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A fuzzy-based decision model application on strategic management

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In this article, the objective is to demonstrate the effects of different decision styles on strategic decisions and likewise, on an organization. The technique that was presented in the study is based on the transformation of linguistic variables to numerical value intervals. In this model, the study benefits from fuzzy logic methodology and fuzzy numbers. This fuzzy methodology approach allows us to examine the relations between decision making styles and strategic management processes when there is uncertainty. The purpose is to provide results to companies that may help them to exercise the most appropriate decision making style for its different strategic management processes. The study is leaving more research topics for further studies that may be applied to other decision making areas within the strategic management process.

Key words: Strategy, strategic management, decision making, decision styles, fuzzy logic.

INTRODUCTION

Decision making is one of the most important activities for managers. Over the years, researchers have discussed the influence of the ability of managers on organizational outcomes. Some authors have argued that managers have a remarkable impact on organizational performance. Robins (1999) describes in his book the manager's impact as the essence of the manager's job and a critical element of organizational life. Meanwhile, Rowe (1994) suggests that decision making is synonymous with managing. Different kinds of computer-based information systems have been developed to support decision making and decision support systems, group support systems and executive information systems. In order to be a more competitive organization in though market conditions, it is widely agreed that managers must make good decisions which affect their organizations significantly.

In this study, it is considered that by using fuzzy logic methodology, we can propose good examples of decision making in strategic management and present a useful application. In this study, different styles of decision making in strategic management process will be discussed and it will be tried to propose the most adequate decision making style using the fuzzy logic method. The study is going to leave topics for further research so that the model can be approved afterwards by applying data to different techniques of fuzzy logic.

FUZZY LOGIC

Zadeh (1965) published the first fuzzy set theory. Zimmermann (1991) explained fuzzy set theory as a strict mathematical framework in which vague conceptual phenomena was precisely and rigorously studied. The theory can also be thought as a modeling language which suited well for situations that were containing fuzzy relations, criteria and phenomena. Afterwards, Rowe (1994) proved the portfolio matrix and 3Cs model which

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were enabling companies to analyze their strategic business units and projects, and providing strategic directions in an efficient way. This has not worked very well. Certain values in decisions making are not always correct because there are always vague processes and it is difficult to estimate decision making processes with an exact numerical value. Pap and Bosnjak (2000) defined the main problem of using the classical portfolio matrix as the precise determination of the numerical value for the criteria. As a result, it would be useful to use the linguistic assessments which have been introduced by Zadeh (1965) and Bellman (1970) instead of numerical indicators.

Fuzzy number and linguistic variable

Dubois and Prade (1970) defined the fuzzy numbers. They described its meaning and features. A fuzzy number $\tilde{N}$ is a fuzzy set whose membership function is $\mu_{\tilde{N}}(y): R \rightarrow [0,1]$. A triangular fuzzy number $\tilde{N} = (a,b,c)$ can conform to different set of *a, b, c* characteristics. If we explain those characteristics in management terms, *a* value is the optimistic estimate, when everything goes great. The value *b* is the most likely estimate, which implies that the situation is neither very good nor very bad. The *c* value is a pessimistic estimate, when everything goes badly.

Zadeh and Bellmann (1970) defines a linguistic variable as a variable whose values are not numbers but words or phrases in a natural or synthetic language. In a problem when we are working on linguistic variables, we can present their means. At that moment, we can rate and weight the various conditions by using the fuzzy numbers and linguistic variables. Linguistic variables represent the relative importance and appropriateness of each ranking method that simultaneously considers the metric distance and fuzzy mean value is proposed. The distance from the ideal solution and the fuzzy mean value are the usual criteria for ranking fuzzy numbers.

Moon et al. (2000) define fuzzy numbers as if *Y* is a collection of objects represented by the generation of *y*'s, then a fuzzy set $\tilde{N}$ in *Y* is a set of ordered pairs:

$$\tilde{N} = \{(x, \mu_{\tilde{N}}(y)) \mid y \in Y\}$$

$\mu_{\tilde{N}}(y)$ is the membership function or grade of membership of *y* in $\tilde{N}$ that maps *Y* to the membership space *N* (when *N* contains only the two points 0 and 1, $\tilde{N}$ is no fuzzy and $\mu_{\tilde{N}}(y)$ is identical to the characteristic function of a no fuzzy set). The range of the membership function is a subset of the nonnegative real numbers whose

supreme is finite. Elements with a membership of zero degrees are normally not listed. The authors characterize a linguistic variable by a quintuple $(y, F(y), A, B, \tilde{N})$ in which y is the name of the variable; *F(y)* denotes the term of y set; for example the set of names of linguistic values of y, with each value being a fuzzy variable denoted generically by *Y* and ranging over a universe of discourse *A* that is associated with the base variable a; *B* is a syntactic rule for generation of the name, *Y*, of values of *y*; and $\tilde{N}$ is a semantic rule for associating with each *Y* its meaning $\tilde{N}(y)$ which is a fuzzy subset of *A*.

