



MULTICRITERIA DECISION ANALISYS TO LEAD ABOUT MESSES PROBLEMS: AN ILLUSTRATED CASE

André Andrade Longaray

FURG - Federal University of Rio Grande, Brazil

E-mail: longaray@yahoo.com.br

Leonardo Ensslin

UNISUL - Universidade do Sul de Santa Catarina, Brazil

E-mail: leonardoensslin@gmail.com

John Robert Mackness

LUMS - University of Lancaster, United Kingdom

E-mail: mackness@lums.edu.uk

Submission: 22/09/2013

Revision: 06/10/2013

Accept: 20/01/2014

ABSTRACT

This paper shows the use of two approaches in Operations Research - Soft Systems Methodology (SSM) and Constructivist MultiCriteria Decision Aid (MCDA-C) - into one decision aid model (SSM/MCDA-C) to lead about messes problems. In order to this, describes the approaches which give theoretical framework support to the proposal, MCDA-C and SSM, as well as presenting the SSM/MCDA-C model. There is also a demonstration of its practical application. Finally, presents the general theoretical and practical considerations and recommendations with regard to the integrated problem structuring model proposed.

Keywords: Decision Aid; Multicriteria Methods; SSM/MCDA-C



1. INTRODUCTION

This paper describes how the researchers developed a model to integrate SSM and MCDA-C to lead about messy problems. The integrated model had three phases. In the first structuring phase, SSM helped to scope and structure the situation and smooth the path towards a hierarchical tree structure for use by MCDA-C with its exploration of situation descriptors. In the evaluation phase, the values of local preferences and the compensation rates between the descriptors were determined together with local and global evaluations of the different criteria used in the model. Finally, using a comparison between different scenarios of decision-maker performance together with sensitivity analysis, the recommendations phase led to the development of a really useful decision aid model for the decision-maker.

Section one of the paper shows how the SSM/MCDA-C integrated model was developed and how this contributed to the structuring of the problem of the decision-maker in question. Section two describes the approaches which give theoretical framework support to the proposal, MCDA-C and SSM. Section three describes the methodological procedures of research. In section four, as well as presenting the SSM/MCDA-C model, there is also a demonstration of its practical application. Finally section five presents the general theoretical and practical considerations and recommendations with regard to the integrated problem structuring model proposed.

2. THEORETICAL FRAMEWORK

The decision aid process for the problematic situation in question was elaborated based on the theoretical-methodological model developed by the researchers, which made the integration of the Soft Systems Methodology (SSM) with the Multi Criteria Decision Aid Constructivist (MCDA-C) (LONGARAY, 2004).

The MCDA-C methodology originates from the development of the ideas and convictions proposed by Bernard Roy (1996) (for more details, see ENSSLIN et al., 2010). Roy (2005) describes a process of an eminently practical nature, based on the use of knowledge constructed with the user, which requires the participation and interaction between the facilitator (in this case, the researchers) and the decision-maker. This results in better understanding about that situation which for the decision-maker is problematic. MCDA-C is the main decision aid process and has



three phases: the structuring phase, the evaluation phase and the recommendations phase (BANA E COSTA, 1990).

The principal objective of the structuring phase of the MCDA-C is to increase understanding about the problem and of its context (LONGARAY; ENSSLIN, 2013). In order to achieve this objective, the structuring phase is subdivided into three steps: the use of a soft approach to understand the complexity of the decision-making context and the identification of the criteria judged by the decision-maker as relevant to the context; the hierarchical classification of the criteria through the construction of a criteria tree; and the construction of descriptors (ordinal scale). For each descriptor there are different impact levels, linked to a base criterion, which serves as a reference to describe the possible impacts of potential actions (alternatives) of that criterion (BANA E COSTA; VANSNICK, 1995).

The evaluation phase consists of the development of a multi-criteria model, which enables the measurement of the performance of both local and global potential actions. Using the single synthesis criterion method (KEENEY; RAIFFA, 1976), the MCDA-C evaluation phase develops in three stages: the construction stage of the multi-criteria model; the local and global evaluation of the actions stage; and the results analysis stage.

