Systems & Management 10 (2015), pp 623-632

MULTICRITERIA CLASSIFICATION OF THE ORGANIZATIONAL COMMITMENT FACTORS: APPLICATION OF THE UTADIS METHOD

Luis Alberto Duncan Rangel

Fluminense Federal University

Abstract

The objective of this work is the classification of the organizational environment survey items of Petrobras regarding its impact on the organizational commitment according to the preferences of the employees of a managing department. The items classification method of was the multi-criteria decision support to UTADIS, using criteria of the questionnaires of organizational commitment measurement. As a result obtained with the participation of the management staff, six items of total 61 were classified in the high impact group in the organizational commitment. The study showed the applicability of the method to the problem, opening the possibility of investing in other managers of the same company.

Keywords: Multi-criteria decision support; UTADIS method; Organizational commitment.

1. INTRODUCTION

The organizational environment, also known as organizational climate in research in business administration, is considered "an important concept for understanding how the work context affects the behavior and attitudes of people in this environment, their quality of life and performance of the organization "(Martins, 2008).

Among the duties of the Sector of Human Resources (HR) Petrobras is the process of managing organizational environment, which consists in measuring, evaluating and improving the organizational environment of the company with the aim of contributing to the creation of a body of satisfied employees, motivated and committed to company results (Gonçalves, 2011).

To measure the organizational environment, HR annually conducts a survey covering all employees of the company, which is seen by the company as the main instrument for ambience monitoring as part of its strategic planning. The survey consists of four groups (or dimensions), two of which are sources for corporate strategic indicators: of employee satisfaction index (ISE) and level of commitment among employees and the company (NCE).

After analyzing the results of the research and identifying points, the work aimed at improving the ambience are started. These works are conducted by HR teams dedicated to the areas of the company, and are held with employees in order to raise suggestions and requests from these employees on what could improve the ambience of the company. Normally the work method used in the survey is subjective: interviews with each employee (or groups of employees) followed by the empirical analysis of the responses. The result of the work is the consolidation of various requests, which are translated into an action plan accompanied by managers – ambience is a strategic input for the company.

Thus, for this research we used a method to support multi-criteria decision - the UTADIS method, which aims at classifying actions according to the preferences of the employees of a managing department and the criteria identified by the organizational behavior measurement.

Therefore, this research aims at a process for classifying the items of organizational environment survey of PETROBRAS in order to prioritize it in relation to its impact on the organizational behavior of employees, according to their preferences (Devaud *et al.*, 1980).

PROPPI / LATEC
DOI: 10.20985/1980-5160.2015.v10n4.638

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

2. PROBLEM DEFINITION

Held in the management area of Information Technology (IT) of the company, the environment survey has shown results lower than the average of the managements of the same level and also lower than the results of IT aimed at the satisfaction and commitment indicators. This occurred in the last four ambience research carried out, despite the efforts of the HR department and staff in preparing the ambience improvement action plan. In the last research, held in 2011, there was even a reduction in results compared to the previous year (Gonçalves, 2011).

As the survey of employees' requests is performed subjectively in the post-research work, important aspects may be lost during the proposition of the action plan aimed to improve the ambience. The subjectivity of the work may also result in difficulty to realize the importance of the applications identified for the company, that because there is no established criteria to assess the requests of employees. In addition to these issues, it should also be noted that the fact that, even with impartiality and confidentiality guaranteed by the HR staff and employees who assist in the survey work, some employees may not feel comfortable expressing their needs fully.

The inability to perform actions for all requests leads to the establishment of priorities for implementation. It is important for the criteria established to prioritize the subjects of the plan to be related to the company and to the employees, otherwise, even if the improvement actions are successfully executed, the results may not be beneficial for both. It can be exemplified as a hypothetical case the prioritization of actions that are easier to accomplish. In this case, they could have an insignificant reflection on the routine of employees, the company and, consequently, in the search result in the subsequent year.

The result of the environment survey to the management departments in question indicates a low value for the index commitment to the company (Gonçalves, 2011). The organizational commitment is a concept related to the company and employees. Several studies have shown that the result of the organizational commitment growth benefits the company and employees. Meyer *et* Allen (1997) cite several studies showing the following consequences related to increased organizational commitment: reduced employee turnover; reduced absenteeism; improved performance and exertion at work; improved organizational citizenship; and reduced physical and emotional stress. It is noteworthy that the studies cited by Meyer and Allen are correlations evaluated for different dimensions of commitment. Meyer *et al*. (2002) show, by means of the meta-analysis of several studies of the 90s made in North America, the correlations between the dimensions of commitment and its consequences.

In Brazil, Bastos (1993) points out that research shows correlations between the commitment and the reduction of the intention to leave the company and reduction in terms of absence from work (absenteeism), although these are moderated by career training. The commitment-turnover relationship is stronger in the early stages of the career; commitment-absenteeism and impairment-performance are stronger in the intermediate and final stages (Bastos, 1993). Cançado *et al*. (2006) mentions in a study on organizational commitment and human resources management practices that "The commitment must also be understood as a business resource to mitigate losses and damages."

Another fact that should be considered is the multidimensional composition of the organization's commitment, which involves using more than one criterion to evaluate and sort the items in the survey. To perform the classification of items of research in different priority groups was necessary to choose a method to describe the preferences of employees in a transparent manner and which was appropriate to work, considering the various criteria related to organizational commitment.

