Research methods for decision criteria analysis

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An interesting part of the decision analysis is the elicitation of the criteria used by the decision maker. This task is present in various studies – the author's example is the individual supplier selection decision. Interesting questions about values and objectives, and about the thinking processes of the decision maker in general can be answered by decision criteria analysis.

From methodological perspective, the examination of decision criteria is not an easy research task. Although one can get fast results by using some of the research methods, the results might be hard to interpret. There are certain cases when methods like Likerts scales and similar can (must?) be used because of various boundaries (for example the shortage of research "manpower", time, or financial resources) of the research project. This paper tries to show some weaknesses of such methods and presents the hipothesis that they might not answer our questions exactly, even if conducted properly. The hardest task is to interpret the results of these methods correctly. The author collects a few research techniques for decision criteria analysis, which could get us closer to understanding of the mental processes of the decision makers.

The methods presented are the Interpretative Structural Modelling, the Repertory Grid Analysis, Discrete Choice Analysis and Verbal Protocol Analysis. Evaluation of these methods from a decision theory perspective are present in the paper, as well as the methodological weaknesses of these research tools.

The author believes that there are certain factors biasing the results of decision criteria research (for examples overlooking the relationships between criteria, cognitive dissonance, social desirability and alike) and that the presented methods or their combination might eliminate some of these factors. Thus its view on the decision analysis tools is like that of a toolbox, even if these methods vary in character. The author believes that these methods – although more time consuming – could provide much deeper knowledge of the individual decision making processes than the simplier, widely used methods. That tradeoff can only be undertaken if this knowledge is valuable for the researcher or/and the management practice.

Keywords: decision analysis, decision criteria, supplier selection

RESEARCH METHODS FOR DECISION CRITERIA ANALYSIS

JUSTIFICATION OF THE TOPIC

Examination of decision criteria is a crucial part of decision analysis. Building knowledge about the criteria used in the process helps in uncovering real objectives, followed values and tradeoffs during decision making. Research of criteria is not an easy research task, and as decision situations get more complex, so does the complexity of this research problem rise. In this paper I focus my attention on the supplier selection problem. Since Dickson's study (1966) this has been a popular topic for different reasons. Researchers have tried to uncover what values do decision makers follow, striving to identify the "most important criterion". This knowledge was sought also by the field of industrial marketing trying to find out who to address and which advantages of their output is valued by buyers. For detailed review of the literature see for example Weber, Current and Benton (1991), DeBoer, Labro and Morlacchi (2001) and Sonmenz (2006). All these works give an overview of several decision tools supporting supplier selection and analyze the criteria used in this decision. These reviews also follow and describe the major trends and changes in supplier selection in the time interval reviewed. In further research tasks they express the need for better tools, and for better understanding of not just the choice phase of the decision, but also the previous phases.

THE SUPPLIER SELECTION PROBLEM

In this section I present the characteristics of the supplier selection problem from a decision theory perspective. From this point of view the supplier selection problem is a probabilistic problem (opposed to deterministic), because the outcome of choosing a certain alternative can not be predicted with certainty. In time, this problem is dynamical: the alternatives and the constraints change in time. When we take the number of variables into account, this problem is rather complex. (These three dichotomies form the classic problem space of Howard, 1968) The selection problem can be one-off decision, or regularly repeated. Depending on the decision maker this problem can be the subject of individual or group decision making in the organisation. The methods presented in this paper presume individual decision making (or asking one decision maker about a group decision, but I do not deal with the problematic issues of this case in this paper). In the well structured-ill structured dimension from Simon (Nevell and Simon, 1972) one can find supplier selection problems of both kinds.

This is true for nearly all the characteristics, it depends on the context: the product type, the relationship, the buying situation (see for example Sheth 1973, Robinson, Faris and Wind 1967) and similar contextual factors.

Although this is true, there is one characteristic, that I find as true for nearly all supplier selection problems: it is a multidimensional decision problem. It is appealing to believe that there are situations where really only one attribute is important, but I find these situations as marginal. In most cases the choice on one attribute is actually only the last phase of a longer decision process (which is for example preceded by screening) or the attributes are transformed to one attribute.

I will use terms criteria and attributes in this paper. I find terms multiattribute choice and multicriteria as synonyms for our present purpose.

THE “TRADITIONAL” METHODS

In this section I identify the most widely used methods for identifying supplier selection criteria. To start with, here is a non- (or quasi-) empiricist method: *the examination of the literature*. For example Weber, Current and Benton (1991) had done a precise review of the literature and tried to provide useful knowledge about the importance of various decision criteria in supplier selection. They made a parallel connection between the importance of a certain criterion and the frequency of its occurrence in the literature. There is a question of validity: do we measure the importance of a criterion for the decision maker, or the popularity of that criterion (or the ease of its research, or how interesting the criterion is...). Papers using these methods provide useful knowledge for creating the base of new research programs, but one might want to get a hand on a more empirical method.

