MAPPING A COMPLEX DECISIONAL SITUATION

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Abstract:
Any organization is confronted with a multitude of problems in a dynamic and complex environment. These problems can be independent, but, many times, they are interconnected. In this myriad of situations, it is difficult to identify the causality relations between problems, which, logically, should also determine the solving order. An organization is faced with a cash crisis, a substantial loss of clients, production equipment wear, poorly qualified personnel, and unsuitable products from a quality- related perspective. And in this context, what is the original problem, primary, and through its solving, the solution to the other problems could be found? Is this the loss of clients, or cash crisis? Are we facing a cash crisis because the products are of poor quality and don't sell, or is it because we are facing a cash crisis we are unable to invest in research- development, in order to increase product quality?
We will try to find an answer to such dilemmas in this material. The problem is not a new one in the specialized literature. In the first part of the article we will present a couple of previous solutions this problem has been given, and during the second part we will propose a model derived from those known in the specialized literature.

Keywords: decisional problem, key problem, structuring the decisional situation.

What is a „decisional problem"?

Elaborating a decision, either seeing it as a sequential or emerging process, an iterative process, or with embedded phases, starts with identifying the „decisional problem". Although the vast majority considers this phase as being distinct and important, it is often poorly treated, the attention concentrating on the occasional alternative delimitation, or on selecting the optimum/ satisfying alternative from past ones.

But what does really mean a „decisional problem"? In very broad terms, the problem can be defined [Kepner Ch., 1981] as a deviation from the plan. In a different kind of approach [Fontela E., 1976] the decisional problem is considered to be „a situation identified as being unacceptable, which can be corrected by different kinds of action.

Frequently, the notion of „decision" is more or less intimately related to the notion of „problem". There are authors [Schneider P. D., 1996] that consider that there is no decision without a problem. In most definition, managerial decision is associated with a „problem", „crisis" situation that must be overcome through the respective decision.

We consider this closeness as a phase in the dynamics of organization, economic activities already overcome by the situation. During the present conditions, marred by very unpredictable changes, decisions (at least those considered to be important) are focused on the reconfiguration of resources in order to benefit from the emerging occasions. The ability to keep

and rapidly set resources represents an essential capacity for the future [Prahalad C. K., 2002].

Somewhat in the same key are also the opinions of Gh. Gh. Ionescu, etc. [1999]. Thus, they distinguish between three types of problems on which they can focus central managerial decisions: crisis (a serious kind of difficulty, that calls for immediate action), non-crisis (a problem that calls for a solution, but does not simultaneously have the importance and/ or the „emergency" characteristics or the immediate pressure of a crisis), the opportunity (a situation that offers a considerable potential to win, to materialize certain advantages if the right kind of actions are adopted and set into practice).

M. Landry [1995] has a more complex and profound approach. In this material the author suggests that there is a set of four conditions interconnected that can be used as general frames signaling the presence of the problem: first, a past, present or future occurrence within organizational context, which can be appreciated as negative by an individual or a group; second, supposes a preliminary appreciation on the organization's capacity to act; third, implicates the existence of an intention to undertake something or to engage resources; forth, refers to the uncertainty regarding the right kind of action and the way to implement it, respectively. These four coordinates cover the main significations the term "problem" has received lately.

In order to continue our analysis, we need to mention that it is possible, in a certain decision-making situation that signals from the field perceived by potential decision-making characters lead to the identification of several decisional problems, more or less connected.

Structuring the decisional situation

In very broad terms, structuring the decisional problem is an identification activity for the relevant variables in a decision- making situation and for the relations between these variants. [Kunene K. N., 2002].

We have to make a distinction between structuring the decision-making situation, by which we understand the identification and determination of the relations between decision- making problems that come from a certain decision-making context and structuring the decision-making process, which refers to the phases undergone in order to adopt a decision for a decision-making problem that has already been defined. Structuring the decision-making situation is a distinct phase in the decision-making process.

The first solid approach to the decision-making process belongs to H. A. Simon (in his work „The New Science of Management", published in 1960). The model he proposes comprised of three main phases: acknowledging the decision-making situation and data gathering for postulating and classifying the decision-making problem; projecting (or identifying) alternatives and choosing the principle and the elements necessary for evaluation; choosing the decision and starting its implementation.