The purpose of the last stage of a model based on the MCDA-C is to identify possible actions which come about to help the decision-maker to make good decisions in relation to the situation which is perceived as problematic. These actions are specific and individual to each case (ENSSLIN; MONTIBELLER NETO; NORONHA, 2001).

Of the MCDA-C phases, the structuring phase is the one which requires great flexibility in its operation, specifically with regard to its first step, the use of a soft approach to explore the problem and help the decision-maker to improve the understanding of the situation. This stage offers the opportunity for the decision-maker to explore the situation which is perceived to be problematic without any type of restriction imposed by the use of the methodology (BANA E COSTA, 1993).

Taking into consideration current literature, one can say that the MCDA-C approach, the soft approach of cognitive mapping (EDEN, 1988) has been used in a significant number of researches (ENSSLIN; MONTIBELLER NETO; NORONHA,



2001). However, there are other problem structuring soft approaches in operations research literature, for example Strategic Choice (FRIEND; HICKLING, 1987), Robustness Analysis (ROSENHEAD, 1989), Hypergame Approach (BENNET; HUXHAM; CROPPER, 1989) and Soft Systems Methodology (CHECKLAND; SCHOLES, 1999).

Among these, Soft Systems Methodology (SSM) resonates with the vision proposed by the MCDA-C methodology, as it postulates that real-world situations are often perceived by people as complex and confusing and for one same situation, each observer may make a different reading of the facts, based on that person's knowledge, presuppositions and convictions, as well as the influences that this observer receives from his environment.

As Checkland and Scholes (1999) states, SSM, enables the exploration, questioning and learning about complex and badly structured problems. It emphasizes the possibilities of identifying opportunities for change and encourages the actors who are involved to understand the diverse inter-relationships, which are present in a determined decision-making context.

To achieve its objectives SSM requires the use of certain techniques such as rich pictures, to characterize the situation which is perceived as problematic; conceptual models, constructed from human activity systems, identified in the decision-making context and a list of desirable systemic and cultural actions, which emerge from the amplified understanding of the problem. The outcome of this process does not however result in an exact reply to the problem.

As Checkland and Scholes (1999) points out, in problems of human activity, the idea of "solution" must be substituted by the understanding that to resolve a problematic situation, is a process of "knowledge construction", in which reality is undergoing constant change and is being continually recreated by the participants.

The process of SSM however is to some extent limited in its capability to analyze the impact of which actions contribute most to achieve the objectives of the decision-maker. This is because the approach does not include any form of performance measurement of the various actions which might be made. Therefore, it is not possible to measure which actions are preferable in relation to others which



also might be options for change. Adoption of a possible action is carried out by an informed debate rather than a quantitative analysis.

This paper has as its aim to demonstrate how the increased understanding and representation of a problem which emerges through the SSM process can be augmented in a quantitative way by the robustness of the MCDA-C, which runs through all the phases of the decision-making process.

3. METHODOLOGICAL PROCEDURES OF THE RESEARCH

This section discusses the methodological design of the research and classifies the work as to its purpose, nature, source of data collection, search logic, methodological approach and the intervention instrument employed.

Regarding its purpose, the research is classified as an exploratory study. According to Gil (2002), the main objective of exploratory studies is to develop ideas and to lead to relatively systematic procedures for obtaining empirical observations, as well as to enable the identification of the relationships between the studied phenomena. This perspective is consistent with the objective of this research.

The objective is to build an integrated SSM/MCDA-C model to lead about messy problems.

The nature of this research is described as a case study. The case study was conducted in order to help a determined decision-maker to understand, organize and structure the context and the circumstances which led this person to suffer from stress, as well to enable the measurement and comparison of the different options available to improve her quality of life. The person concerned found it difficult to establish a cause and effect relationship between emotional and behavioral factors and the physiological manifestations of stress. This was shown by the development of hyperthyroidism, migraine and teeth grinding without an apparent organic cause.

As sources of data collection, this study used interviews, document analysis, and bibliographic search (GIL, 2002). Unstructured interviews were conducted to obtain primary data and a survey of documents and bibliographic search was done as a source of secondary data.