The multi-criteria support methods for decision provide adequate tools for the problem at hand, since besides the fact that they are focused on the treatment of decision problems involving two or more criteria of choice, they give transparency to the decision-making process with the "documentation" of the preferences of decision makers in a clearly presented model, explaining the decision to be made (Gomes *et al*., 2004).

This study was conducted with employees of a Petrobras manager who participated in the organizational commitment research. Thus, the results are limited to this company's management department. Other results can be obtained by consulting with other managers, as each one is subject to peculiar situations. This methodology, which seeks to provide support to the classification of organizational behavior factors of managing sector, discusses a topic that seeks to improve the management environment.

The objective of the study is to identify the critical factors for increasing organizational commitment among the items measured in the environment survey from the perception of the managing sector's employees through their classification into different priority groups, using the UTADIS method proposed by (Devaud *et al*., 1980). The proposed classification can be used as a basis for discussion between employees and the HR staff in setting priorities for the ambience improvement action plan.

As the secondary objective of the survey, it is possible to create a process of evaluation and prioritization that can be reused in other managing areas of the company.

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

3. BIBLIOGRAPHIC REVIEW

3.1 Multi-criteria classification methods

In the context of Multi-Criteria Decision Aid (MCDA), the most widely used methods for classification problems (Pβ) are families Outranking Relation Theory (ORT) and Multi-Attribute Utility Theory (MAUT), Zopounidis and Doumpos (2002).

The MAUT is an extension of the theory of utility for multidimensional problems (Zopounidis and Doumpos, 2002). These are methods of the American school (Gomes *et al*., 2004), where the preferences of the decision maker are modeled from the utility function U (g) - in which g is the set of the criteria representing the aggregate result of evaluation of alternatives as shown in equations 1 and 2:

$$U(\mathrm{g_x}) > U(\mathrm{g_{x'}}) \Leftrightarrow \mathrm{x} \succ \mathrm{x'}\ (\text{alternative x is preferable to x'}) \quad (1)$$

$$U(\mathrm{g_x}) = U(\mathrm{g_{x'}}) \Leftrightarrow \mathrm{x} = \mathrm{x'}\ (\text{alternative x is indifferent to x'}) \quad (2)$$

The ORT methods for overcoming relationship are methods of the European school (Gomes *et al*. 2004) and they are based on overcoming relations (S) that are binary between alternatives to indicate whether an alternative is at least as good as the other; for example, for $\mathrm{x}S\mathrm{x'}$ it is necessary that x is at least as good as $\mathrm{x'}$.

The methods Preference Disaggregation Analysis (PDA) seek to form a model that represents as closely as possible the preferences of decision makers from decisions made by them earlier. Opposed to the process used in MAUT and ORT methods, decision makers do not participate in modeling informing the parameters required to make up the model, they only state their decisions and the method searches the relationship between them and the evaluation factors (criteria). PDA methods were based on the principle that it is usually difficult to raise the necessary information for setting and defining the model along with the decision makers, due to decision maker's time constraints and unavailability to actively participate in the development process (Doumpos *et* Zopounidis, 2002).

Among the multi-criteria support methods for the PDA family decision used for classification problems are the UTADIS methods, its variants and the MHDIS method of Zopounidis *et* Doumpos (2000).

The Discriminating Additive Utility method (*UTilitès Additives DIScriminantes* – UTADIS), first presented by Devaud *et al*. (1980), is a variant of the method UTA (*UTilitès Additives* - Additive utility), of Jacquet *et* Lagrèze-Siskos (1982). According to Campos *et* Zopounidis (2002), the method has become of interest to the MCDA researchers during the 90's, and it was used in 1995 by Jacquet-Lagrèze for evaluation of the R&D projects and, from 1997, it was widely used for classification in decision-making models for finance in various jobs such as Zopounidis *et* Doumpos (1997, 1998, 1999) and Zopounidis *et al*. (1999a, 1999b). During the 2000s, the method continued to be used with the proposal of new variants such as UTA-CR, Gomes *et* Rangel (2000), Rangel (2002), Araya *et al*. (2002), Rangel *et al*. (2003), Gomes *et* Rangel (2009) and UTADISGMS, Greco *et al.* (2010).

The goal of the method is to perform the classification of alternatives in q foreordained groups, $C_1 \succ C_2 \succ \ldots \succ C_q$ by means of an additive utility function, where, from the function result for each alternative it is assigned to the groups so that those with greater result remain in the group C1 and those with lower values in C_q. The additive utility function is expressed as follows (Equation 3):

$$U(\mathbf{g}) = \sum_{i=1}^{n} p_i u_i(g_i) \quad (3)$$

where $\mathbf{g} = (g_1, g_2, \ldots, g_n)$ is the assessment vector for each criterion, p_i is the weight of each criterion and $u_i(g_i)$ is the marginal utility function for the g_i criterion. The marginal utility functions are increasingly monotonous ranging from g_{i^*} to g_{i^*}, where g_{i^*} is the lowest evaluation value of the alternatives in the criteria g_i and g_{i^*} is the highest assessment value in terms of alternatives on the same criteria.