Maybe the most simple method is the *simple ranking* of the criteria. This is the situation, when the researcher asks the subject to rank *n* number of criteria from *1* to *n*.

One step closer to the real thinking process of ranking is the explicit use of *pairwise comparisons* (this is maybe the most natural thinking process used even in the simple ranking – I use pairwise comparisons when I am asked to rank *n* criteria – but this is only a weak hypothesis). It is also time-consuming, but the advantage here is, that the decision maker has to concentrate always only on two criteria and their relative importance. This is the base of Saatys well known AHP model (Saaty, 1980).

Likert's scales is the most widely used attitude scaling method. In supplier selection problem the researcher asks the subject to mark the importance of a decision criteria in the decision process on the scale. This way the decision maker has to make only *n* judgments about the importance or relevance of the criteria.

SOME PROBLEMS WITH THE PRESENTED METHODS

There are certain factors justifying the use of the presented methods. They can be conducted through questionnaires, the answers are quantitative, seem comparable and easy to evaluate. Accepting that all the methods – these, and also those presented later – have their weaknesses, let's have a look at these.

In case of using for example fifteen decision criteria the subject might find using *simple ranking* exhausting. The other problem is that the distance between rankings can not reflect the psychological distances between two criteria: mathematically criterion 1 is as close to criterion 2 as is criterion 5 is to criterion 6, but the psychological “distances” may not be this regular in the mind of the subject. He might find the difference in importance changing – this difference may not be as significant between the fifth and sixth criterion as between the first two.

The *pairwise comparison* can be even more time-consuming, but its advantage is (what was the weakness of the simple ranking above) that here you can choose the strength of preference.

On *Likert's scales* there is no option to indicate small differences between the importance of certain criteria, and the decision maker is bounded by the scale – if you rate fifteen criteria on five points wide scales, you can distinguish only to a certain degree.

These are the mathematical problems, but there are some others. In case of the Likert's scales McGreevy mentions four biases – the centrality bias (when the decision maker avoids indicating extreme values on the scale), acquisence bias (when the question is formulated in positive way, subjects tend to agree more than in the opposite case), social desirability bias

(when the decision maker indicates what is good , acceptable for the community/society and not what he really thinks) and positivity bias (when the decision maker avoids indicating too many negative values) (McGreevy, 2007, p2).
Further, these methods cannot handle the causal connections between the criteria existing in the mind of the decision maker. If I am the subject, and in my thoughts criterion A affects criterion B, should I evaluate a product according to its B attribute or A attribute? Which one will I rank as more important in a research questionnaire?
The last problem I mention here is the problem of judgment model used by the decision maker. The presented research methods somehow include a premise of thinking in a compensatory model – that means that the attributes are handled in a parallel way, so judgments of one attribute does not precede that of the other. But what happens if decision maker uses a non-compensatory model, for example one of the lexicographic methods? In these methods in the decision theory we assume that the first criterion is the most important. Does the decision maker think in the same way? Or will he indicate the last criterion as more important?

THREE MORE CHARACTERISTIC METHODS

The first thing to note is: these are more sophisticated but also more time consuming methods. The author accepts that these methods require more time in the field, the presence of the researcher and extra time to evaluate the answers. On the other side, the results can be more in-depth compared to the previously mentioned methods.
I call these methods as "not traditional" because usage of these is not that widespread in decision analysis of the supplier selection process as of the methods presented above.
The methods I present here are the Repertory Grid Analysis, the Discrete Choice Analysis, the Interpretive Structural Modelling and the Verbal Protocol Analysis. Advantages and disadvantages are presented after each method.
Not all these methods are suitable for evaluation of the criteria. They are rather explorative methods; they can be used separately, but when used in combination with one of the traditional methods, they can help in correct evaluation of the results. They are suitable for the examination of different parts of the decision process: Repertory Grid for exploring the criteria, Interpretive Structural Modelling for handling causal relationships between criteria, Discrete Choice Analysis for tradeoffs and Verbal Protocol Analysis for research of the judgment model and the process of using criteria as a whole (these are not the only objectives of using these methods, but I tried to stress what is their main result).