The search logic adopted was inductive and deductive. It is inductive in the structuring stage of the model, which does not presuppose the existence of



principles, but of facts and observations resulting from insertion into reality. It assumes a deductive approach in the evaluation stage, since it is from the constructed model that particular conclusions are established (GIL, 2002). Finally, the logic is inductive in the development of the recommendations stage, since the analyses are based on the understanding gained throughout the development of the entire model.

The methodological approach of the study is quali-quantitative. Gil (2002) advocates the idea of combining qualitative and quantitative methods in order to provide a richer contextual basis for the interpretation and validation of research results. From this point of view, the present study is quantitative at the evaluation stage and qualitative in the structuring and development of recommendations stages.

The intervention instrument employed in the study is the SSM/MCDA-C. This methodology for decision aiding is used because of its ability to provide conditions for the identification, implementation, and measurement of the criteria that represent the perception of the decision makers about the possibilities of evaluating the performance of trade marketing activities of the company. It also enables the incorporation of improvement suggestions for alternatives, with a performance profile incompatible with expectations.

4. SSM-MCDA-C METHODOLOGICAL PROCEDURES TO SUPPORT AN INDIVIDUAL COMPLEX DECISION

Respecting the logical order of the steps presented in the previous section and of the methodological bases of the model, which uses a combined SSM and MCDA-C approaches (LONGARAY; ENSSLIN; MACKNESS, 2013), this section describes the personalized decision aid model in three phases: the structuring phase, the evaluation phase and the elaboration of recommendations phase.

4.1. Structuring Phase

Initially, using SSM, the researchers elaborated a soft model of the decision-maker composed from the rich picture of the problem situation, of the list of preoccupations, of conceptual models, of the transformation map (Ts) and from the list of possible desirable and feasible actions.



Table 1 presents a list of preoccupations identified by the decision-maker in its context of decision, based on the analysis and legitimation of the rich picture of the context of decision.

Table 1: List of preoccupations identified by the decision-maker in the analysis of the rich picture

LIST OF CONCERNS OF THE DECISION-MAKER	
RELEVANT SYSTEMS	COMPONENT CONCERNS
physical health	11. have vital organs working well 12. have good aesthetics
mental health	01. have emotional control 07. have good cerebral capacity
harmony at home	06. share home chores 08. administer time at home
relationship with husband	03. have life in common with husband 02. have sentimental equilibrium 04. have affective goals
material comfort	09. have professional aspirations 15. have economic aspirations
productivity	14. administer time at work 05. have control over the situation in the sector in which you work
harmony at work	13. get on well with colleagues 10. get on well with the boss

In the right hand column of Table 1, it is possible to identify the preoccupations, which the decision-maker defined as being the most relevant for the problematic situation, already grouped by a criterion of relationship. In the left hand column there is the name given by the decision-maker for each group of preoccupations, which Checkland and Scholes (1999) calls, relevant systems.

Once the relevant systems were established, the next step in the construction of the soft model was the development of the charts with the root definitions and the CATWOE for each one of these systems. Table 2 shows, as an example, the chart developed for the relevant system “physical health”.

The following step was the construction of the conceptual models for each relevant system, taking into consideration the charts with the root definitions and CATWOE. A worksheet was developed along the lines presented by Mackness (2002) as it offers a graphic mode for better visualization of the systems and of the information, which subsidizes its elaboration, to be utilized as a guide in the construction of each conceptual model.



Table 2: Root definitions and CATWOE of relevant system “physical health”

RELEVANT SYSTEM <i>physical health</i>	
ROOT-DEFINITIONS	CATWOE
<p>Concern: 11. have vital organs working well</p> <p>RD: a system to rate the possibilities of keeping vital organs working well, taking preventive measures, in order to improve physical health and contribute to the decision-maker to lead a life without <i>stress</i>.</p>	C decision-maker
	A decision-maker, medical professionals in the area
	T not able to cope with illnesses which affect the nervous, cardiac and hormonal systems ↓ able to cope with illnesses which affect the nervous, cardiac and hormonal systems
	W problems with organs like the heart, affect the quality and expectation of life
	O decision-maker
	E family, work
ROOT-DEFINITIONS	CATWOE
<p>Concern: 12. have good aesthetics</p> <p>RD: a system to rate the possibilities of having good aesthetics, by investing in body care, which improves physical health and assists the decision-maker to lead a life without <i>stress</i>.</p>	C decision-maker
	A decision-maker, sporting and medical professionals
	T not satisfied with your body ↓ be satisfied with your body
	W If decision-maker feels beautiful her self-esteem is improved
	O Decision-maker
	E work, study, home chores