In 1977, H. A. Simon came back to this system, talking now about four phases: intelligence – targets the postulation of the decision-making problem and means data gathering regarding the state of the system and the evolutions that have taken place or are thought to take place in their environment, having in mind at all time the objectives targeted by the decision-making responsible; design – by which we try to understand the decision-making problem, generating possible ways for action, alternatively named, evaluating their feasibility and consequences; choice – it's purpose is selecting one of the alternatives (the

decision) in order to act; implementing and reviewing the results obtained as a result of effectively applying the decision.

The design phase, identified by H. Simon, also comprises of what we have named „structuring the decision-making problem", respectively „breaking" the problem into controllable problems and potentially better defined [Akin O., 2001].

Structuring the decision-making situation is differentiated when it is realized by an individual or by a decision-making group. In Figure 1 the simplified mechanism of structuring the decision-making problem within a group is presented:

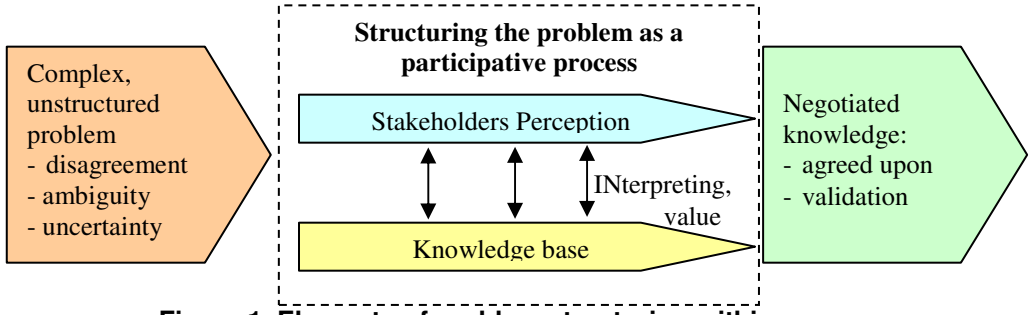

Figure 1. Elements of problem structuring within a group

Source: Problem structuring in decision-making processes, http://www.encora.eu/ coastalwiki/Problem _structuring_in_decision-making_processes.

Interconditioning decision-making problems

Decision-making problems that are more difficult to define (the starting symptoms being very vague, unclear, confusing) that are connected in a complex system are very hard to „withhold" by the human mind. The quality of the decisions is strictly related to the way the definition is made, perceiving the problem respectively. Perceiving and implicitly structuring the decision-making problem can be improved by using certain methods and techniques. These are synthetically presented in Table 1:

Table 1

Structural analysis models

Model	System structure	Purpose	Applications	Relevant literature
DEMATEL	Once created, the model is hard to modify	Quantitative quantification of interactions between the factors involved in a problem	Systems in which causal relations can be defined quantitatively	Developed by the Battel Institute in Geneva during the 70s. The most renowned author to tackle on this subject was J. N. Warfield.
ISM	The model is very flexible and easy to modify. Causal relations	Classifying factor relations.	Systems that include human processes and for which causal	J. N. Warfield (Interpretive Structural Modeling, 1982) A. P. Sage (System

	between the elements can be defined. There is a possibility to quantitatively measure relations.		relations cannot be defined quantitatively.	Engineering – Methodology and Aplicati-ons, 1977)
Hayashi quantification theory	Allows the quantification of quality elements, but also their grouping and evaluation.	Extracting main factors in case of complex symptoms.	Complex ensemble of symptoms	C. Hayashi (Prediction of Phenomena from Qualitative Data and Qualifica-tion of Qualitative, 1952) A. Gifi (Nonlinear Multivariate Analysis, 1990) M. J. Greenance (Corespondence Analysis in Practice, 1993)
Cognitive maps	Allows the analysis of cognitive structures based on a causal chain.	Decisions related to social problems.	Complex social systems Political decisions	A. S. Huff (Mapping Strategic Thought, 1990)
SSM	Allows problem structuring through the difference/ discrepancy between the real and ideal world.	Provides a reference point to beginner decision-making representatives	All human processes	P. Checkland J. Scholes (Soft Systems Methodology in Action, 1990) N. C. Jackson System Thinking: Creative Holism for Managers, 2003)

Source: Nakamura etc. [2008]

These models suppose, almost totally, on the decomposition of a complex system into components, and subsequently determining the binary relations between these components. In Table 1 the somewhat generic term of causal relations between components is used.

J. N. Warfield (cited by R. Bolanos etc. [2005]) has identified a wider range of interdependency relations between two components of the same ensemble. These are synthetically presented in Table 2.

