Fuzzy expert marketing-mix model

Expertní fuzzy model pro marketingový mix

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Abstract: A marketing-mix setting model is presented. The all four P's are integrated and identified. The model makes strong utilization of relevant experts' knowledge and expertise through a fuzzy-decision-making system tailored to dynamically set the marketing-mix periodically in response to changing business environment. Quantitative, qualitative, uncertain, and vague variables are handled necessary to provide a realistic solution. The proposed model is particularly applicable to changing business environments that are full of such qualitative, stochastic, uncertain, and vague variables as in the case of agricultural business (e.g., agro-food companies, fertilizers and agro-chemical producers), and generally applicable to any other business sector. The method can be considered as the fuzzy-expert system for determining values of the marketing decision variables.

Key words: marketing-mix, fuzzy-decision-making system, stochastic variables, subjective variables, fuzzy expert system

Abstrakt: Článek popisuje výkonnou metodu pro nastavení marketingového mixu. Metoda silně využívá relevantní znalost experta a expertízy prostřednictvím fuzzy systému pro podporu rozhodování, který je uzpůsoben tak, aby periodicky dynamicky nastavil marketingový mix v souladu se změnami podnikatelského prostředí. K získání realistického řešení se využívají kvantitativní, kvalitativní, nejisté a neurčité proměnné. Navržená metoda je obzvlášť vhodná pro turbulentní podnikatelské prostředí se spoustou náhodných, neurčitých a nejistých proměnných, což je typické pro agro-potravinářský komplex (od prvovýroby přes zpracovatelský průmysl až po obchodní řetězce, včetně výroby vstupů, např. hnojiv, herbicidů, pesticidů, ap.). Metoda je ale dostatečně obecná pro použití i v jiných sektorech. Metodu lze považovat za fuzzy expertní systém pro určení hodnot marketingových rozhodovacích proměnných.

Klíčová slova: marketingový mix, fuzzy systém pro podporu rozhodování, stochastické proměnné, subjektivní proměnné, fuzzy expertní systém

INTRODUCTION

Philip Kotler (1972) has defined marketing management as the analysis, planning, implementation, and control of programs designed to bring about desired exchanges with target audiences for the purpose of personal or mutual gain. One of the most critical marketing management decisions is that decision of setting the marketing mix values, and selecting and employing strategy that periodically changes that marketing mixes in response to changing business environment. The marketing mix problem involves setting the values of the marketing decision variables; the four P's; namely, Product (its quality), Price, Place (distribution and sales-force expenditures) and Promotion (advertising, selling). Developing an effective marketing mix is important for product planners seeking to gain competitive advantage in industrial markets. The decision regarding specifying the marketing mix depends on a set of variables, the majority of which are **stochastic**, **dynamic**, **vague** or **inexact**, and **qualitative** or **intangible;** such as competitor's price, competitor's product quality, competition level, forecasted sales and others**.** These types of variables necessitate adoption of appropriate approaches that can deal with such variables' nature. These variables natures are inherent in various business sectors, specially in case of agriculture business, like agro-food companies, producers of fertilizers, and other agro-chemical products, where the existence of some stochastic variables such as climate, forecasts, demand and a varieties of qualitative variables like food safety, availability, competition, etc. The proposed model is generally applicable to any business sector or industry and specially useful and appropriate in the situation where stochastic, qualitative and vague variables are inherent in the inputs to the problem.

LITERATURE REVIEW

Traditionally, the problem of setting the marketing-mix has been dealt with in a partial manner, in the sense that most of the articles considered only one element of such mix at a time. For instance, in 1987 Magruth, and Kenneth (1987) provided three major criteria for evaluating marketing channels. In 1989, Lyrch and Hooky (1989) explored the question of possible changes in industrial advertising practice by focusing on the advertising budgeting approaches revealed in recent large-scale U.K. survey. In 1995, Earl Cox (1995) described a model for new product pricing. The model combines the expertise of financial, marketing, sales, and manufacturing management to develop a recommended initial pricing position for a new consumer product. This pricing model showed how fuzzy rule-based system can combine the intelligence of several experts into a single, cohesive process. Little literature attempted to deal with the stochastic, vague and qualitative nature of variables, which inherently affects such marketing decision or provide a whole method for setting the four P's and also very little ones that have considered the practical expression of product quality and integrating it with other 3 P's. However, in attempting to treat the problem from a total perspective, Bay Arinze (1990) in 1990 described a computer-based marketing decision support system to support planning strategy for marketing and as an expert system shell aid in the selection of marketing mix variables' values. In 1992, Arinze and Burton (1992) developed a simulation model as the heart of a marketing decision support system (MKDSS) to model the stochastic element of the marketing mix, marketing dynamics, the interactions between marketing instruments and competitive effects, to support decision making process and developing the marketing mix. In 2001, Fazlollani and Vahidov (2001) attempted to extend the effectiveness of simulation-based DSS through genetic algorithms. They applied a hybrid method based on the combination of Mont Carlo Simulation and GA to the marketing mix problem to improve the process for searching and evaluating alternatives for decision support.