This is filled in with the relevant system, the preoccupation, from which the conceptual model will be constructed, the CATWOE, identifying what transformation, (T) should occur, as well as the systemic layers. Table 3 shows a support worksheet for the construction of the conceptual preoccupation model “11.have vital organs working well”, of the relevant system “physical health”.

Table 3: Support plan for the construction of the conceptual model “11. have vital organs working well”

<p>RELEVANT SYSTEM: <i>physical health</i></p> <p>CONCERN: 11. have vital organs working well</p> <p>ROOT-DEFINITIONS-(RD): a system to rate the possibilities of keeping vital organs working well, taking preventive measures, in order to improve physical health and contribute to the decision-maker to lead a life without <i>stress</i>.</p>	<p>CATWOE:</p> <p>C →decision-maker A →decision-maker, medical professionals in the area T →not able to cope with illnesses which affect the nervous, cardiac and hormonal systems ► able to cope with illnesses of the nervous, cardiac and hormonal systems W →problems with organs like the heart, affect the quality and expectation of life O →decision-maker E →family, work</p>
---	---

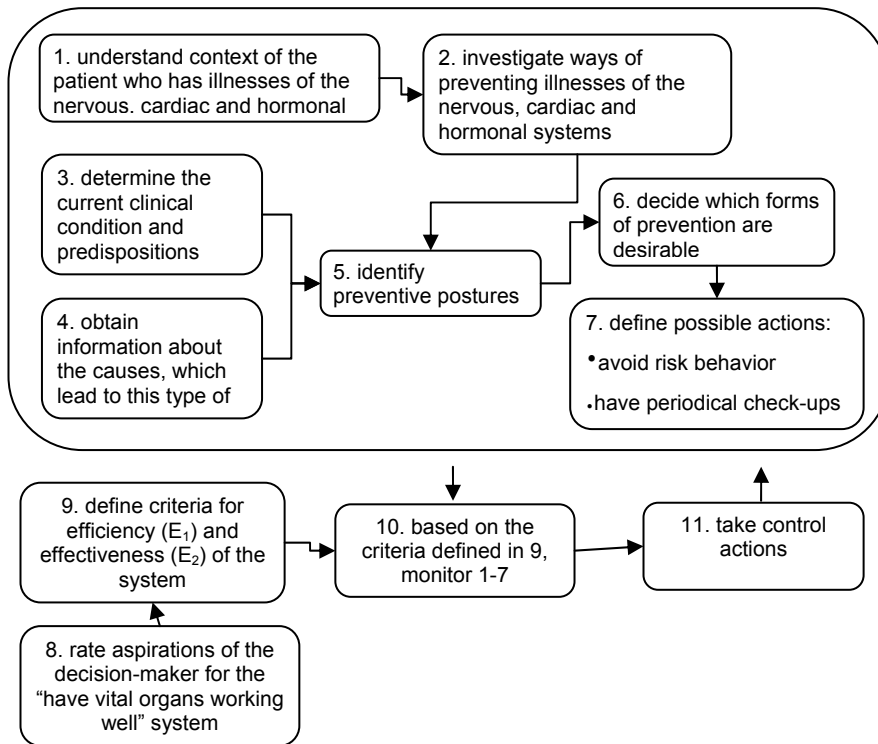


CONCEPTUAL MODEL	
LAYERS	
PQR logic	Discription
Why? (overall system)	lead a life without stress
What? (system)	11. have vital organs working well
How? (sub-systems)	PREVENT illnesses of the vital organs

Measured by:
 E_1 = whether there is adoption of reasonable behavior and regular medical follow up
 E_2 = whether illnesses of the nervous, cardiac and hormonal system are prevented

The next stage was to effectively construct each one of the conceptual models. In order to do this, the steps suggested by Checkland and Scholes (1999) were followed. Figure 1 shows a conceptual preoccupation model “11.have vital organs working well”.

