Which Tools Are Needed to Assist Audit Managers in Project Portfolio Selection When Divergent Views Emerge?

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Abstract: In Brazil, government programs differ in terms of territorial coverage, of sectorial action, and vary according to regional contexts. Similarly to other public auditing organizations, the Ministry of Transparency and Comptroller General of the Union (CGU) is responsible for monitoring the application of funds in these government programs as a means to promote transparency and accountability in public spending. In order to fulfil this mission, it is necessary to select the audit projects to be executed by the CGU teams. Several multidisciplinary teams and stakeholders participate in this process of selecting auditing projects across distinct management and public policies themes, with different opinions and views arising. The most important challenges for CGU are to compare the audit projects submitted by these teams on a common and transparent basis (under the presence of scarce resources) and to consider in the selection of projects the divergent and often conflicting perspectives of those involved. In this study, we explore which tools from the multicriteria portfolio decision analysis and negotiation literature can be used to inform a transparent and negotiated selection of audit projects, as well as discuss which type of multicriteria portfolio decision analysis models and features for negotiation should be combined in future research.

1 INTRODUCTION

The Ministry of Transparency and Comptroller General of the Union (CGU) is responsible for checking the application of public funds in government programs as a means of promoting transparency and accountability in public spending. Decisions regarding which projects the CGU should audit can be considered multicriteria resource allocation problems, since they involve multiple strategic objectives, the benefits are usually multi-dimensional (related with the delivery of effective and quality public policies, losses recovery, transparency in public management, social responsibility), and there limitations on the resources available to dedicate to auditing. At a time when public resources are particularly scarce, CGU needs to decide on this allocation of resources in audit projects. This allocation of resources is not always straightforward as it is typical to have divergent and conflicting views among those participating in the auditing selection process, and a compromise solution needs to be negotiated.

Thus, it is central for the CGU to decide: how to select the audit projects to compose the Operational Plan while considering the different views and perspectives from CGU stakeholders? Selecting sub-set of projects is a portfolio decision, and up to our knowledge we have not identified literature integrating negotiation with portfolio analysis, nor negotiation literature associated with auditing decision-making. This study aims to contribute to these fields by digesting concepts and models from the Multicriteria Decision Analysis (MCDA), Portfolio Decision Analysis (PDA) and negotiation literature, and reflecting upon how such concepts and models can support the selection of projects in auditing contexts.

In the next section we detail the results from a review of MCDA, PDA and negotiation studies that provides useful concepts and models to support the selection of audit projects under the presence of divergent views among those involved in the selection process and under limited resources. Departing from the results of the review, section 3 systematizes tools that can inform the selection of audit projects, as well as identifies which type of

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models may be developed. Final conclusions and remarks are drawn in section 4.

2 REVIEW OF STUDIES

Taking a constructivist view in MCDA (Lee, 2012; Peterson, 2012) that involves research is performed with the collaboration of participants/evaluators and accepts that *"a decision situation is, in general, an ill-defined entity, unclear even to the actors involved in the decision process"* (Bana e Costa and Pirlot, 1997), our review of studies started by searching studies that report multicriteria evaluation models and tools to evaluate projects and that use some type of negotiation instrument to deal with divergent opinions. Our search protocol focused on combinations of several keywords – negotiation, group decisions, conflict analysis, disagreement, MCDA, PDA, integrative negotiation, auditing – in the data sources B-on; Web of Science; ScienceDirect; SCITEPRESS Digital Library. Surprisingly, a small number of studies filled these search criteria. These studies typically make use of multicriteria resource allocation and of multicriteria portfolio decision analysis models and explicitly make use of some type of negotiation or consensus building mechanism, which are key features for models to inform the selection of projects when there are scarce resources and participatory processes are endorsed. Before introducing these studies, we present key concepts.