Table 2

Types of relations between the elements of an ensemble

Determination	Includes; It is included; it is member of; Covers; Is part of; It's necessary to; It's enough for; belongs to the same category as; it's isomorphism with;
Comparison	It's larger than; It's preferred to; It's more important then; It's more useful than; It's more critical then; Requires more space than
Influence	Causes; Affects; Strengthens; Increases; Diminishes; It's independent in relation with;
Temporal	Must precede; Must follow; Precedes or coincides with; Requires more time than; It is disjointed in time from; It overlaps temporally with;
Spatial	Located Eastward from; Located on the right; Located above;
Mathematics	It is a function of; Can be calculated as; It is calculable through; It equals; It is larger than; It is smaller than; It is congruent with; It is part of;

The relations between the problems that compose the network of a decisional context are oriented: if between problem A and problem B there is any relation, this means that problem B is the result, the effect, it is influenced by problem B. At the same time we can talk about a reversed relation, between problem B and problem A respectively, in which case problem A is the result, the effect, etc., of problem A.

In this context, in the network we are talking about, there can be identified problems that are being influenced by a large number of other problems, problems which influence the majority of the other problems. This situation is graphically presented in Figure 2:

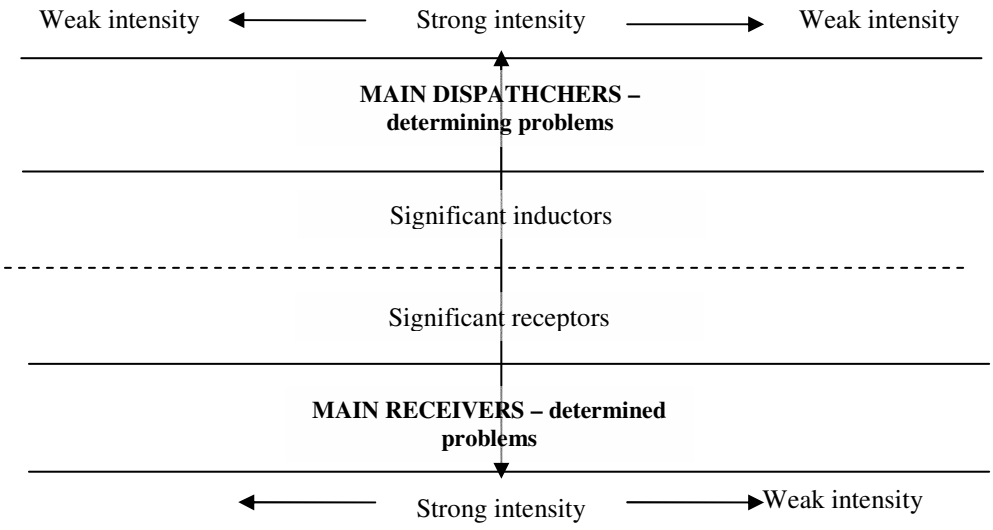

Figure 2. Relations between the subcomponents of a decisional problem

E. Fontela etc. [1976] show that main inductors can be treated as "key-problems" of a decision-making situation. These are the real problems on which managerial decision needs to focus. At the same time, main receptors can constitute themselves into objectives for the identified "key-problems" (figure 3).

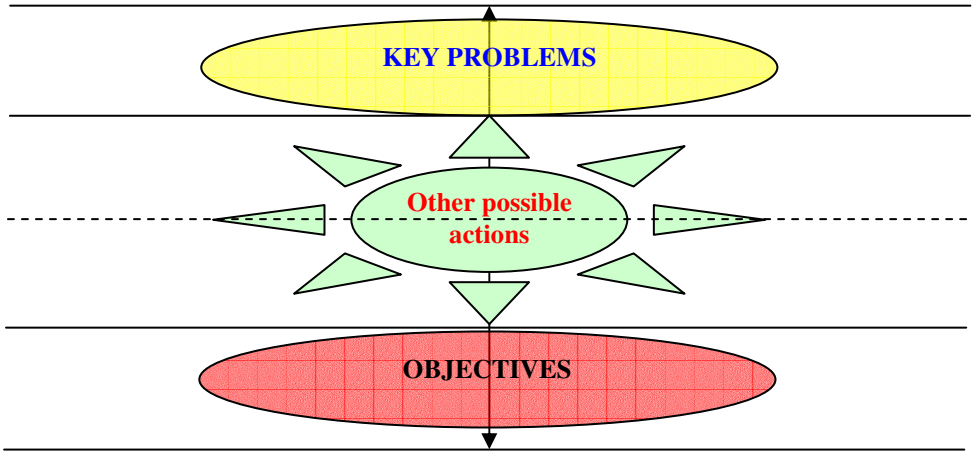

Figure 3. Key- problems- objectives report

Methodological considerations

Further, we will try to present a methodology for identifying the key-problem in a certain decisional situation. The methodology is an adaptation after the ISM model.