Figure 1: Conceptual preoccupation model “11. have vital organs working well”



Having constructed the conceptual models for all the preoccupations, listed by the decision-maker, the next step was to determine which of the possible actions identified in the conceptual models (for example, in Figure 4, the possible actions are in activity 7) could be put into place by the decision-maker. Having determined the possible actions, the use of the soft model was considered as terminated.

The transition in this case, of the soft model to a tree structure for the MCDA-C approach was made based on a map which shows how the possible actions from



each relevant system relate to the overall objective – the decision support for the person with stress. This map contained the seven relevant systems described in Figure 1 and the possible actions which were thrown up by each conceptual model for the component concerns for each relevant system.

Table 4 presents the complete criteria hierarchical tree for the MCDA-C, after the transition process.

Table 4: Criteria hierarchical tree to problem of the “patient suffering stress” problem

LEADS ALIVE WITHOUT STRESS	1. physical Health	1.1 vitals organs	1.1.1-avoid risk behavior		
			1.1.2-have periodical chekup		
		1.2-aesthetics	1.2.1-sporty activities		
			1.2.2-control feed		
	1.2.3-aesthetic treatment				
	2. mental health	2.1-emotional control	2.1.1-professional support		
			2.1.2-curtailment strategies		
		2.2-cerebral capacity	2.2.1-rest		
			2.2.2-share of the activities		
	5. harmony at home	3.1-share of the tasks	3.1.1-responsibilities		
		3.2-administration of the time in home	3.2.1- services of 3 ^o s		
			3.2.2-appliances		
			3.2.3-chronogram		
	6. relationship with husband	4.1- life in common	4.1.1-leisure	4.1.1.1-entertainment	
				4.1.1.2-breakage of the routine	
		4.2-sentimental balance	4.2.1-complicity		
			4.2.2-negotiation		
		4.3-affective goals	4.3.1-sons		
			4.3.2- couple's feeling		4.3.2.1-time to the couple
					4.3.2.2-romantic activities
	5. material confort	5.1-professional aspirations	5.1.1-languages course		
			5.1.2-post graduation course		
		5.2-economic aspirations	5.2.1-provision for accidental		
			5.2.2-retirement		
			5.2.3-patrimony		
	6. productivity	6.1- administration of the time at work	6.1.1-allocation		
			6.1.2-priorities		
6.2-control of the situation		6.2.1-leadership			
		6.2.2-hierarchical structure			
7. harmony at work	7.1-conviviality with colleagues	7.1.1-dialog	7.1.1.1-meetings		
			7.1.1.2-intervals		
		7.1.2-integration	7.1.2.1-work in group		
		7.1.2.2-confraternity			
	7.2-conviviality with the boss	7.2.1-performance standards			
		7.2.2.control of the standards		7.2.2.1-term	
			7.2.2.2-results		
		7.2.2.3-satisfaction degree			

After established the transition of the *soft* model to a hierarchical structure, the third stage of the arrangement leads to the construction of describing elements, which enable the decision maker to measure how much a potential action could impact upon a determined criterion. In this sense, it was created ordinal scales for each criterion, with impact possible levels.

The Table 5 presents the impacts levels to “1.1.1 - avoid risk behavior” criterion.



Table 5: Impact levels descriptor to criterion “1.1.1 - avoid risk behavior”

Impact levels to “1.1.1 – avoid risk behavior” criterion		
level	anchorage	Description
N5		Do not smoke, do not take coffee or another stimulant, do not ingest drunk alcoholic and to do not do analgesic use and tranquilizing
N4	Good	Do not smoke, do not take coffee or another stimulant and to do not ingest drunk alcoholic
N3		Do not smoke and do not take coffee or another stimulant
N2	Neutral	Do not smoke
N1		Smoke, take coffee or another stimulant, ingest drunk alcoholic and to do analgesics use and tranquilizing

It was developed possible impact levels descriptors for all the remainder criteria of the model.

4.2. Evaluation Phase

The evaluation phase consists of the development of a multi-criteria model, which enables the local and global measurement of the potential actions. Using the single synthesis criterion method (KEENEY; RAIFFA, 1976), the MCDA-C evaluation phase develops in three stages: the construction stage of the multi-criteria model (preference scores); the local and global evaluation of the actions; and the results analysis stage.