PROBLEM STATEMENT

Philip Kotler stated that surely among the most difficult business decisions are those that have to do with marketing. The variables in marketing problem do not generally exhibit neat quantitative properties; attitudinal variables play a large role in marketing; marketing decisions must be made in the context of insufficient information about processes that are **dynamic**, **nonlinear, lagged, stochastic, interactive,** and **downright difficult.** Also many essential factors affecting the response to the mix can be assessed only based on the experts opinions in form of If-Then. In addition, Kotler stated that the main obstacles standing in the way of more fruitful marketing application of linear programming in determining the marketing-mix are nonlinearities, product and marketing mix interactions and lack of reliable data. The major recourse may be to plug in the estimates of company's experts. Consequently, there must be an appropriate methodology to deal with marketing problems that can handle vagueness, uncertainty and that can treat the dynamic nature of such problems. One way is to use **fuzzy logic sets** (Zadeh 1969; Ross 1995; Dweiri, Meier 1996), which effectively handle vague, inexact, stochastic input variables, and treat the dynamic nature of such variables.

THE AIM AND METHOD

The aim of the article is to develop an appropriate and efficient model to deal with an important marketing problem, the determination of current-period marketing-mix of company's products. The model is considered appropriate in the sense that it handles vague, inexact, stochastic, dynamic input variables to such problems; and is considered efficient in the sense that it makes a decision regarding marketing mix based on aggregation of opinions of company's experts, some of their opinion may be conflicting. It is also considered efficient in the sense that they can manipulate any kind of variables, regardless of their quantitative or qualitative nature. The model is based on fuzzy-decision-making-system, and is to be used as a reliable expert system to determine the marketing-mix for each product. Consequently it could also be used to perform marketing allocation in proportion of determined marketing mixes.

In order to develop the fuzzy marketing-mix model, the basic logical and causal relationships between marketing-mix (product quality, price, distribution expenditures, and advertising and promotion expenditures) and the various input variables and factors affecting such decision should be identified. Fuzzy-decision making system is then used to model such relationship.

Fuzzy marketing-mix model

The marketing-mix problem is a typical problem, which involves vague and uncertain type of input

variables and dynamic, non-linear relationships. The problem involves setting the values of the marketing decision variables; the four P's (Product quality, Price, Place - distribution expenditures and Promotion - Advertising, selling and promotion). The input variables to the marketing mix problem may be classified into:

- Current objectives and targets
  - Target sales
  - Target profit, etc.
- Recent (Current) development and performance
  - Last sales and profit
  - Competitor's last sales and profit
  - Last and current marketing effort
  - Company's competitive position or strength, etc.
- Changing market environmental conditions
  - Forecasts (expected sales, expected marginal market response, economic variations, etc.)
  - Competition level,
  - New opportunities
  - New threats, etc.
- Company financial capability
  - Available budget.

Looking over such input variables; some of them, particularly the forecast of sales, are a variable whose value is uncertain. Competitor sales, advertising and distribution expenditures are variables whose values cannot be known exactly, but can be expressed as high, low, with associated center or mean value. Variable like marginal market response, whose value is vague, and cannot be determined exactly, or cannot be assured to be fixed, as it is based on estimation or extrapolation of unreliable data. Subjective factors such as competition levels, and company's competitive positions, for which quantification is based on pure judgment of company's experts and consequent human judgment, should be viewed as vague. The relationship among targets, economic conditions, developments, and other input variables from one side and the marketing-mix setting in the other side is non-linear and difficult or cannot exactly defined unless it is expressed in forms of experts' If-Then decision rules. It is now clear and evident that one way to handle all such aspects of the marketing mix problem is the use of fuzzy logic sets, which effectively handle such vague, uncertain, subjective inputs and efficiently model nonlinear relationships between problem inputs and outputs. Moreover, fuzzy logic makes vigorous use of company expert's knowledge, intuition, and expertise in form of If-Then rules and in such situations in which this is considered more convenient.