When it comes to taking objective decisions in management, we know the difficulty in evaluating them by binary definite numbers 0 and 1s. Therefore, in this study, we use transform linguistic expressions which can be transformed to numerical values easier. We propose the following semantics for the set of three terms to point different styles of decisions on the strategic management process:

A) HIGH = (High-High, High-Medium, High-Low)
B) MEDIUM = (Medium-High, Medium-Medium, Medium-Low)
C) LOW = (Low-High, Low-Medium, Low-Low)

Each of these three semantics also includes three other semantics which enables us to evaluate the decisions in wider intervals. This approach facilitates us to value easier, the relationships between decision making styles and strategic decisions when it is hard to link them in an objective way (Aluja, 1998; Lafuente, 2002).

In this study, we represent every linguistic semantic by the following numeric values:

A) HIGH = (0.9, 0.8, 0.7)
B) MEDIUM= (0.6, 0.5, 0.4)
C) LOW = (0.3, 0.2, 0.1)

In the study, triangular fuzzy numbers are used and therefore, the aforementioned semantics are presented in Figure 1.

STRATEGIC DECISION MAKING AND DECISION MAKING STYLES

Ultimately, in management research topics, strategic decision making has become one of the most appealing areas. Behavioral decision theory and transaction cost economics have fed the area and the studies about strategic decision making have increased during 1990's (Schwenk, 1995). Although there are many studies about this area, the knowledge of strategic decision making is inadequate. Eisenhardt and Zbaracki (1992) implied in
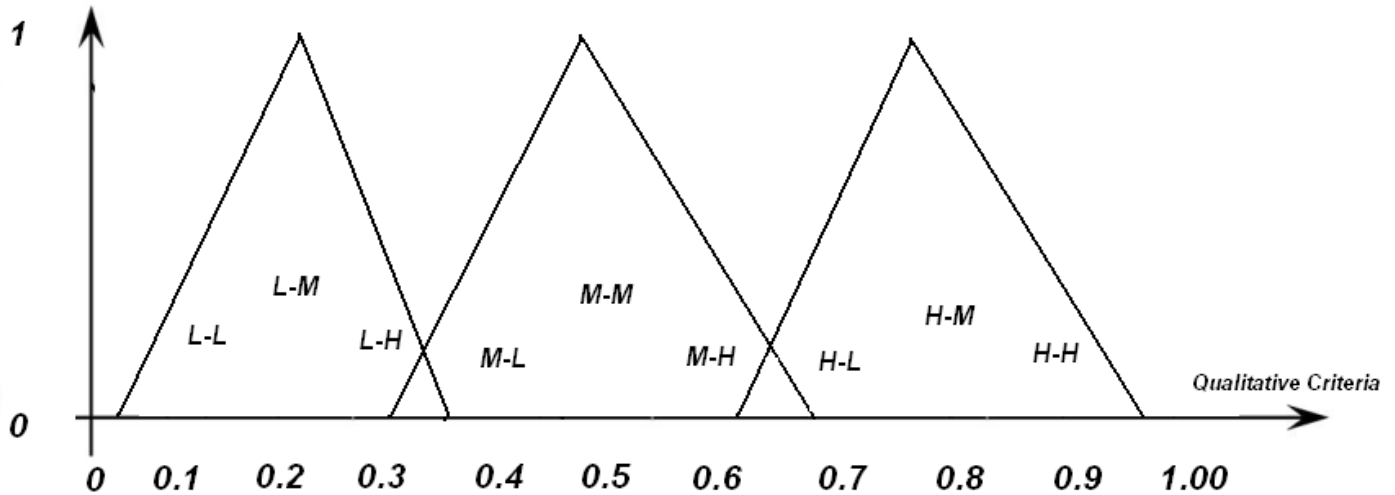
Figure 1. The membership functions for fuzzy numbers according to the depending qualitative criteria.

Figure 2. Decision style model (Rowe and Boulgarides, 1994).

their study that strategic decisions have vital roles for companies but strategy process subject has not been researched considerably from a stage of being based on mature paradigms and incomplete assumptions.

Strategic decision making and different styles of decision making are strongly connected. For this reason, when we are talking about strategic decision process, we should also investigate decision making styles. In the

literature, there are many types of decision makers and decision making styles. For example, in the 1980's, there were studies that investigated personality types and therefore different decision making styles. More recently, Rowe and Boulgarides (1994) proposed a model of decision styles that recognizes the influence of values and perceptions. In Figure 2, their model is shown. Rowe and Boulgarides in their model suggest that decision

Table 1. Semantic representations of the relations between decision making and management styles.