The construction of the local preference scores, usually called value functions, for the multi-criteria model of the problematic situation, was made based on the Direct Scoring method. The Measuring Attractiveness by a Categorical Based Evaluation Technique – MACBETH (BANA E COSTA; VANSNICK, 1995) was used to determine the compensation rates.

Table 6 presents hierarchical structure of SSM/MCDA-C with compensation rates of criteria and neutral/good levels anchorage of descriptors to the “patient suffering stress” problem.

The local and global evaluation stage of the multi-criteria model was carried out in two steps. The first defined the profile of the impact of the potential actions (local evaluation) and the second, the additive aggregation of the criteria (global evaluation) of the model.

Attending to the decision-makers’ request, we sought to identify what would be the effect of different actions. From the moment in which the decision aid process



was initiated, called Performance Profile 1 (PP1) to the end of the construction of the evaluation model, labeled Performance Profile 2 (PP2).

Table 6: Compensations Rates and anchorage of descriptors to the “patient suffering stress” problem

Cluster	Criteria	Compensations Rates	Levels		Anchorage	
1.1- vital organs						
	1.1.1-avoid risk behavior	62,00%	N2	N4	0,00	100,0
	1.1.2-have periodical check-ups	38,00%	N2	N4	0,00	100,0
1.2 – aesthetics						
	1.2.1-sporty activities	33,00%	N2	N4	0,00	100,0
	1.2.2- control feed	56,00%	N2	N4	0,00	100,0
	1.2.3- aesthetic treatment	11,00%	N2	N4	0,00	100,0
2.1- emotional control						
	2.1.1- professional suport	70,00%	N2	N4	0,00	100,0
	2.1.2- curtailment strategies	30,00%	N2	N4	0,00	100,0
2.2- cerebral capacity						
	2.2.1- rest	33,00%	N2	N4	0,00	100,0
	2.2.2- share of the activities	67,00%	N2	N4	0,00	100,0
3.1- share of the tasks						
	3.1.1- responsibilities	0,00%	N2	N4	0,00	100,0
3.2- administration of the time in the home						
	3.2.1- services of 3 ^{os}	55,00%	N2	N4	0,00	100,0
	3.2.2- appliances	35,00%	N2	N4	0,00	100,0
	3.2.3- chronogram	10,00%	N2	N4	0,00	100,0
4.1- life in common						
	4.1.1- leisure	75,00%				100,0
	4.1.1.1- entertainment	60,00%	N2	N4	0,00	100,0
	4.1.1.2- break of the rotine	40,00%	N2	N4	0,00	100,0
	4.1.2- social activities	25,00%	N2	N4	0,00	100,0
4.2- sentimental balance						
	4.2.1- complicity	42,00%	N2	N3	0,00	100,0
	4.2.2- negotiation	58,00%	N2	N4	0,00	100,0
4.3- affective goals						
	4.3.1- sons	72,00%	N2	N4	0,00	100,0
	4.3.2- couple's feeling	28,00%				100,0
	4.3.2.1- time to the couple	57,00%	N2	N4	0,00	100,0
	4.3.2.2-romantic activities	43,00%	N2	N4	0,00	100,0
5.1- professional aspirations						
	5.1.1- languages course	67,00%	N2	N4	0,00	100,0
	5.1.2- post graduation course	33,00%	N2	N4	0,00	100,0
5.2- economic aspirations						
	5.2.1- provision for accidental	12,00%	N2	N4	0,00	100,0
	5.2.2- retirement	25,00%	N2	N3	0,00	100,0
	5.2.3- patrimony	63,00%	N2	N4	0,00	100,0
6.1- administration of the time at work						
	6.1.1- allocation	29,00%	N2	N4	0,00	100,0
	6.1.2- priorities	71,00%	N2	N3	0,00	100,0
6.2- control of the situation						
	6.2.1- leadership	40,00%	N2	N3	0,00	100,0
	6.2.2- hierarchical structure	60,00%	N2	N3	0,00	100,0
7.1- conviviality with colleagues						
	7.1.1-dialog	54,00%				100,0
	7.1.1.1- meetings	33,00%	N2	N4	0,00	100,0
	7.1.1.2- intervals	67,00%	N2	N4	0,00	100,0
	7.1.2- integration	46,00%				100,0
	7.1.2.1- work in group	55,00%	N2	N3	0,00	100,0
	7.1.2.2- confraternity	45,00%	N2	N3	0,00	100,0
7.2- conviviality with the boss						
	7.2.1- performance standards	57,00%	N2	N3	0,00	100,0
	7.2.2- control of the standards	43,00%				100,0
	7.2.2.1- term	38,00%	N2	N4	0,00	100,0
	7.2.2.2- results	16,00	N2	N4	0,00	100,0
	7.2.2.3- satisfaction degree	46,00	N2	N4	0,00	100,0

