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A MCDA-C APPLICATION TO EVALUATE THE APPROVAL SECTORS MANAGEMENT

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ABSTRACT

The length and poor quality of the issuance process of building permits is the subject of many complaints at City Halls. When these procedures are slow and bureaucratic, there is always a direct impact on the construction industry, harming businesses and directly affecting the economic development of the municipality. An analysis shown that most of them originate from management deficiencies. The lack of standardization and transparency, communication failures, and low productivity can be listed as some of the shortcomings present in most cases. This research project aims to a build a management model able to identify flaws and opportunities for improvements on the issuance process using the "Multiple Criteria Decision Aiding – Constructivist Model (MCDA)" method. The model was verified through a case study in the agency responsible for the approval of construction projects and the obtainment of all building permits in the City Hall of the municipality of Joinville, Brazil. The current situation was identified by mapping the process flow, defining the interface between actors and the way they interact, and observing the barriers that hinder the development of the work. The results demonstrated that the model was able to evaluate the current performance of the issuance process and identify how proposed actions can affect the future scenario

Keywords: Public Work Management, Building Permit, Performance Evaluation, MCDA-C

1 INTRODUCTION

The construction industry has been emerging as an important sector for the economic development of Brazil. Thus, as with other sectors in the country's productive chain, the success of its projects is strongly related to the quality of the public services provided.

The business flow in construction is led by the investor, and comprises the following stages: survey of the project's needs; get approvals with the City Hall; contract, control, and build the project until its completion. Most of these activities are administrative tasks, and there is a great flow of information in this process (Reis, 2004). The studies currently being carried out in the construction field usually focus on reduce material waste, time spent in the activities of the construction work, and management of process related to construction phases. However, little is known about the administrative activities required for a

project's construction, especially procedures related with the issuance process of building permits (Reis, 2004).

2 BACKGROUND

Public management is an external management of a complex sociopolitical context, in which governments must act with transparency, achieving efficiency, efficacy and effectiveness in the quality of services provided to the population (Matias-Pereira, 2009). In this context, the municipality must provide quality public service to citizens and exercise its police power for the good of the community. In Brazil, the Building Police, also known as Construction Police, are responsible for supervising buildings and constructions, whether public or private, in order to ensure technical-functional control related to the compliance with urban norms. These police can be both administrative and judicial. In the first case, they act before the fact occurs, through, for example, the issuance of the Building Permit; in the second, they act after the occurrence of the fact (Bernardi, 2015).

The issuance of a Building Permit by the public agency is then characterized as a public service provided to the citizens, which is an essential service to the population (Bernardi, 2015). The quality of the services provided, as perceived by the citizens who use them, is considered one of the determining factors for good business performance. Performance evaluation tools have been used as a management process to build, fix and disseminate knowledge. Therefore, the identification, organization, measurement and integration of aspects of a given context are relevant to assess and manage the performance of the organization's strategic objectives (Ensslin et al., 2001).

3 METHODOLOGY

In order to improve the performance of these processes, this article aims to assist agencies that work with project approval by showing the building of a management model able through the use of "Multiple Criteria Decision Aiding – Constructivist Model (MCDA)." Through a case study, a management model was created for project approval departments based on the municipal government of Joinville, Brazil. The data were obtained using a semi structured interviews and statistical data from the project approval department.

Most methods for measuring performance on the basis of indicators have been developed without regard for the preferences and values of the persons responsible for improving the unique environment —in this case, the approval departments. This Multiple Criteria Decision Aiding – Constructivist methodology (MCDA-C) brings specific analysis tools for each case in support of the manager's decisions. The method takes into account the uniqueness context of each service, individual characteristics, particularities and requirements, by identifying, organizing, measuring, and integrating values and preferences.