The methodology involves several stages. So, the first stage aims at the establishment of a list of "decisional problems" which, through directed action, determines a resulting problem, for which the causes are harder to identify. In some situations, a resulting problem is not reached; it is only about certain problems interconnecting and in order to solve them it is necessary to establish determined and the determinant decisional problems, an important fact when they are solved.

From the very beginning, we must underline the fact that, in our opinion, the proposed model is worth being applied, considering the ratio time consumed per results, for the complex decisions, respectively with a considerable impact on the activity of an organization, possibly strategic. That is why we believe that, first and foremost, representatives from the top-management must participate at the establishment of this list of problems.

In the second stage, the focus is on an analysis of the ratios between the problems. For that, I believe that a new decisional group has to be co-opted, which is different from the one that, in the previous stage, made up the list of problems. In this case we believe that the stakeholders of the various decisional problems in the list must take part, more likely from the average level management, as they know the decisional contexts better. The accuracy and the objectiveness of the acquired results depend on the professional skills, the experience and the number of the persons who are consulted. Regarding the first two elements, the professional skills and the experience, they have to be as heterogeneous as possible to allow the group to master the decisional situation with all its aspects. As far as the number is concerned, it is hard to tell. The number has to be large enough to ensure a great array of experiences and skills and small enough not to obstruct the activities of the group.

If we believe it is useful that in the first stage the specialists co-opted for the organization of the list of decisional problems be in dialogue (as the confrontation of certain heterogeneous viewpoints is needed, especially the allotment of the knowledge), in the second stage we consider that it is better for the specialists to work individually, so that everyone can form their own points of view, undistorted by the others` opinions. Later, the individual viewpoints will be aggregated, as we will show in the proposed methodology.

The method can even be applied in the case of the unipersonal decision. In our opinion it would only be an activity that would take too much time, to get a result known in advance or at least latently existing in "the mind" of the person who decides. He/she does not need a model, be it sophisticated, to systematize his/her perceptions on some problems. Any individual, including a manager, who is confronted with a quicker or harder set of problems, will make himself a representation of the problems, of the relationships between them. The referring to a model as the one proposed in this article would probably be a "push" of the person who decides to the "trap of confirming the evidence".

In the third stage it is requested to every member of the decisional group to make up an X matrix, whose elements are complete numbers in the [0, 3] interval. These elements will reflect the intensity of the connections between the identified problems. So, if $x_{ij} = 0$, then, in the vision of the respective person who decides, his problem does not exert a direct influence on the j problem. On the contrary, if $x_{ij} = 3$, the person who decides considers that their problem directly, powerfully determines the j problem.

Now, the role of the members of the decisional group ceases, the following stages actually assuming only a processing of the collected data from the ones who decide, which were synthesized in the X matrix.

So, we will go to the fourth stage to analyze the intensity of the connections between the identified decisional problems. In this stage a directional graph is drawn. A directional edge will be represented from i to j if $x_{ij} > 0$.

In the fifth stage the B matrix draws up. The b_{ij} element will be 1 if there is a directional link from i to j, and 0, in the opposite case. The proof is valid to any i, j, including i = j.

In the sixth stage, the C matrix builds, based on the B matrix, so: $c_{ij} = 0$, if there is no connection between i and j ($b_{ij} = b_{ji} = 0$); cij = nd, if its problem directly or indirectly does not influence the j problem. But the j problem influences the i problem ($b_{ij} = 0$, $b_{ji} = 1$); $c_{ij} = 1$ if the i problem influences the j problem, but the j problem does not influence the i problem ($b_{ij} = 1$, $b_{ji} = 0$); $c_{ij} = 2$, if they influence each other ($b_{ij} = 1$, $b_{ji} = 1$).

In the seventh stage, an oriented graph is drawn based on the C and X matrix. In this graph, an oriented edge will be drawn from i to j if $c_{ij} \geq 1$ and $x_{ij} > 1$. Based on this graph, the problem that needs to be approached with a priority is determined.

Further, we will show a short example of applying this model. A society goes through a difficult time. The main problems identified by the general manager, the financial-accountant director and the production manager are: P_1 – The decrease of the turnover; P_2 – The decrease of the market share; P_3 – The used production equipment; P_4 – Low skilled staff (because of the staff's fluctuation); P_5 – Low quality products.