For each criterion, for we developed descriptors, the decision-maker defined the level of the impact which best described its performance in PP1 and PP2. From



the determination of the level of impact, we obtained the local evaluation of the potential actions PP1 and PP2 for each one of the model's criteria. Utilizing the additive aggregation function formula, the global evaluation of the potential actions was obtained.

As an example, Table 7 shows the local and global evaluation to PP1 profile.

Table 7: performance PP1

Cluster	%	Local Scores	Global Contribution
1.1- vitals	8,00%	-19	-1,5
1.2- aesthetics	7,00%	-50	-3,5
2.1- emotional control	8,00%	-65	-5,2
2.2- cerebral capacity	7,00%	-50	-3,5
3.1- share of the tasks	6,00%	-50	-3
3.2- administration of the time in the home	6,00%	-32,5	-2
4.1- life in common	9,00%	-50	-4,5
4.2- sentimental balance	10,00%	-42	-4,2
4.3- affective goals	9,00%	-44,8	-4
5.1- professional aspirations	3,00%	-33,5	-1
5.2- economic aspirations	4,00%	-62,5	-2,5
6.1-administration of the time at work	5,00%	-85,5	-4,3
6.2- control of the situation	5,00%	-100	-5
7.1- conviviality with colleagues	7,00%	-73	-5,1
7.2-conviviality with boss	6,00%	-78,5	-4,7
Global Evaluation	100,00%		-54

4.3. Recommendations' Elaboration Phase

The recommendations for the problematic situation are provided as and when the facilitator requested the decision-maker to authorize any procedure, or even from requests, which came from the decision-maker herself. These came about during the decision aid process.

Indeed, the result of the local and global evaluations enabled the decision-maker to see that, globally the model performance improved from PP1 to PP2.

Furthermore, the individual performance analysis of each criterion in PP1 and PP2, made it possible for the decision-maker to identify in which criteria its performance could be improved and which of them had already reached a satisfactory performance.

5. CONCLUSIONS

This paper presented the development process of a decision aid model, based on the integration of SSM to MCDA-C, with the purpose of helping an individual who suffers from an high degree of stress by identifying opportunities to improve her quality of life. In order to do this, the researchers brought together into one model,



the capacity of the understanding and representation of a problem made possible by the SSM process, with the robustness of the MCDA-C process. Given its constructivist orientation, the decision aid process involved the effective participation of the decision-maker in all its phases.

In the first structuring phase, SSM was used for the elaboration of the soft model and the transition from this model to a hierarchical tree structure and the construction of the descriptors. In the evaluation phase, the local preferential rates and the compensation rates between the criteria were determined, as well as the local and global evaluations of the multi-criteria model. Following comparisons between some of the decision-maker performance profiles PP1 and PP2 and sensitivity analysis, the elaboration of recommendations phase enabled model adjustments to be made.

As such, the SSM/MCDA-C model proved to be sufficiently robust to be applied in a decision aid process, in which the decision-maker had little knowledge of the decision-making complexity. When beginning the decision aid process, the decision-maker did not manage to perceive how she would identify and cope with the generating factors of the stress problem. Currently the decision-maker utilizes the SSM/MCDA-C model developed for the accompanying of the performance of the desirable and culturally possible systemic actions.

In closing, the value of the paper methodologically speaking is to show how SSM and MCDA-C can be combined to develop a fuller understanding of a complex situation in its context. We believe that this approach can be used in other complex situations.