The MCDA-C methodology is structured into three phases (Figure 1). The first one is the Structuring phase, in which the organizational context is explored. The second is the Evaluation phase, in which the perception of the decision-maker is translated into a mathematical model. The final phase is the Recommendation phase, in which actions aimed at improving the performance of the context are identified, and the impact of these actions on the general context of the model is also evaluated. The phases are shown in Figure 1.

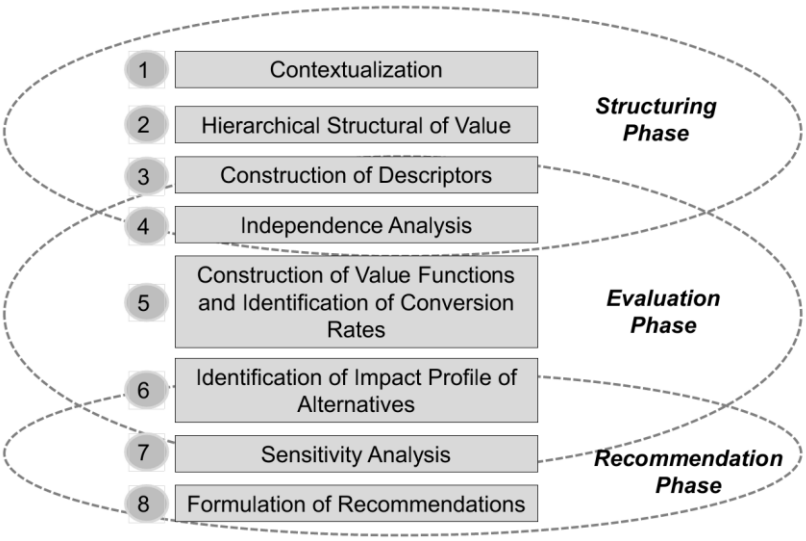

Figure 1 – The phases of the MCDA-C methodology (adapted from Lacerda et al., 2011).

As can be seen in Figure 1, the three phases of the MCDA-C methodology are composed of eight steps.

1. Contextualization: this step is characterized by the generation of knowledge in the context in which the problem is inserted. The goal is to make the decision-making process clearer, contextualizing problems and opportunities to be evaluated. The structuring of the problem consists of recognizing the importance of the environment (boundaries of the problem), the decision-makers, the values (objectives) of those involved, their preferences; and, from there, searching for the alternatives that best suit the situation (Enssilin et al., 2009).
2. Hierarchical Structure of Value: with the facilitator's support, the decision-maker talks about the context and the facilitator can understand the focus of the decision-maker's main concerns. These concerns are transformed into Primary Elements of Evaluation (PEE). Then, each PEE is transformed into a concept that represents the decision-maker's preferences. The concepts are grouped into Areas of Concern, and then the means-end relationship maps are constructed. The Hierarchical Structure of Value (HSV) is composed of Fundamental Points of View (FPV) and Elemental Points of View (EPV). The FPV represents the strategic dimension and the EPV represents the operational dimension. For each element in the lower level of the HVS, a descriptor is constructed.
3. Descriptors: the Descriptors are constructed with the information from the cognitive maps. For the construction of each of the Descriptors, two reference impact levels are defined, "good" and "neutral." These reference levels help in the perception of what actions exceeded the expectations (above "good"), which are within the decision-maker's expectations (between "good" and "neutral") and which fell short of the decision-maker's expectations (below "neutral"). The Descriptors serve as a basis for describing the performance of actions in each FPV. However, when built, Descriptors are based, even at a quantitative performance level, on an ordinal scale, which does not allow the decision-maker to measure all aspects of the model in an integrated way. The qualitative scales of the Descriptors must be transformed into cardinal scales and then integrated. The transformation of the ordinal scale of each descriptor into a cardinal scale is done through the construction of a Value Function.
4. Independence Analysis: to achieve a condition in which the conversion rates are a constant, the criteria must be independent, and must be analyzed before the transformation to a cardinal scale.
5. Construction of Value Functions and Identification of Conversion Rates: the Value Function is used to rank the intensity of preference (difference in attractiveness) between pairs of impact levels or potential actions. In this model, the construction of this Value Function was done through the semantic judgment method, through pair-to-pair comparisons of the attractiveness difference