Fuzzy marketing-mix model of an ABC company: A detailed illustrative example

An application of the fuzzy marketing mix model to an ABC profit-company will demonstrate how fuzzy methodology is adequate to utilize in such marketing problem. The model is based on the Fuzzy decision-making system (FDMS) adapted to model the marketing-mix relationship. The model maps the input variables that mostly affect the values of marketing decision variables into output variables, which are the marketing-mix settings:

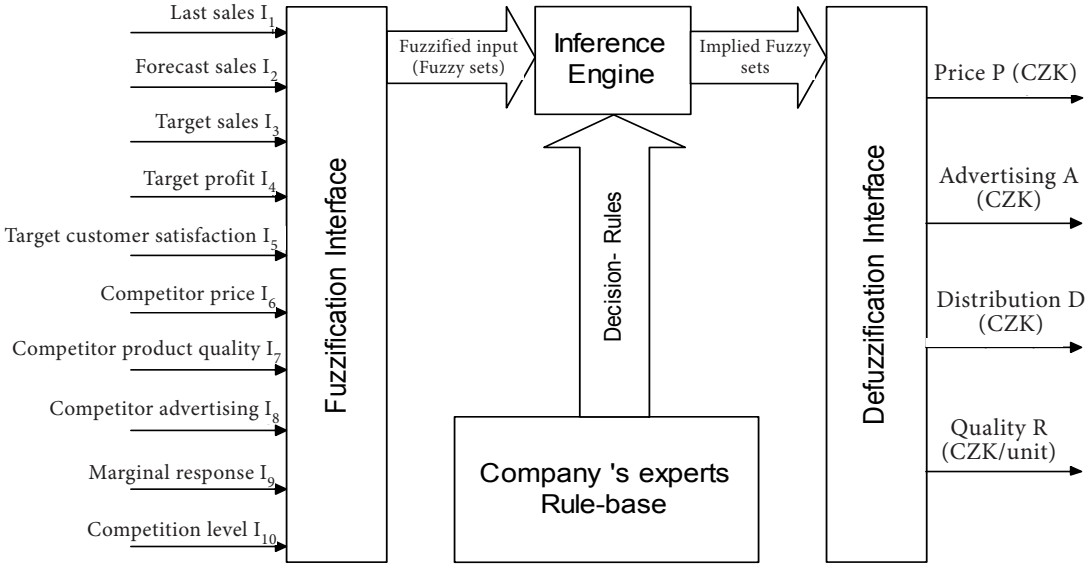

Figure 1. Fuzzy marketing-mix model

– Price (P) (CZK/unit)
– Advertising, personnel selling, and promotion expenditures (A) (CZK)
– Distribution (only short-term adjustable sales force and delivery cost) (D) (CZK)
– Product quality (ranging from 0 to 2, with an average 1).

These output variables of the model are fixed, whereas the input variables selection is based on the company's expert's viewpoints and knowledge of their market environment. Supposing that the company's experts have recognized that the following input variables mostly determine the marketing-mix:

– I_1 : Last sales (CZK)
– I_2 : Forecasted sales (CZK)
– I_3 : Target sales (CZK)
– I_4 : Target profit (CZK)
– I_5 : Target customer satisfaction (CZK)
– I_6 : Competitor's price (CZK/unit)
– I_7 : Competitor's product quality.
– I_8 : Competitor's advertising (CZK)
– I_9 : Marginal response (CZK sales/CZK marketing expenditures)
– I_{10} : Competitive level.

The product is assumed to be distributed to specific customer type (segment) and specific sales area, so the input variables are identified for such specifics. Figure 1 depicts the fuzzy marketing-mix model for the ABC company.

Fuzzification interface

The values of input and output variables are fuzzified. Based on opinion of experts and analysts, triangular membership functions with five fuzzy sets are used. Except for the variable competition level, five fuzzy sets are used for all other variables: "Very Low" as VL,

Table 1. Product quality and corresponding unit manufacturing cost

Product quality rating	Unit manufacturing cost (CZK/unit)
0	8
0.5	12
1	16
1.5	20
2	24