2.1 MCDA and PDA

Here, we begin by highlighting the elementary principles of building decision support models that are key for multicriteria modelling. From the perspective of MCDA, one can say that evaluation models for decision support require three interactive phases: (i) the structuring of the decision-making context; (ii) the construction of evaluation model; and (iii) impact assessment and analysis (Bana e Costa and Beinat, 2005). The structuring phase requires understanding the problem and the decision context. To achieve this, a representation in the form of a hierarchical value structure commonly named as a value tree – accepted and negotiated by all stakeholders – is constructed (Keeney, 1992). This tree should represent, in an organized way, the dimensions of values and key-concerns that are relevant to the evaluation process and according to which the options/projects/actions will be evaluated. In the evaluation phase, a mathematical evaluation model (most commonly an additive value model), through which options are evaluated, is constructed. The impact assessment phase is sought to provide those developing the model with the analysis of the consequences of implementing each one of the options considered, with model adjustment and validation procedures being also used (Bana e Costa and Beinat, 2005).

In turn, in case of limited resources we are dealing with portfolio problems and Portfolio Decision Analysis (PDA) is applicable. According to (Salo et al., 2011) PDA means *"a body of theory, methods, and practice which seeks to help decision makers make informed multiple selections from a discrete set of alternatives through mathematical modelling that accounts for relevant constraints, preferences, and uncertainties"*. When one comes across a real situation of audit project selection to compose a portfolio, we need mechanisms to evaluate these projects in multiple dimensions and this has been done by MCDA literature – more specifically by multicriteria portfolio decision analysis literature – applied to real situations, whose models have a potential to help building multicriteria models (Bana e Costa, 2001; Bana e Costa et al., 2001; Mateus et al., 2017; Oliveira et al., 2012) in the auditing context. Since these models are already consolidated in the literature we suggest making use of built-on-purpose additive value models, similar to those presented in these references, to evaluate the audit projects. It is worth mentioning that under the presence of divergent views, the models should reflect the different opinions of the decision-makers' groups (or stakeholders, or those involved in evaluation) and make use of well-designed participatory processes (Phillips and Bana e Costa, 2007); and that when one identifies non-additive cases, models should be restructured so that additivity conditions are respected (having additive models the advantage of being transparent and better understood by evaluators and stakeholders).

Seeking for applications of MCDA in conflict analysis contexts, various approaches and techniques for dealing with divergent views have been proposed. Bana e Costa (2001) explored the use of MCDA to support the search for less conflicting policy options. The author highlighted that public resource allocation often requires the management of conflicting objectives of multiple policy actors at different spatial levels. The mix of limited financial resources, multiple and conflicting concerns, spatial variability of policy impacts and several types of uncertainty in the data available for policy evaluation, make this process problematic. In this case, conflict analysis

was based on the spatial analysis of the results of the value model. Bana e Costa et al. (2001) presented a case study of conflict dissolution in the public sector through identification of the fundamental points of view characterising the different value systems of the stakeholders. The authors brought a pre-negotiation approach aiming to dissolve the conflict in an enlarged frame. Impact assessment revealed the conflicting nature of the alternatives. The authors then engaged the planners in a decision-analysis process oriented towards the generation of win-win solutions – to dissolve the intrinsic value conflict.

Losa and Belton (2006) brought an exploratory application of an integrated approach, combining MCDA and conflict analysis. They have integrated Drama Theory and MCDA to model the situation using confrontation analysis with the following elements: characters, actions, positions and fallbacks, and preferences. The resolution of the conflict consisted of detailed analysis of the characters positions, threats and dilemmas, through a multicriteria evaluation of the different futures. Also worth mentioning is the use of the MACBETH (*Measuring Attractiveness through a Category Based Evaluation TecHnique*) approach, that only requires qualitative judgments about differences in attractiveness to build a multicriteria value model (Bana e Costa et al., 2012), and has been used for consensus generation. Specifically, two studies reported the use of a "MACBETH Voting" decision support system to promote compromise in model building. "MACBETH Voting" is characterised by using the MACBETH (intuitive) qualitative questioning protocol together with voting procedures that potentiate convergence of views in a decision conferencing environment in which key stakeholders physically meet (Bana e Costa et al., 2014; Mateus et al., 2017).

Mateus et al. (2017) describe a real-world application of MCDA and related Decision Support Systems (M-MACBETH, MACBETH Voting, and Web-MACBETH) to support the engagement and participation of a group of key players. Two alternative multicriteria aggregation schemes were applied in order to assist the group in evaluating the added value and doability of the proposed actions. New measures and methods to analyse the dominance relationships between the actions were proposed, further assisting the group in the priority selection of the most effective and doable actions.