between the potential actions. This construction is performed using the MACBETH model (Measuring Attractiveness by a Categorical Based Evaluation Technique), implemented in software by Bana and Costa and Vasnick (Bana E Costa et al., 1999; Vansnick 1999; Ensslin et al., 2000). After the conversion of the scales of the Descriptors, the integration of the criteria is accomplished through Substitution Rates. The Substitution Rates are parameters that the decision-makers have judged appropriate to aggregate, in a compensatory way, local performances into global performance. The calculation of these Substitution Rates indicated the percentage of impact represented by each of the Areas of Concern, FPV and EPV in the global performance. In practice, this consists of, by means of a pair-to-pair comparison of fictitious actions, firstly performing an Ordination Matrix — Roberts's Matrix — and, after that, qualitatively defining the intensity of preference between the pairs of fictitious actions, with the assistance of the MACBETH software (Bana E Costa et al., 1999; Vansnick 1999; Ensslin et al., 2000).

6. Identification of the Impact Profile of Alternatives: after the construction of the model, it is possible to identify the evaluation of the performance profile for the case under study. The model constructed shows the result of the performance in numerical and graphic form.
7. Sensitivity Analysis: the objective of this analysis is to compare two or more alternatives in order to obtain a broad view of the stability of each performance alternative.
8. Formulation of Recommendations: the objective of this stage is to identify actions that can improve the performance of the context under analysis and understand the consequences of implementing those actions in their global context.

4 MODEL CONSTRUCTION

This study aims to improve the quality of the licensing service for construction provided by the municipality through the implementation of a management model for the Project Approval Department. All the information related to the problem was obtained through interviews with the decision-maker and others actors involved.

4.1 Structuring phase

Contextualization

The actors involved in this study problem were classified as follows: the decision-maker was the Secretary of the Environment; the interveners were project analysts, work supervisors and supervisory bodies; the facilitator was the study author; and the affected were the engineers and architects who work in the municipality, the entrepreneurs of the municipality, the construction and development companies and the citizens who want to build or legalize their residence.

Hierarchical Structure of Value

The focus of the model according to the decision-maker is to develop a Management Model for Project Approval Departments in City Halls. For this purpose, a total of 70 PEEs were identified during the interviews with the decision-maker. The next step after the identification of the PEE was the concept construction. The four most important PEEs of this research and their associated concepts are shown in Table 1.

Table 1: PEEs and concepts associated

PEE	Concept
Customer Relationship	Having strategies for maintaining a good relationship with the customer
Project Analysis	Ensuring that project analysis is efficient and effective
Internal Routines	Ensuring that the execution of internal routines follows an efficient standard
Structure	Having a good structure to perform tasks

According to the grouping made by the decision-maker, the Areas of Concern for the construction of the model are: Costumer Relationship, Project Analysis, Internal Routines and Structure. The concepts were organized in a top-down structure according to their cause-effect relationships in a means-end map. Figure 2 shows schema for the means-end map for the area of concern "Customer Relationship".