The marginal utility functions can be linear or nonlinear and provide a mechanism for transforming the scale of the criteria in a new scale that represents the utility function of the decision maker for each criterion, with the advantage of allowing the modeling of the nonlinear behavior of the decision maker when evaluating the options and the advantage of providing a methodology by means of a regression model to convert a qualitative scale into a quantitative scale (Doumpos *et* Zopounidis, 2002). The classification of the alternatives is given by equation 4:

$$\left.\begin{array}{ll} U(\mathbf{g}_j) \geq u_1 & \Rightarrow \mathbf{x}_j \in C_1 \\ u_1 > U(\mathbf{g}_j) \geq u_2 & \Rightarrow \mathbf{x}_j \in C_2 \\ \ldots & \\ u_{q-1} > U(\mathbf{g}_j) & \Rightarrow \mathbf{x}_j \in C_q \end{array}\right\} \quad (4)$$

The modeling process of multi-criteria supporting problem for decision in the UTADIS consists of defining the criteria weights (p_i), the marginal utility functions ($u_i(g_i)$) and the limit values between the groups (u_i) from minimizing the misclassification of an alternative subset, called reference set, which are pre-classified by the decision maker and are used for linear programming techniques. Once the classification of the reference set by the model is consistent with the classification made by the decision maker, the model is used to classify the remaining alternatives.

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

The mathematical formulation of the linear programming problem (LPP) is obtained after the application of the changes proposed by Doumpos *et* Zopounidis (2002) and Siskos *et* Yannacopoulos (1985), in which the marginal utility functions of each criterion are made by adding functions linear rji-1 intervals. The objective function of the mathematical model is shown in Equation 5, and the model constraints are shown in equations 6 to 12:

$$\text{Min}\left\{\sum_{k=1}^{q}\left[\frac{\sum_{\forall \mathbf{x}_j \in C_k}\left(\sigma_j^+ + \sigma_j^-\right)}{m_k}\right]\right\} \quad (5)$$

Subject to:

$$\sum_{i=1}^{n}\left(\sum_{p=1}^{r_{ji}-1} w_{ip} + \frac{g_{ji} - g_i^{r_{ji}}}{g_i^{r_{ji}+1} - g_i^{r_{ji}}} w_{ir_{ji}}\right) - u_1 + \sigma_j^+ \geq \delta_1, \forall \mathbf{x}_j \in C_1 \quad (6)$$

$$\left.\begin{array}{l}\sum_{i=1}^{n}\left(\sum_{p=1}^{r_{ji}-1} w_{ip} + \frac{g_{ji} - g_i^{r_{ji}}}{g_i^{r_{ji}+1} - g_i^{r_{ji}}} w_{ir_{ji}}\right) - u_k + \sigma_j^+ \geq \delta_1 \\ \sum_{i=1}^{n}\left(\sum_{p=1}^{r_{ji}-1} w_{ip} + \frac{g_{ji} - g_i^{r_{ji}}}{g_i^{r_{ji}+1} - g_i^{r_{ji}}} w_{ir_{ji}}\right) - u_{k-1} - \sigma_j^- \leq -\delta_2\end{array}\right\}, \forall \mathbf{x}_j \in C_k (2 \leq k \leq q-1) \quad (7)$$

$$\sum_{i=1}^{n}\left(\sum_{p=1}^{r_{ji}-1} w_{ip} + \frac{g_{ji} - g_i^{r_{ji}}}{g_i^{r_{ji}+1} - g_i^{r_{ji}}} w_{ir_{ji}}\right) - u_{q-1} - \sigma_j^- \leq -\delta_2, \forall \mathbf{x}_j \in C_q \quad (8)$$

$$\sum_{i=1}^{n}\sum_{p=1}^{a-1} w_{ip} = 1, \quad (9)$$

$$u_k - u_{k+1} \geq s, \forall k = 1, 2, ..., q-2 \quad (10)$$

$$\sigma_j^+ \geq 0, \sigma_j^- \geq 0, \forall j = 1, 2, ..., m \quad (11)$$

$$w_{ip} \geq 0, \forall i = 1, 2, ..., n, \forall p = 1, 2, ..., a-1 \quad (12)$$

The error is obtained by the equations 13 and 14:

$$\sigma_j^+ = \max\left\{0, u_k - U(\mathbf{g}_j)\right\}, \quad \forall \mathbf{x}_j \in C_k, k = 1, 2, ..., q-1 \quad (13)$$

$$\sigma_j^- = \max\left\{0, U(\mathbf{g}_j) - u_{k-1}\right\}, \quad \forall \mathbf{x}_j \in C_k, k = 2, 3, ..., q \quad (14)$$

The σ_j^+ means that the alternative $\mathbf{x}_j$ was ranked in a group under which it belongs to, and so that it is classified correctly, the function value $U(\mathbf{g}_j)$ should increase by $u_k - U(\mathbf{g}_j)$. Similarly, σ_j^- means that the alternative $\mathbf{x}_j$ was classified in a group to which it belongs. For it to be classified correctly, the function value $U(\mathbf{g}_j)$ should decrease by $U(\mathbf{g}_j) - u_{k-1}$..