Decision making style / strategic decision	New business investment	New product introduction	Pressure	Decision uncertainty	Threat/crisis
Analytic	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)
Conceptual	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)
Directive	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)
Behavioral	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)	(H, M, L)

makers are driven by four forces.

The four forces – directive, analytic, conceptual, and behavioral – can be related to the typology of needs developed by McClelland (1962) who had proposed that behavior is motivated by the needs for achievement, power and affiliation. Subsequently, he recognized that the need for achievement may be satisfied in two different ways, either intrinsically by taking on new challenges or extrinsically by receiving praise and recognition. According to Rowe and Boulgarides, the primary need of directive decision makers is power. They are results oriented, but also want to dominate others. They have a low tolerance for ambiguity and prefer low levels of cognitive complexity. This preference limits the amount of information that they gather and the number of alternatives that they consider. Analytic decision makers have a strong need for achievement in the form of new challenges. They have greater tolerance for ambiguity than their directive counterparts. Their comfort with cognitive complexity strongly encourages data collection and processing. They make decisions slowly because they want to examine the situation thoroughly and consider many alternatives systematically. Conceptual decision makers are achievement oriented like their analytic counterparts, but crave extrinsic rewards, such as praise, recognition, and independence. They are comfortable with a high degree of cognitive complexity and also have a strong people orientation. Conceptual decision makers typically gather information from multiple sources and consider many alternatives. They tend to take a long-term perspective, exhibiting considerable creativity and idealism. Behavioral decision makers are driven primarily by a need for affiliation. This type has a low cognitive complexity, but a strong people orientation. Behavioral style managers tend to communicate easily and be very concerned with the well-being of their peers and subordinates. They are typically receptive to suggestions, willing to compromise, and prefer loose controls. It is interesting to analyze different styles of decision making. In their study, Rowe and Boulgarides (1994) present a decision style inventory (DSI) to measure the relative propensity to make use of the four decision styles. This instrument does not measure absolute values on each style. Instead, scenario-based items

are used to determine the relative scores of either an individual or a sample drawn from one population compared to samples drawn from other populations or the population as a whole (Martinsons and Davison, 2007). In the end, DSI is a useful utility to compare the decision-making styles of specific individuals or groups. Likewise, in the other studies, the inventory's reliability and validity have been confirmed. It has "a very high face validity and reliability.

Application

In this study, our objective is to find out the best decision making styles that we have presented earlier for the different strategic management processes. In order to do that, in Table 1, the study presents a matrix that refers to the correlations between different kind of management strategies and different strategic decisions. The decisions presented further, pertain to different styles of management:

a) New business investments: Consist of the decisions of acquisitions, mergers, joint ventures, new company establishment, and investments in capital equipment and also consists of internal reorganization investments such as information systems, internal reorganization.
b) New product introduction: It concerns expansion of production equipment, storing facilities, modernization of production equipment, and investment in the marketing domain (Papadakis et al., 1998).
c) Pressure: It is the extent of pressure exerted either on the organization or the time pressure felt by the participants in the strategic decision process. (Beach and Mitchell, 1978)
d) Decision uncertainty: As Beach and Mitchell (1978) imply, it is the composite variable which consists of three 7-point Likert-type scales measuring the uncertainty about actions to be taken, general uncertainty surrounding the decision, and uncertainty concerning the information to be collected.
e) Threat/crisis: Is a variable that consists of two scales measuring the extent to which the SD is perceived as a crisis situation and the second the threat of financial loss.

(Billings et al., 1980)

CONCLUSION AND FURTHER RESEARCH

In this study, a fuzzy based model which can be applied in strategic decision making process was proposed. Four kinds of decision making styles (analytic, conceptual, directive and behavioral) and five kinds of strategic decisions (new business investment, new product introduction, decisions under pressure, decisions with uncertainty and decisions among threat/crisis) are presented and in further studies, the correlations between those decision making styles and strategic decisions can be identified and pointed by fuzzy numbers according to their correlations; H = High = (H-H, H-M, H-L) = (0.9, 0.8, 0.7); M = Medium = (M-H, M-M, M-L) = (0.6, 0.5, 0.4); L = LOW = (L-H, L-M, L-L) = (0.3, 0.2, 0.1). From here, a fuzzy model can be presented and the results can be discussed. It is also considerable that a fuzzy-based AHP model can be applied which can be built on the model that was presented in this study. Once the correlations between decision making styles and strategic decisions are recognized, the practical business and managerial results can be shown in further research.

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