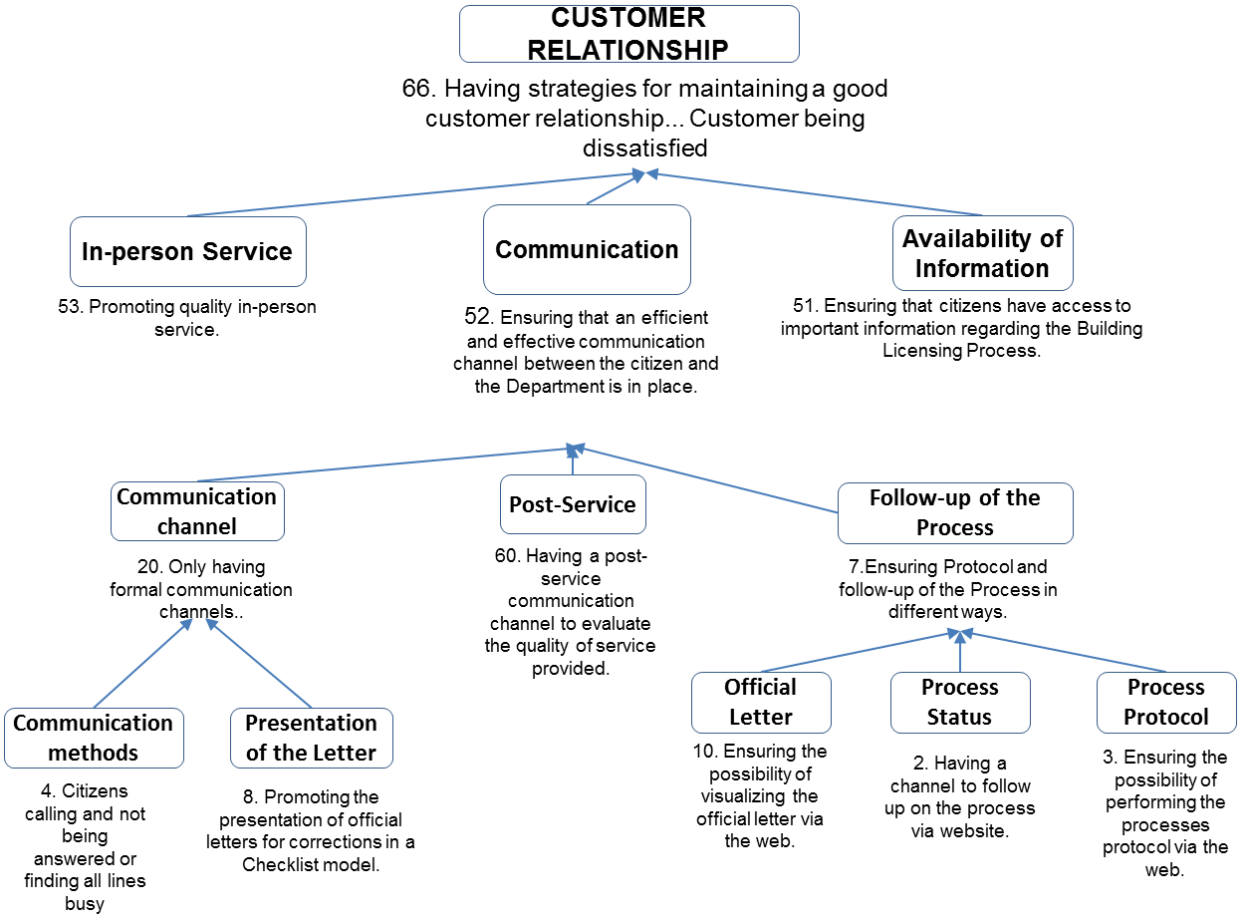

Figure 2 – Means-end map for the area of concern "Customer Relationship"

Hierarchical Structure of Value (HSV) phase is conducted after finalizing the cognitive map. The HSV is composed, at the strategic level, of the Areas of Concern and the Fundamental Points of View, concepts

which cannot be measured. At the operational level, the HSV is composed of the Elemental Points of View, which will later be transformed into Descriptors.

The HSV of this research is composed of 4 Areas of Concern, 12 FPVs, 34 EPVs and 12 sub-EPVs. The composition of each HSV, with their Areas of Concern and FPVs, can be seen in Figure 3.