The *Discrete Choice Analysis* is an experimental method. The decision maker is not asked to evaluate the importance of certain criteria. He is introduced with a set of fictional choices instead. The researcher creates a set of potential suppliers with *n* attributes. The potential suppliers in the set differ for example in geographic distance, price, quality and so on (the variation of such a fictional set is counted through an algorithm). The decision maker chooses one supplier from this set. Then he is presented with a different set, where the attributes are changed, and this process is repeated several times. As the attributes change, the choice of the decision maker may vary and this is why mostly the tradeoffs can be examined. What change in the attributes induces the choice of another supplier? This way it is a combination of simulation and sensitivity analysis. This and similar methods were used by Verma and Pullman (1998) and Cardozo and Cagley (1980). The advantage of the model is that it helps to reveal the real importance of a certain attribute, and it is done through a decision situation,

not individual and isolated judgments about criteria. The disadvantage is that on a certain market the setup of a fictional situation requires previous market research. The other methodological issue is that these are created, not real situations, so it is not precisely "how decision makers make their decisions" but "the way decision makers would decide if having no stake and constraints". It is partly in the hands of the researcher, how many of the real world constraints are taken into account by the subject. The interesting thing is that according to the results of Cardozo and Cagley (1980) the "buying game" is found by the purchasing agents as close to reality.

The traditional methods cannot handle the causal realtionships between attributes. What if the purchasing agent thinks that the speed of the delivery is the function of the geographic distance and the vehicle types of the supplier? Which criteria is then important? The distance and vehicles? Or the speed of delivery? Which should he mark as more important for example in a ranking method? The point is that it does not matter, what real causal relationships exist between the attributes. It is the mental model of the decision maker that matters.
Is it correct to ask for ranking in these cases? If one accepts that these causal relationships exist (in reality or in the mind of the subject) he might find the *Interpretive Structural Modelling* as the right method to get a picture about the causal net or hierarchy of criteria.

In the *Interpretive Structural Modelling* we ask the subject to reveal the criteria for decision making in supplier selection. Then the criteria are organized in a matrix and the subject should indicate the relationship between the pairs of criteria – a causal relationship; or there is a relationship, but cannot identify in what direction; or there is no relationship. Then through an algorithm (for this process see for example Mandal and Deshmukh, 1994) this matrix is transformed to a figure where the criteria are organized into a hierarchy depending whether they are rather influencers or rather influenced by other factors. The advantage of this method is that it reveals why a certain criterion is marked as important and others not.
The disadvantage is that the hierarchies can be hardly aggregated and the researcher does not get a picture about the importance of the criteria – although the hypothesis is that suppliers are selected through the criteria at the top of the hierarchy (so the through factors which are more dependent).

Another method is an in-depth explorative method. Its process can be very exhausting and might be hard to present to the the subject. This method is the *Repertory Grid Analysis,* which has its roots in the constructivist psychology of Kelly (Gaines and Shaw, 1993 refer to Kelly, 1955). According to this theory people differentiate things through a set of constructs, which are in terms of decision theory the attributes. Constructs are created to differentiate. The process of the method is easy, but it can appear as a game. The subject is asked to identify a set of possible alternatives – for example eight real, possible suppliers – where two or three should be suppliers which he would not choose. These eight alternatives are written to eight cards. The researcher picks three of them randomly and the subject has to find a construct (a criterion) according to which two of the alternatives are similar and one is different. For example the subject sees that on the three cards there are suppliers A, B and C. After thinking it through, he finds that A and C are never late with delivery but B is usually late. Then the construct will be the punctuality of delivery time, and there are two extremes of this construct: punctual and late. This way the researcher gets one criterion through which the subjects compare suppliers. Then the process is repeated: the three cards back in the pack, mixed and three cards picked again. With the rising number of iterations the subject runs out of objective constructs and starts to reveal his subjective criteria.

The disadvantage of this method is – besides that it looks like a game – that this way the researcher may find criteria which are really in the mind of the subject, but he does not use them in the process of decision making. Using this method does not tell anything about the importance of the criteria or the judgment model used by the subject (the order and way criteria are treated). It is useful in exploring the possible set of constructs, so this method could precede some of the simpler ones, when there is a doubt about the knowledge of the criteria set. For a short overview see the work of Gaines and Shaw (1993).