Fasth et al. (2016) presented a method based on disagreement constrained action selection in participatory Portfolio Decision Analysis. They investigated the stakeholders' disagreement with regard to each action, and how portfolios can be generated that elucidate how conflicting preferences affect the portfolio composition. Their method for participatory PDA consisted on: eliciting stakeholder preferences; measuring stakeholder disagreement; disagreement constrained portfolio generation; and sensitivity analysis.

Salo (1995) developed an interactive approach for the aggregation of group members' preference judgements and presented joint preference representation in the form of value trees that conveys areas of conflict and disagreement. Vilkkumaa et al. (2014) described a multicriteria portfolio modelling for the development of shared action agendas in group decision and negotiation. When seeking for consensual compromise solutions, non-dominated portfolios with a high acceptability index are viable candidates because they contain topics that are in the core or borderline for many group members.

2.2 Negotiation

Moving towards studies focusing mainly on the negotiation process, as emphasized by Vetschera (2013), negotiations are one means of resolving conflicts. Negotiation depends exclusively on the parties involved and on their attempt to reach an agreement that is acceptable to all parties. It can be seen from a prescriptive-descriptive perspective, where rationality of the negotiator are supported by prescriptive theories such as game theory and, on the other hand, actual human behavior is considered (Raiffa, 1982). Therefore, a negotiation can be seen as a process at the group level, in which those involved influence each other and try to converge toward some point of agreement. The author points out that negotiation processes can be based on concessions, in which each party begins from a desirable position and over time reduces its demand until a point considered satisfactory for both parties and an agreement is found. Or the parties can start from a solution which is not attractive to either party, and jointly look for improvements, as in single negotiation text (SNT) type of negotiation (Raiffa, 1982).

Keeney (1992) also suggested procedures for empathetic negotiation within a value focused thinking frame: "*view the situation from the perspective of other stakeholders; structure his values as much as possible; begin by identifying the negative impacts of your desired alternative relative to the status quo in terms of his values; follow their implications through a mean-end objectives network to the fundamental objectives of the stakeholder;*

create modified alternatives that can at least improve matters in terms of these objectives while maintaining the key consequences desired by you". In the end, the goal is to create an alternative that both parties win.

In an integrative negotiation process, as explained by Sarabando et al. (2013), successful strategies include cooperation, information sharing and joint resolution of problems. Mediation and arbitration are particularly useful in integrative negotiation, since they can help negotiators to identify potential areas of improvement for both sides. A value-based evaluation model allows each party to evaluate their potential own proposals, proposals made by the other party, and their BATNA (best alternative to a negotiated agreement).

Filzmoser and Vetschera (2008) highlighted the bargaining process that can be seen as a sequence of offers and often, formal models of negotiation processes based on theories such as game theory or decision analysis focus on the exchange of offers. Greenhalgh and Chapman (1998) showed that information sharing could facilitate joint gain because negotiators disclose and learn about the interests of each party, providing integrative bargaining.

Górecka et al. (2016) presented an approach in the verbal and holistic evaluation of the negotiation template to evaluating negotiation offers when the negotiator's preferences are expressed verbally. Present Measuring Attractiveness near Reference Situations (MARS) approach, these authors combined the algorithms of two multiple criteria decision making methods: ZAPROS and MACBETH. They also suggested a pre-negotiation preparation, with a negotiation template, designed and evaluated by means of the negotiation offer scoring system. The problem of evaluating the negotiation template from an individual negotiator's viewpoint is similar to a decision-making problem with multiple criteria involved and negotiation offer scoring system was modelling as a simple additive weighting (SAW) method.

2.3 Key Aspects from Reviewed Studies

Table 1 summarizes key aspects from the reviewed studies that may be specifically useful to the design of inform and tools to assist the selection of auditing projects in the presence of divergent opinions and of resource constraints.

From the review of studies, we observe that no study has focused on the negotiation process for conflict resolution in auditing portfolio management context, and that there is space for developing new models and tools in the area of multicriteria PDA.

Table 1: Key aspects from reviewed studies.