3.2. The method choice

The problem at hand has as its characteristic a large number of alternatives to be categorized: there are 76 options, which were reduced to 61 to be classified by six criteria in three groups, according to the modeling of the problem which will be presented in section 4. For using an ORT method such as ELECTRE TRI, it would be necessary to conduct 242 paired reviews among the alternatives and profiles of the classification groups, for each criterion, leading to a total of 1,452 ratings considering all six criteria. Besides working harder to carry out the evaluations of the alternatives, the decision maker must actively participate in defining the parameters for the model development process. Another feature of the problem is the large number of decision-makers, who are all employees of the managing sector in question. There would be some difficulty in achieving the dedication of all of them in order to determine all the parameters of the model, due to term issues for the conclusion of the study, as the reconciliation of the agendas of them all.

As previously mentioned, the PDA methods assume that it is usually difficult to raise the necessary information to create the model and, in this case, this difficulty becomes clear. Considering this purpose of the PDA methods exposed by Doumpos *et* Zopounidis (2002) and the smallest quantity of necessary evaluations to be carried out by decision makers, 366 (61 alternatives per six criteria), the UTADIS Preference Disaggregating method was chosen to perform the classification.

4. CASE STUDY

4.1 Criteria

The evaluation criteria of the alternatives were defined from the basic concepts of the organizational commitment theories and its constructs.

The work commitment and especially the organizational commitment are the most investigated constructs in the area of the organizational behavior (Smith *et al*., 2008).

Among the most widespread theories in terms of the nature of organizational commitment is the model of three components of Meyer *et* Allen (1991). According to Medeiros (2003), the largest contribution of Meyer *et* Allen was the operationalization of existing theories, developing a series of tools for the study of organizational commitment. The three components proposed by Meyer *et* Allen are: Affective, Normative and Continuity.

To define the criteria, the most used questionnaires were analyzed, according to Smith *et al*. (2008), to measure the organizational commitment: EBACO, proposed

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

by Medeiros (2003); ECOA (Affective Commitment Scale), proposed by Smith *et al*. (2008) from the adaptation of the questionnaire proposed by Meyer *et* Allen (1997); ECON (Normative Commitment Scale), proposed by Smith *et al* (2008) from the adaptation of the questionnaire proposed by Meyer *et* Allen (1997); ECOC (Continuity Commitment Scale), proposed by Smith *et al* (2008) from the adaptation of the questionnaire proposed by Meyer *et* Allen (1997).

It was found that the criteria relating to continuity commitment were redundant with the ambience survey questions, which assesses employee satisfaction in relation to financial and professional benefits. It did not make sense to use these criteria to assess other survey items.

According to the large number of questions in these questionnaires, it would not be possible to have a criterion for each question. Following the recommendation to avoid using more than nine criteria regarding problems that utilize the additive utility functions, thus providing a manageable number of criteria (Gomes *et al*., 1992), an analysis on the questions was performed and three criteria have been proposed for the Affective and Normative bases, reaching a total of six criteria.

This research had the participation of employees of a Petrobras managing sector for data collection. And the importance in terms of the criteria was defined in consensus with a group of decision makers.

For the purpose of the proposed classification, it was decided to give equal weights to the criteria, considering only the marginal utility functions of each criterion as a decision maker's preference predictor in terms of the classification of alternatives regarding the criteria.

4.2 Alternatives

The ISE in the environment survey consists of 76 items, divided into 11 groups, such as Leadership (fifteen items), Benefits (five items) and Team Spirit (six items), for example.

The alternatives to be sorted are the environment survey items being evaluated under six criteria defined in the previous item. However, some items are closely related or, in some cases, are very generic in relation to the other in order to be used as a reference to an action plan.

To address this issue, a heuristic analysis of alternatives was carried out based on the method presented by Gomes *et al*. (1992) for heuristic minimization of the interdependence between criteria.

After the analysis fifteen items were excluded, leaving 61 that formed the alternatives to be sorted through the UTADIS method.

4.3 Data collection

As described above, the application of the UTADIS method is necessary for decision-makers (in this case, the management staff) to conduct the evaluation of alternatives according to the criteria and classify a subset of alternatives that will be used as a set of references for disaggregation of their preferences.

For this, a questionnaire was created in two parts. The first was used to evaluate the alternatives according to the criteria. Each criterion was built in the form of a statement that should be evaluated by the employee, stating how much he would agree with the period considering the impact of an improvement in their satisfaction in each alternative. To measure the degree of agreement a Likert scale with five values, ranging from "1 - strongly disagree" to "5 - strongly agree" (Gonçalves, 2011) was used.

In the second part of the questionnaire, for the formation of the reference set rated by decision makers it was requested that each one classified three to five alternatives in each priority classification group: high, medium or low.

The alternatives classified as high priority would be those which, in the employee's opinion, should be in the action plan for considering its high impact in their organizational commitment. Those classified as medium priority could enter the action plan, but would not have much impact. Finally, the low priority ones should not enter the action plan for not having any link with its organizational commitment, according to its own judgment.

The questionnaires were presented and submitted to all 48 employees of the management. Only 18 were answered, representing 38% of the total. For term issues the method was performed only with the participation of these employees.

4.4 Method Application

The final matrix for the evaluation of the alternatives according to the criteria, presented in table 1 was calculated from the simple average of the ratings of decision-makers. Values g_{i^*} and g_i^* for each criteria are shown in table 2.