The last method presented here is a process-tracing method. The *Verbal Protocol Analysis* helps to uncover the mental processes during decision making. Information about the used criteria and the order and way of their usage can be gathered this way.
The subject is asked to give the researcher continuous verbal reports about his own mental processes, to "think aloud". "The researcher treats the verbal protocol as a record of the subject's ongoing problem-solving or decision behavior…"(Payne-Bettman, 2004,p115). The decision maker is introduced to a real or a fictional decision situation and thinks aloud while choosing. Dictaphones or cameras can be used to record this process. Depending on the time of the recording, protocols can be done real-time or retrospectively. Kuusela and Paul (2000) consider the concurrent protocols as better – they provide much more information and less rationalization. Crow et al.(1980) mention that this method is widely used on extremely small samples: they present examples of sample size from one to six. These small samples can be justified by the fact that the method is explorative and thus can be a base for creating theories or models even on a small sample.
The method is unique because most of the methods focus on the criteria used or the result of the decision, but none on the process: how alternatives are compared, in what order criteria are used and how decision is reached. It is a trial look-in into the black box of human mind, but it can never be that precise: the observation of the human mental processes is impossible, so it is impossible to control, what correlation exists between what the subjet thinks and what does he refer about (according to Bainbridge et al., 1991 p160.) Even if this is true, we can say that we will not get closer to the real processes than this, and that for explorative purposes this qualitative method is really useful.
The „weirdness" of this method is one of its disadvantages. How many researchers have already asked the subject to think aloud? Maybe no one, never. The process will therefore be less effective: the subject would make his decision much faster, but during this process a certain part of his mental capacity is used for formulating his words about his thoughts. The main disadvantage of the method is the loads of work with coding and evaluation of the protocols.
The four methods described above are summarized with their advantages and weaknesses in table 1.

Table 1. Advantages of and possible problems with using the four methods described

Method	Focus	Advantages	Possible problems
Verbal Protocol Analysis	The whole cognitive decision process	Provides knowledge about all conscious elements of the process	May be problematic to conduct concurrent analysis Validity problems
Interpretive Structural Modelling	Causal relationships among criteria	Better interpretation of the relative importance of criteria	A list of criteria is needed in advance
Repertory Grid Analysis	Decision criteria	Subjective criteria are revealed as well	Criteria found may not be used
Discrete Choice Analysis	Decision strategies, tradeoffs	Generates real-time observable decision process	Precise knowledge of the decision characteristics is needed to create relevant situations

The author's own summary

A FEW POSSIBLE BIASING FACTORS

When asked to indicate the criteria used during decision making, the answers of a subject may be biased by several factors. I am planning to use some of these methods in research and I am preparing to wipe out the possible validity threats to this research. As the first step, I started to write a list of the possible biases. This list will surely grow longer during the research and I will have to find proper tools to eliminate these biases, or at least identify them. In this stage these are only assumptions, which could prove to be true in research. The majority of them are based on experiences of managers (for example the first two on the list), or are deducted from theory (the last two, if there really exists a hierarchy proposed by ISM). The list below is only an intuitive collection of possible biases, but there are certainly more of them. A few can be tested – even if raising some ethical issues, but the main thing is to realize the effect of these factors and, if possible, handle them by using the proper tools.

- When a purchasing agent can choose whether he mentions an objective or subjective (or intuitive) decision criterion, he would choose to mention the objective. This can happen in an organizational culture where rationality is sought.
- He judges a criterion as important, if there was a previous decision, where the selected alternative is good in this attribute – othervise he would claim he did not choose correctly then.
- Knowledge I. He reads books, meets various research questionnaries and has already learnt which are the examined criteria. He might judge these as important (“These are the popular – according these I should choose” or “I will look professional using these”) or unimportant, to claim his individality.

- Knowledge II. He knows what does the researcher search for. If a researcher introduces himself as doing a research in greening the technologies, the subject might claim to follow environmental objectives even if he does not.
- We do not know what will he sign as the “most important” criterion if thinking in a non-compensatory model: the first criterion, with which he screens the set of alternatives, or the last criterion, which helps him to choose between the few alternatives at the end.
- If there is a (real or hipothesized) relationship between two attributes, we do not know whether he will sign the influencer or the dependent as more important.

Some of these issues are handled better by the non-traditional methods presented here (but others may not be), but it is clear that no method can eliminate all of these biases. Rather we could choose using the right combination of methods.

CONCLUSION

Summary

This paper does not argue to leave the traditional methods of decision criteria research. Rather it offers four less known research methods that can help where the weaknesses of the traditional methods occur. Short descriptions of these methods, and references to literature are offered in the paper. Of course there is no possibility of using all techniques and it seems there is no perfect technique. The researcher is bounded by several constraints, so he has to choose the best methods that suit his research objectives.

Further research

Me myself plan to use some of these methods in my thesis. After that experience I should be able to continue this paper and offer empirical evidence and examples which are absent in this paper. Methods could then be evaluated according to their usability, the quality of data they provide or generate, and in general the knowledge these methods help to gain.

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