The limitations of the study were the time spent during interviews with the decision-maker and interveners, the need for involvement of the decision maker throughout the research process, and the singularity of the constructed model, which cannot be generalised. It is noteworthy that while the process can be replicated in other contexts, the developed model itself, since it was constructed to suit the specific conditions of the environment, cannot be used as constructed.

As a suggestion for future studies, the use of the SSM/MCDA-C model is recommended for integrated evaluation of the performance of others individual contexts. Another possibility is the replication of this research in an organizational



segment. Finally, it is interesting that other aspects of the SSM and MCDA-C will be analysed.

REFERENCES

- BANA E COSTA, C. A. (1990). **Readings in multiple criteria decision aid**. Springer-Verlag, Berlin.
- BANA E COSTA, C. A. (1993). Três convicções fundamentais na prática do apoio à decisão. **Revista Pesquisa Operacional**, n. 13, p. 1-12.
- BANA E COSTA, C. A.; VANSNICK, J. C. (1995). Uma nova abordagem ao problema de construção de uma função de valor cardinal: MACBETH. **Investigação Operacional**, n. 15, p. 15-35.
- BENNET, P.; HUXHAM, C.; CROPPER, S. (1989). Modelling interactive decisions: the hypergame focus. In: **Rational analysis for a problematic world**. [Edited by J. Rosenhead], Wiley, New York.
- CHECKLAND, P.; SCHOLLES, J. (1999). **Soft Systems Methodology in Action: include a 30 years retrospective**. Wiley, New York.
- EDEN, C. (1988). Cognitive mapping. **European Journal of Operational Research**, n. 36, p. 1-13.
- ENSSLIN, L.; MONTIBELLER, G.; NORONHA, S. (2001). **Apoio à Decisão: Metodologias para Estruturação de Problemas e Avaliação Multicritério de Alternativas**. Insular, Florianópolis.
- ENSSLIN, L.; GIFFHORN, W.; ENSSLIN, S. R.; PETRI, S.; VIANNA, W. (2010). Avaliação de desempenho de empresas terceirizadas com o uso da metodologia multicritério de apoio à decisão – construtivista. **Pesquisa Operacional**, n. 30, p. 125-152.
- FRIEND, J.; HICKLING, A. (1987). **Planning under pressure**. Pergamon Press, London.
- GIL, A. C. (2002). **Como elaborar projetos de pesquisa**. São Paulo: Atlas.
- LONGARAY, A. A. (2004). **Estruturação de situações problemáticas baseada na integração da Soft Systems Methodology e da MCDA-Construtivista**. Universidade Federal de Santa Catarina, Tese de Doutorado em Engenharia de Produção.
- LONGARAY, A. A., ENSSLIN, L., MACKNESS, J. R. (2013). Uma proposta de integração da soft systems methodology à MCDA-C. **Pesquisa Operacional para o Desenvolvimento**, v.5, p. 331-372.
- LONGARAY, A. A.; ENSSLIN, L. (2013). Uso da MCDA na identificação e mensuração da performance dos critérios para a certificação dos hospitais de ensino no âmbito do SUS. **Produção**, Epub May 14, 2013. Retrieved January 25, 2014, from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-65132013005000021&lng=en&tlng=pt. 10.1590/S0103-65132013005000021.
- KEENEY, R. L.; RAIFFA, H. (1976) **Decision with multiple objectives: Preferences and Value Trade-offs**. Wiley, New York.



MACKNESS, J. R. (2002). **Marginal notes from the Systems Evaluation Course**. UFSC, Florianópolis.

ROSENHEAD, J. (1989). **Rational analysis for a problematic world**: problems structuring methods for complexity, uncertainty, and conflict. John Wiley and Sons, Chichester.

ROY, B. (1996). **Multicriteria Methodology for Decision Aiding**. Kluwer Academic Publishers, Dordrecht.

ROY, B. (2005). Paradigms and challenges. In: **Multicriteria Decision Analysis: state of the art survey** [edited by J.F. Greco and S.M. Ehrgott], Springer Verlag, Boston, Dordrecht, London, 3-24.