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

Table 1. Mean values of the assessments of the alternatives for each criterion.

Alt.	Criteria					
	1	2	3	4	5	6
1	2,333	2,500	2,333	1,611	1,056	1,111
2	4,111	3,222	3,278	2,667	1,278	1,611
3	3,444	2,611	2,667	2,889	1,556	1,889
4	3,444	2,833	2,778	2,667	1,611	1,944
5	3,000	3,167	2,833	1,500	1,278	1,278
6	2,778	2,778	2,667	1,667	1,500	1,500
7	3,056	2,778	3,000	1,333	1,278	1,167
8	3,222	3,278	2,889	1,556	1,444	1,389
9	3,667	4,222	3,056	1,944	2,111	2,778
10	3,833	4,167	3,167	2,333	2,111	2,500
11	3,889	4,222	3,667	1,889	1,889	2,611
12	4,056	4,333	3,444	2,000	1,778	2,389
13	3,167	3,889	2,667	1,444	1,278	1,444
14	3,667	3,833	2,944	1,556	1,500	2,000
15	4,278	4,611	3,944	2,444	2,556	2,333
16	3,444	4,000	3,222	2,611	1,889	2,056
17	4,167	4,167	3,500	2,889	2,500	2,167
18	3,667	3,667	3,167	2,389	2,000	2,111
19	3,889	4,222	3,444	2,667	2,333	2,611
20	3,778	3,389	3,611	2,222	2,000	2,556
21	3,778	3,722	3,611	1,944	2,056	2,111
22	3,333	3,444	3,167	2,222	1,889	2,000
23	3,333	3,444	3,111	2,056	1,833	2,000
24	3,889	3,667	3,222	2,333	2,111	2,444
25	3,722	4,000	3,278	2,500	2,056	2,333
26	3,000	2,333	3,278	1,833	1,500	1,611
27	4,000	4,222	3,611	2,611	2,667	2,722
28	2,833	2,667	2,833	2,000	1,667	1,611
29	2,778	2,556	2,667	1,833	1,556	1,611
30	4,278	4,000	3,778	2,778	2,278	2,389
31	4,667	4,500	4,167	3,278	3,444	2,833
32	3,944	3,667	4,056	2,556	2,389	2,056
33	4,333	4,056	4,056	3,556	2,889	2,722
34	4,833	4,167	3,833	3,167	2,889	2,611
35	4,500	3,722	3,722	3,056	2,944	2,722
36	4,222	4,167	3,889	2,778	3,278	2,944
37	4,278	3,944	3,611	3,667	3,000	2,889
38	4,278	3,833	3,556	3,611	2,889	2,667
39	3,278	3,000	3,000	1,944	1,667	1,500
40	2,444	2,167	2,556	1,667	1,389	1,389
41	3,000	2,222	3,000	1,500	1,611	1,444
42	3,111	2,611	2,833	2,111	1,611	1,611
43	3,889	3,167	3,444	3,556	2,444	2,500
44	2,944	2,333	3,389	1,889	1,889	1,833
45	4,556	4,000	3,889	4,167	3,333	3,056
46	3,500	3,722	3,500	3,056	2,500	2,556
47	3,778	3,500	3,833	3,278	2,667	2,611
48	4,167	3,556	3,722	3,389	2,833	2,500
49	3,111	2,389	3,333	1,667	1,667	1,500
50	3,889	3,444	3,611	3,000	2,167	2,000
51	3,222	3,444	3,389	2,333	2,389	2,222
52	2,389	2,167	2,778	1,444	1,278	1,278
53	3,444	2,889	3,556	1,833	1,889	2,000
54	2,444	2,667	2,444	1,556	1,389	1,500
55	3,389	3,722	3,556	2,111	2,389	1,889
56	3,222	2,833	2,833	2,111	1,722	1,667
57	3,278	2,944	3,167	2,333	1,611	1,500
58	2,333	2,056	2,722	1,167	1,111	1,111
59	3,500	3,056	3,333	1,722	1,722	1,611
60	2,889	2,944	2,889	1,667	1,722	1,556
61	4,444	4,444	4,389	2,111	2,167	2,056

Source: Authors.

Table 2. Minimum and maximum values of the criteria alternative evaluations.

Criterion	g_i^*	
1	2,333	4,833
2	2,056	4,611
3	2,333	4,389
4	1,167	4,167
5	1,056	3,444
6	1,111	3,056

Source: Authors.

To form the reference set the five most indicated alternatives by the decision makers were chosen in each priority group. Should there be a tie exceeding the limit of five alternatives per group, the choice would be made at random among the most indicated ones. In choosing the reference set, the existence of alternatives dominated by others which were classified in a lower group was also observed, thus avoiding inconsistencies. Only one had to be replaced in the dominance analysis. The final reference set can be seen in table 3.

After all, we applied the algorithm HEUR 2proposed by Doumpos *et* Zopounidis (2002) to establish the limits of subintervals to approximate the marginal function. The values are shown in table 4.

Once the parameters are determined, the linear programming problem can be described in the format shown

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

in equations 5 to 14. One more constraint (Equation 15) was added to force equal weights between criteria:

$$\sum_{p=1}^{a-1} w_{ip} = 1/6, \forall i = 1, 2, ..., 6 \quad (15)$$

To solve the linear programming problem the free version of the GAMS software was used. The free version limits the number of variables and other parameters that may exist in the problem; in this case the problem was within the limits of version. The parameters δ and S received the values 0.01 and 0.1 respectively.