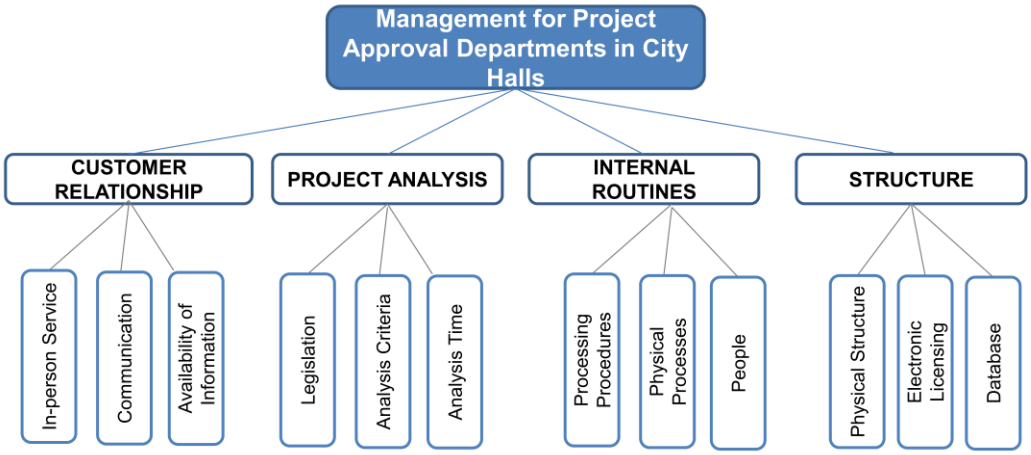

Figure 3 – Means-end map for the area of concern "Customer Relationship"

Descriptors

Following the construction of the model after the decomposition of the FPVs, EPVs and Sub-EPVs comes the construction of the Descriptors. For the elaboration of these Descriptors, the properties defined by Keeney (1992) were used, which propose that the Descriptor must have measurability, operability and comprehensibility. A total of 40 Descriptors were defined for the construction of the model. For the construction of each of the Descriptors, two reference impact levels — "good" and "neutral" — were defined, as shown in Figure 4. These reference levels help in the perception of which actions are in the zone above the expectations of the decision-maker (above "good"), which are within the expectations of the decision-maker (between "good" and "neutral") and which are in the zone below the expectations of the decision-maker (below "neutral"). The Descriptors serve as a basis for describing the performance of actions in each FPV.

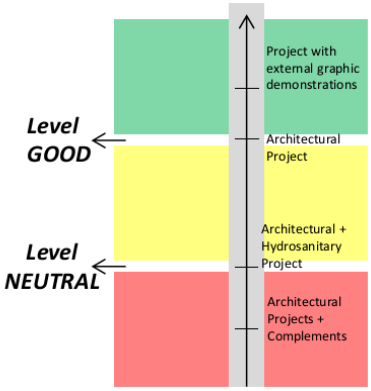

Figure 4 – A descriptor called "Type of Project as Provided by Law/Decree to be submitted for analysis" with two reference impact levels – "good" and "neutral"

Independence Analysis

All Descriptors were tested for mutual preferential independence as described by Keeney (1996) and were found to be mutually preferentially independent.

4.2 Evaluation phase

The Evaluation phase of the model construction consists of quantifying the performance of the potential actions according to the value system of the decision-makers.

Construction of Value Functions and Identification of Conversion Rates

The Descriptors are composed of an ordinal performance scale (qualitative or quantitative). In this phase of the model construction, the ordinal scale of each descriptor was transformed into a cardinal scale through the construction of a Value Function. The Value Functions were calculated in MACBETH software (Measuring Attractiveness by a Categorical Based Evaluation Technique) using the semantic judgment method. Figure 5 shows the calculation of the Value Function for the descriptor "Type of Project as Provided for by Law/Decree."