Reference	Field of Knowledge	Area of study application	Study features with special relevance for a negotiated selection of auditing projects
Keeney (1992)	MCDA Negotiation	Conceptual examples	Concepts for an empathetic negotiation. Structuring values in mean-end objectives network.
Salo (1995)	MCDA Group decisions	Marketing and production	Joint preference representation and dominance concepts. Value tree
Greenhalgh and Chapman (1998)	Integrative bargaining Negotiation tactic	laboratory study	Cohesive relationships encourage information-sharing and discourage use of coercive tactics. Integrative bargaining.
Bana e Costa (2001)	MCDA Resource Allocation	Public sector (road-links)	Conflict analysis based on the spatial analysis of the results of the value model. Structuring multicriteria resource allocation model.
Bana e Costa et al. (2001)	MCDA	Transport planning	Value systems of the stakeholders. Pre-negotiation Conflict dissolution through 'win-win' compromise solution.
Losa and Belton (2006)	MCDA Group decisions	Analysis of conflicts in a social service	Conflict analysis. Integrated use of Drama Theory and MCDA.
Filzmoser and Vetschera (2008)	Bargaining process Offers	Electronic negotiations	Develop a typology of bargaining steps for multi-issue negotiations
Vetschera (2013)	Negotiation Offers	Conceptual examples	Survey of process models of negotiations. Concession-based negotiation. Improvement-based negotiation
Sarabando et al. (2013)	Integrative negotiation	Conceptual examples	Integrative negotiation. Value-based evaluation model. BATNA (best alternative to a negotiated agreement)
Vilkkumaa et al. (2014)	PDA Group decisions	Agenda building (wood products)	Interactive decision process. Group members' preferences synthesized into shared priorities for action topics.
Fasth et al. (2016)	PDA	Urban planning	Disagreement constrained portfolio generation.
Górecka et al. (2016)	Negotiation offer scoring system	Conceptual examples	Pre-negotiation: negotiation template, designed and evaluated by means of the negotiation offer scoring system.
Mateus et al. (2017)	MCDA Group decisions	Brownfield	Evaluating the added value and doability of the actions. Application of MCDA and related DSSs to support the engagement and participation of a group of key players.

3 WHICH TYPE OF CONCEPTS AND TOOLS ARE USEFUL FOR SELECTING AUDITING PROJECTS?

Departing from the auditing context, our proposal for systematizing useful models and tools is organized in the structure shown in Figure 1: we starting by describing the building of multicriteria portfolio decision analysis models through a socio-technical approach; we then describe the tools to display information concerning auditing projects or portfolios; we then focus on participants' interaction for negotiation; and we finally focus upon on relevant negotiation approaches that one can follow.

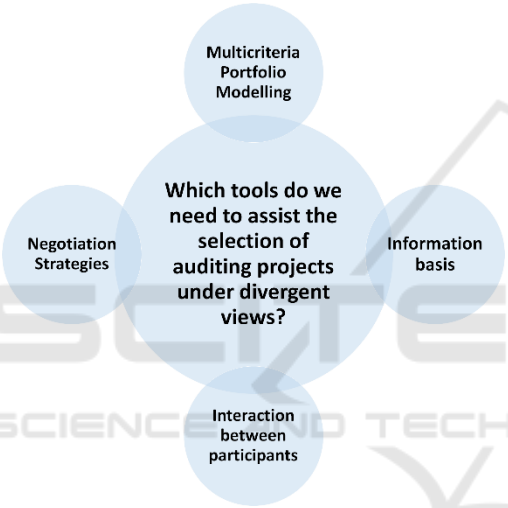

Figure 1: Components for systematizing models and tools to be used in the selection of auditing projects.

3.1 Multicriteria Portfolio Modelling

To build a multicriteria portfolio model (by following a socio-technical approach (Phillips and Bana e Costa, 2007)), one can start by building the value trees, which structure the fundamental dimensions/objectives of the problem and the criteria to assess benefits of audit projects, according to the view of each group of stakeholders (Bana e Costa, 2001; Bana e Costa et al., 2004). At this point, the MACBETH approach (Bana e Costa et al., 2012), supported by the DSS M-MACBETH, is an available approach to assist the construction of a model to evaluate auditing projects (entailing an intuitive protocols and being compatible with the use of voting and negotiation procedures).

