the organization's strategic issues and budget policy for the purpose of developing and discussing public sector effectiveness.	Antipova, T. (2017)
Conduct financial audits to review expenditures and the annual budget.	Ferry, L., & Eckersley, P. (2015)
Carry out performance audits to verify how resources are being used by managers.	Kluvers, R. (2001)
Insert additional elements of cost and management accounting in the budgeting system, with a view to improving financial control and when carrying out internal and external audits.	Veledar, B., & Gadžo, A. (2020)
Have strong and sustained leadership to support the application of performance measurement and deliver effective budgetary outcomes.	Williamson, A., & Snow, D. (2014)

Source: Author's contribution

In this way, we have concluded this comparative analysis, aiming to generate knowledge for the decision-maker regarding the criteria found in the literature and

their comparison with the model's concerns. The identification of criteria aligned with the context and their relationship, or lack thereof, with the developed model assists in pinpointing weaknesses and strengths to achieve meaningful results.

4. Conclusions

In response to the need for more efficient and effective allocation of increasingly scarce budgetary resources, which are sometimes affected by contingencies, and the need for a performance evaluation model for public budgeting to support decision-making, the following research question was addressed: "What criteria should be considered in the budget management process of a public university to support decision-making for the proper use of public resources?" To address this question, a decision support model was developed for the budget manager of the institution using the MCDA-C methodology. Additionally, criteria related to performance evaluation and public budgeting, identified in national and international literature, were compared with the developed model.

To create the model, interviews with the decision-maker were conducted, which contributed to the identification of actors, the label, and their concerns. These were transformed into 118 primary evaluation elements with their respective concepts. The decision-maker established four areas of concern, forming the fundamental viewpoints: planning, execution, control, and responsibility.

Means-ends relationship maps were created to organize all concepts into clusters and subclusters, identifying 34 descriptors and their ordinal scales. Subsequently, in the "Evaluation" phase, cardinal scales were defined, and the diagnosis of the current situation (status quo) was determined. In the overall evaluation, the model yielded a negative result (-1.94), indicating a compromising situation.

This scenario is a result of the decision-maker's attractiveness judgment, where more extreme levels of attractiveness were applied in all judgment matrices. This outcome may be attributed to their extreme caution in using budgetary resources, contributing to this result.

To strengthen the university's budgeting process, eight recommendations were formulated, with the decision-maker responsible for their implementation. Based on the criteria identified in the literature, their alignment with the decision-maker's concerns was verified using the EPVs and descriptors of the model. In this comparison, it was possible to observe an affinity between them, more broadly in some cases and less so in others.

It was found that some of the decision-maker's concerns listed in the model are not present in the criteria identified in the literature, a result of the constructivist bias that considers the relevant aspects of the decision-maker and their context. Out of the 46 criteria found in the literature, only five were not related to the model, on which the decision-maker provided comments, indicating their intention to include them in the budgeting process.

The authors of this work believe they have contributed to the scientific community by identifying criteria related to performance evaluation and public budgeting. In

practice, they have also assisted the manager of the budgeting unit, who now has a support tool developed based on their perceptions and the institution's specificities. For future research, it is suggested to use the MCDA-C methodology to create a model that includes the concerns of decision-makers from different educational institutions operating in the same business area. It is important to consider that the development of a joint model can add knowledge for both parties. Thus, situations or concerns experienced by one manager today can serve as preventive measures for another manager, promoting collective and simultaneous work.

Conflict of Interest Statement

The authors declare no conflict of interest.

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