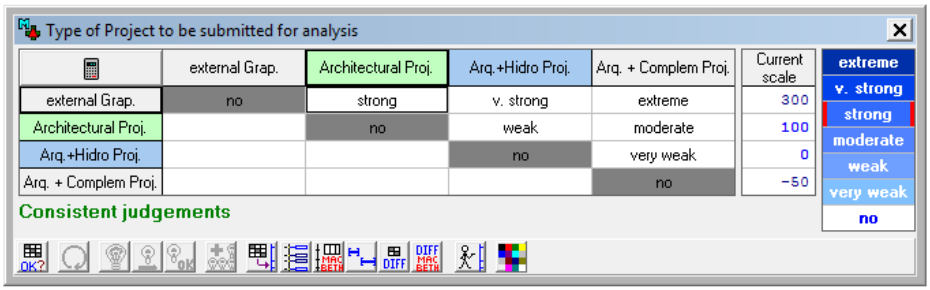

Figure 5 – Calculation of the Value Function for the descriptor "Type of Project as Provided for by Law/Decree"

The calculation of the Value Functions was performed for the 40 Descriptors, and the calculation of the substitution rates was performed for all FPVs and EPVs in this study. As an example, the HSV of the FPV "Disclosure of Information" will be demonstrated, as well as the Descriptors with their respective ordinal and cardinal scales, and the points of view with their substitution rates.

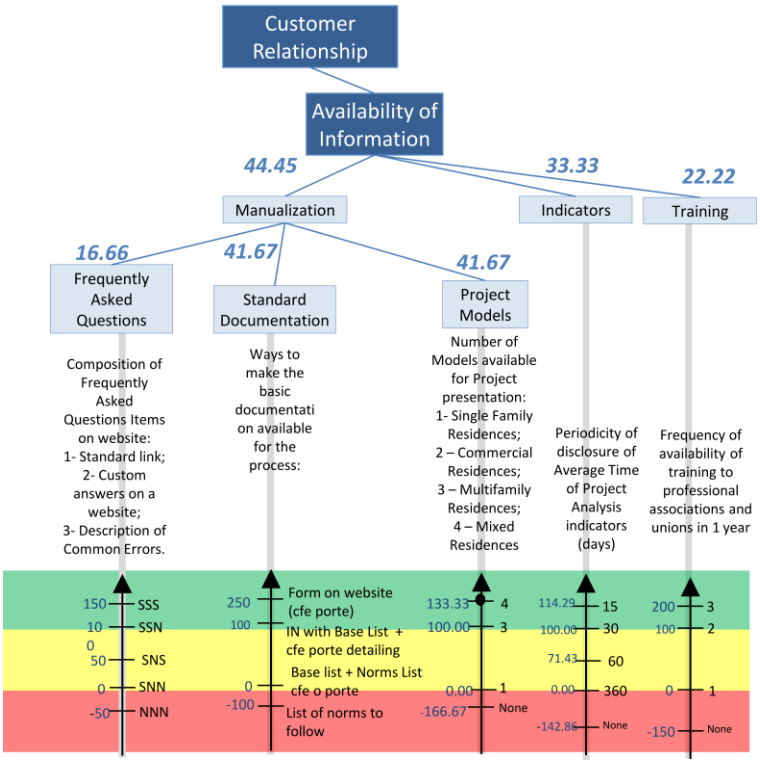

Figure 6 – Calculation Results of the Value Function for the descriptors “Frequently Asked Questions,” “Standard Documentation,” “Project Models,” “Indicators” and “Training” and the Substitution Rates for each FPV and EPV calculated using pair-to-pair comparison of fictitious actions with the assistance of the MACBETH software

According to the calculations made, the general equation of the Project Approval Department Management Model is shown in Equation 4:

Equation 4 – General Equation of the Model

$$VManagement\ for\ Project\ Approval\ Departments = [0{,}28xVCustomer\ Relationship + 0{,}36xVProject\ Analysis + 0{,}12xVInternal\ Routines + 0{,}24VStructure]$$

Identification of the Impact Profile of the Alternatives

The evaluation of the performance profile for the year 2016 (current scenario), which sought to evaluate the current reality of the Project Approval Department of the Joinville City Hall, Brazil was carried out. With the structured model, the performance of each of the model’s objectives could be measured to create a graphical representation of the situation in 2016.