The selection of audit projects can inherently make use of multicriteria PDA models, as shown by Oliveira et al. (2012). Adapting for the auditing context, stakeholders involved in the evaluation process must evaluate each audit project j to be included in the portfolio, according to the group model. The performance x_{ij} of each audit project j on each benefit criterion i can be measured by a level in the respective descriptor with partial value $v_i(x_{ij})$, in which we have $v_i(lower\ reference_i) = 0$ and $v_i(upper\ reference_i) = 1$. Under an additive structure, which requires the respect for mutual independence conditions, the value of the overall benefit v_j of the project j, can be determined as:

$$v_j(x_{1j}, \dots, x_{nj}) = \sum_{i=1}^{n} k_i . v_i(x_{ij})$$
$$\sum_{i=1}^{n} k_i = 1 \text{ and } k_i > 0 \ \ (i = 1, \dots, n) \quad (1)$$

Moreover, in the case of the information on the costs of audit projects are not available, one can make use of the doability concept (Bana e Costa et al., 2014) as proxy for audit cost. Doability can represent the extent to which each audit project can effectively be implemented, considering the limited resources and financial, legal, social, and other constraints that are beyond CGU managers' control (Mateus et al., 2017). The analysis of the divergences will be pointed out from the results of the evaluations of the audit projects in terms of benefits and doability according to each model.

In view of maximizing the value of Equation (1), the following optimization problem must be solved, considering each project j has $v_j > 0$ and cost c_j and B is the total of available resources (as $l_j = 1$, if the project j is included in the portfolio and $zero$ otherwise):

$$maximize: \sum_{j=1}^{m} v_j l_j \quad (2)$$

$$subject\ to: \sum_{j=1}^{m} c_j l_j \leq B,$$
$$l_j \in \{0,1\}, \quad j = 1, \dots, m. \quad (3)$$

Additional constraints can be considered.

On the social component of portfolio modelling, to involve and model the preferences of stakeholders and/or decision-makers, depending on the context, several formats can be adopted in model building. For instance, semi-structured interviews, web questionnaires, Delphi processes (Bowling, 2009), as well as decision conferences that involve a face-to-face meeting with key players (stakeholders and

experts) and an impartial facilitator, typically with the support of MCDA tools (Phillips and Bana e Costa, 2007) can be adopted. Participants need to participate in several modelling tasks that include the structuring of a value model and the building of partial value functions and of weighting scales.

3.2 Information Basis

From the reviewed studies, there are a set of tools that can help auditing stakeholders to analyse projects or portfolios, and to portray the consequences of differences in opinion for an informed negotiation. These tools include:

- **Info 1: Evaluation of Benefits and Doability, separately:** analysis/view of the benefits and doability of each project according to a group or groups of stakeholders (Bana e Costa et al., 2014).
- **Info 2: Benefit x Doability Graph:** trading benefit off against doability should drive the selection of the best actions (Mateus et al., 2017). This graph allows stakeholders to perceive the expected impact and cost of each audit project, in the view of each party involved in the negotiation. We also suggested make use of Strategic Matrix, with 4 distinct quadrants, include the 'pearls' in the portfolio, and negotiate the 'oyster' and 'bread and butter' (Bana e Costa et al., 2014).
- **Info 3: Benefit/Effort Ratio:** prioritise the audit projects by their value-for-effort, defined as the ratio between the benefit and the effort scores (Bana e Costa et al., 2014). This information is useful to rank the list of audit projects, allowing to perceive, in the view of each party, the order of projects with the best benefit / effort ratio.
- **Info 4: Portfolios According to the Views of Each Group:** from the definition of the available budget, it is possible to define which audit projects will compose the portfolios according to the models of each stakeholders group, which means different portfolios of projects may be obtained. For instance, analysis of the differences and implications according to each auditing stakeholder group will allow the identification of divergences should focus in preparation for discussion and negotiation between groups.
- **Info 5: Dominance:** dominance analysis can be useful in negotiation as the dominance criterion is a natural starting point in selecting proposals (Sarabando et al., 2013). When seeking for consensual compromise solutions, the examination of core index values makes it possible to analyse the non-dominated portfolios and provide relevant inputs for group deliberations about viable candidates (Salo, 1995; Vilkkumaa et al., 2014).