Table 3. Reference set alternatives.

High priority (C_1)	Medium priority (C_2)	Low priority (C_3)
X_{31}	X_{12}	X_{26}
X_{33}	X_{20}	X_{41}
X_{34}	X_{38}	X_{44}
X_{36}	X_{39}	X_{49}
X_{61}	X_{45}	X_{52}

Source: Authors.

Table 4. Intervals and limiting values between them.

Criterion	$a-1$	g_i^1	g_i^2	g_i^3	g_i^4
1	3	2,333	3,000	4,222	4,833
2	3	2,056	2,389	4,056	4,611
3	3	2,333	3,333	3,833	4,389
4	3	1,167	1,833	2,222	4,167
5	3	1,056	1,667	2,167	3,444
6	3	1,111	1,611	2,611	3,056

Source: Authors.

The results for the variables u_1 and u_2 were 0.682 and 0.220 respectively. The values for the variables w and σ, as well as the generated classification are shown in tables 5 and 6.

Table 5. Values of variables w.

Criterion	w_1	w_2	w_3
1	0	0,146	0,021
2	0	0	0,167
3	0	0	0,167
4	0	0,167	0
5	0,149	0	0,017
6	0	0,167	0

Source: Authors.

Table 6. Classification of reference set of alternatives and error values.

$\mathbf{x}_j$	Classification of decision makers	Classification proposed by the model	$U(\mathbf{g}_j)$	σ^+	σ^-
X12	Média	Média	0,559	0	0
X20	Média	Média	0,566	0	0
X26	Baixa	Baixa	0,108	0	0
X31	Alta	Alta	0,894	0	0
X33	Alta	Alta	0,708	0	0
X34	Alta	Alta	0,692	0	0
X36	Alta	Alta	0,693	0	0
X38	Média	Média	0,640	0	0
X39	Média	Média	0,230	0	0
X41	Baixa	Baixa	0,135	0	0
X44	Baixa	Baixa	0,210	0	0
X45	Média	Média	0,672	0	0
X49	Baixa	Baixa	0,162	0	0
X52	Baixa	Baixa	0,054	0	0
X61	Alta	Alta	0,779	0	0

Source: Authors.

After classification of all the alternatives generated by the model, those selected for the high-priority group can be seen in Table 7.

Table 7. Alternatives classified in the C1 group.

Alternative	U(Xj)
X15	0,789
X31	0,894
X33	0,708
X34	0,692
X36	0,693
X61	0,779

Source: Authors.

4.5 Post-optimization analysis

For the post-optimization analysis, the results obtained by changing the parameter δ to the values 0.001, 0.005, 0.05 and 0.1 were tested, reducing and increasing the difference between the values of the global functions of the alternatives and the thresholds in order to vary the separation of the sets.

For the results obtained from the reduced values of δ (0.001 and 0.005), there was only one difference in the classification regarding the alternative 28, which changed from the medium-priority group to the low-priority group.

Only three differences were obtained as results to δ =0.05 compared to the generated classification δ=0.01, and

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

a wrongly classified alternative, the X_{45}. On the other hand, the results for δ=0.1 presented changes in terms of the classification of ten alternatives; two alternatives to the reference set were classified incorrectly: X_{39} and X_{45}.

In all cases, the alternatives initially classified as high priority remained in the same group.

Despite the fact that the X_{45} alternative was the one that had more indications for medium priority (seven indications, or 39% of the possible indications) also received five indications (28%) of high priority and high ratings. This made the cutoff value aimed at differentiating the alternatives of high and medium priority group too high.

In addition to the parameter δ, the number of intervals of the marginal utility functions has also varied, increasing the number of *w* variables of each criterion to four and five. The greater number of intervals helps to improve the approximation of the marginal function, increasing the ability of the model to adapt to the reference set. Moreover, there is an increased degree of freedom of the model, bringing greater instability to it (Doumpos *et* Zopounidis, 2002).

Compared to the first result, the classification of four w variables for each criterion had difference in seven alternatives, including changes in the high priority group. With five *w* variables, there were only four variations, but also including changes in the classification of the high priority group.

To assist in the post-optimization analysis and considering the simplicity of the problem, a program that tests the error obtained in all value combinations for the *w* variables from fixed increments was developed.

Thus, considering the increase of 0.06 optimal solutions with zero error in the three-variable model *w* were discovered in each criterion. One of them was identical to the one obtained by the linear programming and the other with only one difference: the alternative X_{59} moved from the low-priority group to the medium-priority group.

As for the model with five w variables, 304 solutions with zero error in the classification in terms of the reference set were found. Of these, the number of alternatives classified as high-priority group ranged from 5 to 12, which illustrates the increase in terms of the instability of the model with the increased number of intervals described by Doumpos *et* Zopounidis (2002).

Only the five alternatives of the reference set that were classified as high priority remained in the same group in all 304 solutions. The X_{15} alternative was in the C_1 group in 84% of the 304 solutions.