Based on the Scenario Performance Profile outlined for 2016, the absolute value of each EPV, FPV, Area of Concern and Global Value were calculated, according to the equations in the Project Approval Department Management Model of the present case study.

4.3 Recommendation phase

Formulation of Recommendations

The Recommendation phase presented here consists of evaluating the EPVs and FPVs in need of improvement, proposing actions to enhance their performance and evaluating the impact that these improvement actions can bring, if implemented, to the model’s overall performance. By evaluating the

performance profile of this case study for the current scenario (2016), it was possible to identify 10 Descriptors, among the 40 that make up the model, whose performance was below the “Neutral” level and, therefore, in need of improvement.

The focus of this Recommendation phase in the present case study was to design a future scenario in which improvement actions are proposed for Descriptors with performance levels below “Neutral”. The model was simulated by individually providing each of the 10 EPVs with performance levels below “Neutral” with a score of at least “100”, elevating these EPVs to a “Good” performance level or above.Table 2 below shows some examples of actions required to improve the EPVs and what the new performance of the EPVs and FPVs would be after the implementation of these actions.

Table 2: Actions required to improve the EPVs

		New performance	
EPV	Action Needed	Ordinal	Cardinal
Frequently Asked Questions	Implementing the Frequently Asked Questions link, Common Errors Description and Communication channel via the web	SSS	150
Statements	Creating an Ordinance with the Statements/Understandings of the Department of the Environment (Processing Routines+Urbanistic Legislation+Environmental Legislation)	SSS	250
Professional Training	Promoting professional training to analysts and encouraging their participation in lectures	4	100
Electronic Handling	Implementing Electronic Information System for document Protocol and Handling via the web	Electronic (Blueprints + Documents)	175
Furniture	Provide ergonomics furniture and organization in stalls	SSS	150

The simulation of the model with these performance improvements in EPVs resulted in the overall values shown in Table 3.

Table 3: Performance Summary – Current Scenario (2016) and Future Scenario

Current Scenario (2016)	Future Scenario	Areas of Concern	Current Scenario (2016)	Future Scenario	Fundamental Point of View	Previous Scenario (2013)	Current Scenario (2016)
62,22	116,04	Customer Relationship	40,68	69,33	*In-person Service*	34,28	34,28
					Communication	-20,31	43,67
					Availability of Information	-82,19	43,21
		Project Analysis	132,00	174,22	*Legislation*	50,00	183,33
					Analysis Criteria	-13,34	173,31
					Analysis Time	-40,68	39,34
		Internal Routines	8,42	134,84	*Filing Procedures*	-62,50	27,50
					Physical Processes	0,00	130,00
					People	-76,19	-76,19
		Structure	9,57	73,84	*Electronic Licensing*	-50,98	-30,39
					Database	-142,86	0,00
					Physical Structure	-37,50	118,75

5 CONCLUSION

The construction of the Management Model for Project Approval Departments in City Halls was based on the Multiple Criteria Decision Aiding – Constructivist Methodology (MCDA-C). This constructivist methodology has a great advantage over other decision-aiding methodologies, as it includes the active participation of the decision-maker. During the construction of the model, it was possible to assist the decision-maker in identifying their preferences and values regarding the problem to be solved, as well as to increase their knowledge on the issuance approval process

With the construction of the model, the research tem was able to trace the performance profile of the Project Approval Department Management Model for the current scenario (2016), resulting in a Global Value of “62.22” for the model.

In this sense, the third phase of model construction consisted in designing a future scenario, in which the performance of 10 EPVs with a performance level below “Neutral” would improve. The simulation of this performance profile for the future scenario considered the hypothesis that these 10 EPVs would undergo improvement actions, reaching a “Good” performance level or above. The result of this simulation for the Management Model for Project Approval Departments in City Halls was a Global Value of “119.04”, which indicates that the actions planned are efficient, efficacious and effective, as they increase the model’s performance profile to a level of excellence.

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