Once these problems are established, the three managers are asked to describe the interdependence between them. Three matrixes are formed, according to the three managers. The elements of these matrixes will be 0, 1, 2, 3 (0 – if the problems do not influence each other; 1,

if the problem placed on the line problem influences the problem placed on the column; 2, if the influence is quite powerful; 3, if the influence is very strong) (figure 4).

To simplify we make a reduction of each element of the amount matrix with 2x3 = 6 (if a negative value is acquired, the element will be 0). Starting from the resulted matrix, the correspondingly orientated graph is built. (figure 5).

Further, the B, C matrixes (figure 6) and the final oriented graph (figure 7) are successively prepared.

The situation is not simple. Surely the first approached problem must be P_4. Once this problem is removed, the four stay in a vicious circle. My suggestion is that the P_3 problem should be approached further – used production equipments. Solving this problem, respectively the buying of modern equipments should be done from external sources (leasing, banking credit) in order to overcome the conditioning that can be seen in the graph above, determined by P_1 – the reduction of the turnover. P_3 and P_4 being solved, conditionings for P_5, then we can approach P_5, then P_2 and, as a result of solving these problems, P_1 will be solved too – the decrease of the turnover.

General manager

	D_1	D_2	D_3	D_4	D_5
D_1	-	0	2	1	1
D_2	3	-	0	0	0
D_3	2	2	-	0	3
D_4	1	1	0	-	2
D_5	2	2	0	0	-

Financial manager

	D_1	D_2	D_3	D_4	D_5
D_1	-	0	3	3	1
D_2	1	-	0	0	0
D_3	3	2	-	1	3
D_4	3	3	0	-	3
D_5	3	3	0	0	-

Production manager

	D_1	D_2	D_3	D_4	D_5
D_1	-	1	2	2	1
D_2	3	-	0	0	0
D_3	0	0	-	0	3
D_4	1	1	0	-	3
D_5	1	3	0	0	-

The amount matrix will be:

	D_1	D_2	D_3	D_4	D_5
D_1	-	1	7	6	3
D_2	7	-	0	0	0
D_3	5	4	-	1	9
D_4	5	5	0	-	8
D_5	6	8	0	0	-

Figure 4. The matrixes of the influences

	D_1	D_2	D_3	D_4	D_5
D_1	-	0	1	0	0
D_2	1	-	0	0	0
D_3	0	0	-	0	3
D_4	0	0	0	-	2
D_5	0	2	0	0	-

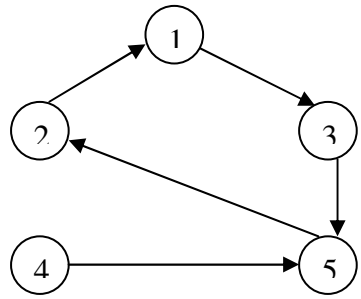

Figure 5. The simplified amount matrix and the associated graph

	D_1	D_2	D_3	D_4	D_5
D_1	1	1	1	0	1
D_2	1	1	1	0	1
D_3	1	1	1	0	1
D_4	1	1	1	0	1
D_5	1	1	1	0	1

	D_1	D_2	D_3	D_4	D_5
D_1	2	2	2	nd	2
D_2	2	2	2	nd	2
D_3	2	2	2	nd	2
D_4	1	1	1	0	1
D_5	2	2	2	nd	2

Figure 6. The synthesis matrixes of the influences (B, C)

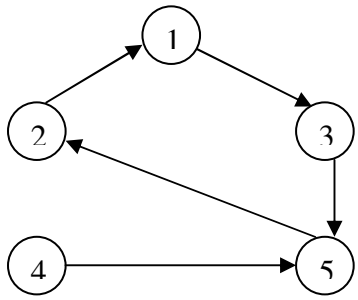

Figure 7. The final graph for the organization of the decisional situation

Conclusions

In this teaching aid we tried to discuss a problem that has not been approached in the Romanian literature yet, at least the one from the management field. Also, we tried to offer a solution to this problem, by adopting a very familiar model in the foreign literature.

The originality of the proposed solution comes from the fact that we tried a simplification of the classic model, very mathematical in its original version, to make it more accessible to the specialist from the management that do not necessarily have a solid mathematical knowledge.

We are not sure of the fact that the model offers the best solution. Keeping that in mind, as future research directions we propose ourselves: the testing of the model in real decisional situations, respectively the comparison and the emphasizing of the differences between the supplied solutions of this model with the ones supplied by other models.

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