3.3 Interaction between Participants for Negotiation

Assuming that we have two groups of stakeholders with divergent views, we must model the different views of each group and how the groups may interact. Figure 2 summarizes key aspects from a project selection process that can help defining the audit projects, for instance to compose the Operational Plan at CGU. Each stakeholder group has representatives who will define the projects of their teams. Considering a group A, with visions according to model G1, and a group B, with vision according to model G2. Individually, each leader of these groups must evaluate their projects to enter the Operational Plan. From the results, differences are raised and the space for negotiation is defined. The groups will need to negotiate to reach the compromise solution. We would thus have general models, based on a common and transparent basis, and at the same time, space to include the knowledge of each stakeholder, for instance, an expert in the field, in the final decision project selection.

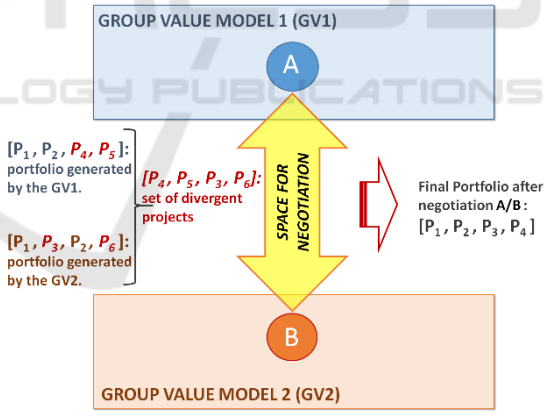

Figure 2: Illustration of the negotiation space for the audit project selection process.

3.4 Negotiation Strategies

As emphasized by (Górecka et al., 2016), a pre-negotiation phase should be defined to establish a detailed "*vision of the negotiation problem, the parties involved and the context and, after analysing them, define a negotiation strategy that would allow the party to obtain the goals*". Thus, the initial negotiation template would be composed of the projects that compose the sets of divergence. The

actual negotiation can start by an initial stage, in which two offers are submitted at the negotiation table, one by each of the parties. At each negotiation stage one can observe the scale of differences that needs to be eliminated to achieve a compromise between the parties and what their endeavours are in achieving the current negotiation status. Moments of reverse concessions should be identified and, by analysing the structure of the offers being presented, competing issues can be identified and addressed within negotiation.

In case of an integrative negotiation is adopted, it is essential to identify potential areas of improvement for both sides, on the exchange of offers, as also their BATNA (best alternative to a negotiated agreement). Thus, parties have to share information to facilitate joint gain.

At the end, by following structured, transparent and informed decision processes, it is expected that a compromise solution will be reached and a final portfolio defined.

4 CONCLUSIONS

The CGU in Brazil faces the challenge of, under the presence of scarce resources, executing auditing projects across distinct management and public policies themes, involving multidisciplinary teams and stakeholders, with different opinions and views. We have shown in this study that portfolio resource allocation models can be built to reflect the opinions of distinct decision-maker and stakeholder groups, and simultaneously auditing projects can be analysed on a common and transparent basis. Negotiation tools can be used to systematize the confrontation of situations of divergence and conflict, and to search converges toward some point of agreement. To implement that socio-technical processes (Phillips and Bana e Costa, 2007) must be considered, in which methods, techniques and tools for model building are intrinsically combined with participatory processes involving stakeholders, decision-makers and/or experts. By combining multicriteria methodology with negotiation tools and techniques, it is possible to build multicriteria resource allocation tools that support the negotiation process in a shape of an informed negotiation framework.

Thus, in this study we show multicriteria PDA concepts and tools couples with negotiation strategies that can be used to inform a transparent and negotiated selection of audit projects; and that there is relevance and scope for developing and testing such type of models to assist the evaluation and negotiation of auditing projects to integrate the Operational Plan at CGU. A real case study is currently being developed through a methodology inspired and combining many of the concepts introduced in this paper.

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