As the main objective of this work is to indicate which environment survey items are priorities in the preference of employees, the proposed model with the initial parameters already presents a satisfactory answer to be presented to the HR team in order to discuss activities to improve the ambience, increasing the focus on six issues classified as priority in the initial solution.

5. CONCLUSIONS AND RECOMMENDATIONS

The classification of the alternatives met the objective of the study, indicating the preference of the decision makers surveyed in relation to the items considered priorities for improving organizational commitment. As a result for the employees, it was obtained a transparent way to explain their needs without exposing anyone. Another benefit is that the method provides an easier understanding regarding the use of interviews on how their preferences have been consolidated.

For the company, in line with the ambience management process, the proposed methodology makes it possible to have a kind of standardized methodology in order to prioritize the action plan that could be applied to other managers, showing the preferences of the employees of each one. The results can be consolidated too, presenting a model of preferences at various levels of management and allowing for the prioritization of issues relevant to a broader scope. However, it should be clear that the use of the method is only an input to define the improvement action plan for the ambience, which seeks to enrich and complement the results obtained with other methods already used in the survey of employee needs. With this, the above secondary objective at the beginning of the work was also achieved.

One difficulty identified in the implementation of the UTADIS method was the strong subjectivity in the evaluation of the criteria, which is an inherent feature of the MCDA methodology, where the situation does not fit into a perfect formalism (Gomes *et al*., 2004). Another problem was the large number of alternatives that together led to greater complexity in terms of the explanation and application of the questionnaire and, consequently, an increase in the commitment of time required by decision-makers in the construction of the model. Thus obtaining the answers to all the employees of the managing sector was not possible within the time available to complete this work.

It was found that there are no studies that employ multi-criteria support methods for the decision in terms of the construction of the action plan for ambiance improvement for the manager concerned in the company. For future research, we suggest the use of other methods to support the multi-criteria classification for decision, as the ELECTRE TRI

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

(Yu, 1992) method, and the comparison of results. Another proposal is to analyze new methods to make the set of model reference.

From a model used in this process it is important to periodically measure the commitment of employees through questionnaires that have already been validated in previous studies on organizational commitment in order to monitor the result of the implementation of improvement actions derived from the study performed. Based on the results of the organizational commitment measures, the criteria used in the model should be reviewed so that they can be reapplied each time, seeking constant improvement of the management indices.

REFERENCES

Araya, M.C.G., Rangel, L.A.D., Lins, M.P.E., e Gomes, L.F.A.M. (2002), "Building the additive utility functions for CAD-UFRJ evaluation staff criteria", *Annals of Operations Research*, Vol. 116, No. 1, pp. 271-288.

Bastos, A.V.B. (1993), "Comprometimento organizacional: um balanço dos resultados e desafios que cercam essa tradição de pesquisa", *Revista de Administração de Empresas*, Vol. 33, No. 3, pp. 52-64.

Cançado, V.L., Moraes, L.F.R., e Silva, E.M. (2006), "Comprometimento organizacional e práticas de gestão de recursos humanos: o caso da empresa XSA", *Revista de Administração Mackenzie*, Vol. 7, No. 3, pp. 11-37.

Coetsee, L. (2011), Peak performance and productivity: a practical guide for the creation of a motivating climate*,* Ons drukkers, Potchefstroom, South Africa.

Devaud, J.M., Groussaud, G., Jacquet-Lagrèze, E. (1980), UTADIS: Une méthode de construction de fonctions d'utilité additives rendant compte de jugements globaux*.* European Working Group on Multicriteria Decision Aid, Bochum, Germany.

Doumpos, M. *et* Zopounidis, C. (2002), Multicriteria Decision Aid Classification Methods*,* Kluwer Academic Publishers, . New York, NY.

Duffy, R.D., Bott, E.M., Allan, B.A., Torrey, C.L., Dik, B.J. (2012), "Perceiving a calling, living a calling, and job satisfaction: testing a moderated, multiple mediator model", *Journal of Counseling Psychology*, Vol. 59, No. 1, pp. 50-59.

Ehrgott, M., Figueira, J.R., Greco, S., editors (2010), Trends in Multiple Criteria Decision Analysis*,* Springer, New York, NY.

GAMS (2011), The General Algebraic Modeling System (GAMS) - GAMS Development Corporation, disponível em: http://www.gams.com (Acesso em 03 de Fevereiro de 2016).

Gomes, L.F.A.M., Araya, M.C.G., Carignano, C., (2004), Tomada de Decisões em Cenários Complexos: introdução aos métodos discretos do apoio multicriterio à decisão*,* Thomson Learning, São Paulo, SP.

Gomes, L.F.A.M., Damázio, H.N., Araújo, G.M. (1992), Minimização heurística da interdependência entre critérios no auxílio multicritério à decisão - uma aplicação à decisão sobre seguro ambiental para transporte rodoviário de produtos perigosos, relatório técnico, Departamento de Engenharia Industrial da PUC, Rio de Janeiro, RJ.

Gomes, L.F.A.M. *et* Rangel, L.A.D. (2009), "Determining the utility functions of criteria used in the evaluation of real estate", *International Journal of Production Economics,* Vol. 117, No. 2, pp. 420-426.

Gomes, L.F.A.M. *et* Rangel, L.A.D. (2000), "Emprego do Método UTA para determinar as funções de utilidade a partir de critérios usados na avaliação de alternativas de padronização de transportadores de correia", apresentado em XXXII SBPO 2000: Simpósio Brasileiro de Pesquisa Operacional, Viçosa, MG, 18-20 de Outubro de 2000, pp. 111-120.

Gonçalves, M.E.L. (2011), Classificação multicritério dos fatores de comprometimento organizacional: uma aplicação do método UTADIS, Dissertação de Mestrado em Administração, Faculdades Ibmec, Rio de Janeiro, RJ.

Greco, S., Mousseau, V., Słowiński, R. (2010), „Multiple criteria sorting with a set of additive value functions", *European Journal of Operational Research*, Vol. 207, No. 4, pp. 1455-1470.

Jacquet-Lagrèze, E. (1995), "An application of the UTA discriminant model for the evaluation of R & D projects", em Pardalos, P., Siskos, Y, Zopounidis, C., editors, *Advances in Multicriteria Analysis,* Kluwer Academic Publishers, Dordrecht, pp. 203-211.

Jacquet-Lagrèze, E., *et* Siskos, J. (1982), "Assessing a set additive utility functions for multicriteria decision making The UTA method", *European Journal of Operational Research*, Vol. 10, No. 2, pp. 151-164.

Martins, M.C.F. (2008), "Clima organizacional", em Siqueira, M.M.M., organizador, Medidas do Comportamento Organizacional: ferramentas de diagnóstico e de gestão*,* Artmed, Porto Alegre, RS, pp. 29-40.

Medeiros, C.A.F., Albuquerque, L.G., Siqueira, M., Marques, G.M. (2003), "Comprometimento Organizacional: o Estado da Arte da Pesquisa no Brasil", *Revista de Administração Contemporânea*, Vol. 7, No. 4, pp. 187-209.

Meyer, J.P., *et* Allen, N.J., (1991), "A three-component conceptualization of organizational commitment", *Human Resource Management Review*, Vol. 1, No. 1, pp. 61-89.

_____ (1997), *Commitment in the Workplace: Theory, Research, and Application*, SAGE Publications, Thousand Oaks.

Meyer, J.P., Stanley, D.J., Herscovitch, L., Topolnytsky, L. (2002), "Continuance, and normative commitment to the organiza-

Electronic Journal of Management & System
Volume 10, Number 4, 2015, pp. 623-632
DOI: 10.20985/1980-5160.2015.v10n4.638

tion: a meta-analysis of antecedents, correlates, and consequences", *Journal of Vocational Behavior*, Vol. 61, No. 1, pp. 20-52.

Rangel, L.A.D. (2002), Determinação de funções de utilidade através das preferências dos decisores sobre o conjunto de critérios empregando o método UTA, Tese de doutorado em Engenharia de Produção, Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ.

Rangel, L.A.D., Gomes, L.F.A.M., Lins, M.P.E., Fuks, S. (2003), "Avaliação dos programas de pós-graduação em engenharia da UFRJ empregando uma variante do método UTA", *Pesquisa Operacional*, Vol. 23, No. 2, pp. 285-299.

Roy, B. *et* Bouyssou, D. (1993), Aide Multicritére à la Décision: Méthodes et Cas, Economica, Paris.

Siqueira, M.M.M. (2008), Medidas do Comportamento Organizacional: ferramentas de diagnóstico e de gestão, Artmed, Porto Alegre, RS.

Siskos, Y., *et* Yannacopoulos, D. (1985), "UTASTAR, an ordinal regression method for building additive value functions", *Investigação Operacional*, Vol. 5, No. 1, pp. 39-53.

Yu, W. (1992), ELECTRE TRI – Aspects Méthodologiques et Guide d'Utilisation, Document du LAMSADE, 74, Université de Paris – Dauphine, Avril.

Zopounidis, C., *et* Doumpos, M. (1997), "A multicriteria decision aid methodology for the assessment of country risk", *European Research on Management and Business Economics*, Vol. 3, No. 3, pp. 13-33.

Zopounidis, C., *et* Doumpos, M. (1998), "Developing a multicriteria decision support system for financial classification problems: The FINCLAS system", *Optimization Methods and Software*, Vol. 8, No. 3-4, pp. 277-304.

_____ (1999), "Business failure prediction using UTADIS multicriteria analysis", *Journal of the Operational Research Society*, Vol. 50, No. 11, pp. 1138-1148.

_____ (2000), "Building additive utilities for multi–group hierarchical discrimination: The MHDIS method", *Optimization Methods and Software*, Vol. 14, No. 3, pp. 219-240.

_____. (2002), Multicriteria classification and sorting methods: a literature review, *European Journal of Operational Research*, Vol. 138, No. 2, pp. 229-246.

Zopounidis, C., Doumpos, M., Zanakis, S., (1999), "Stock evaluation using a preference disaggregation methodology", *Decision Sciences*, Vol. 30, No. 2, pp. 313-336.

Zopounidis, C. et Pardalos, P.M., editors (2010), Handbook of Multicriteria Analysis, Springer, Berlin.

Zopounidis, C., Slowinski, R., Doumpos, M., Dimitras, A.I., Susmaga, R. (1999), Business failure prediction using rough sets: a comparison with multivariate analysis techniques, *Fuzzy Economic Review*, Vol. 4, No. 1, pp. 3-33.