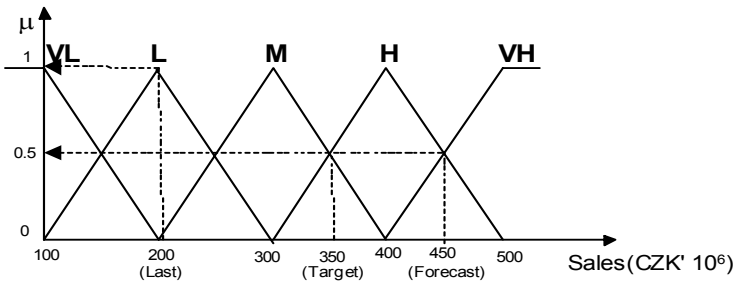

Figure 2. Fuzzification of sales

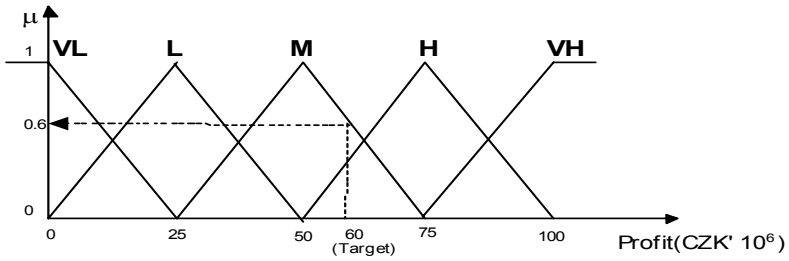

Figure 3. Fuzzification of profit

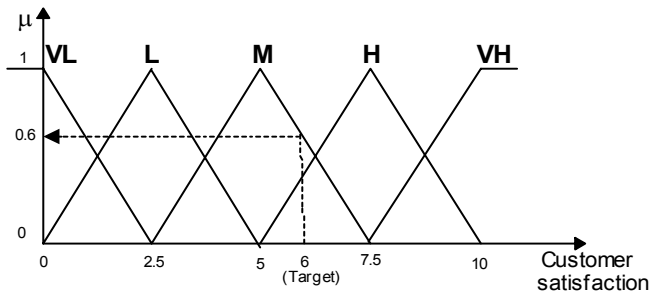

Figure 4. Fuzzification of customer satisfaction scale

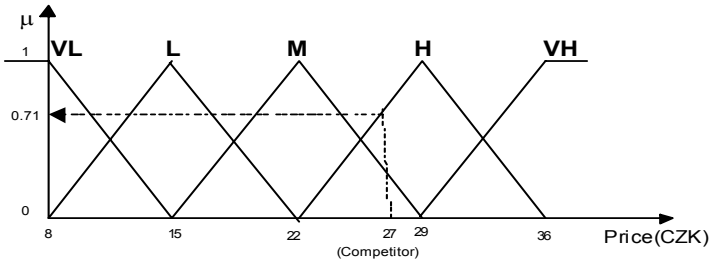

Figure 5. Fuzzification of price

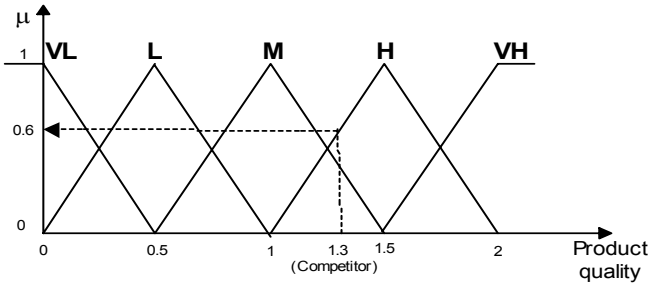

Figure 6. Fuzzification of product quality rating

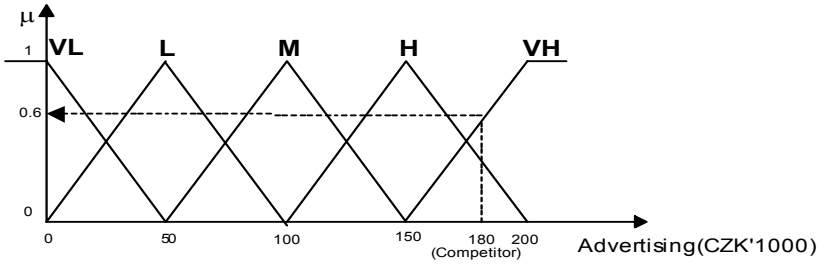

Figure 7. Fuzzification of advertising expeditures

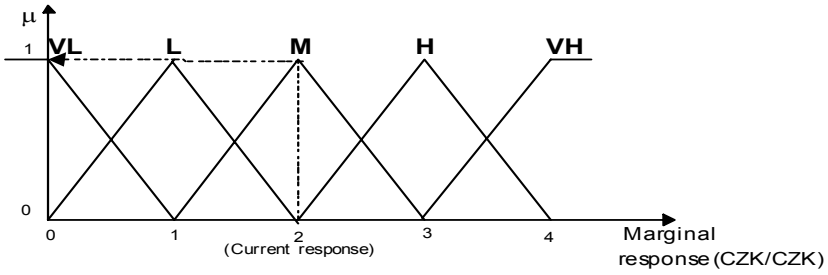

Figure 8. Fuzzification of marginal response

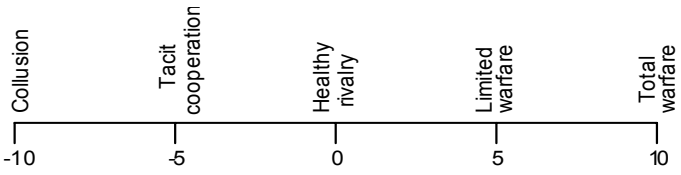

Figure 9. Spectrum of competition states

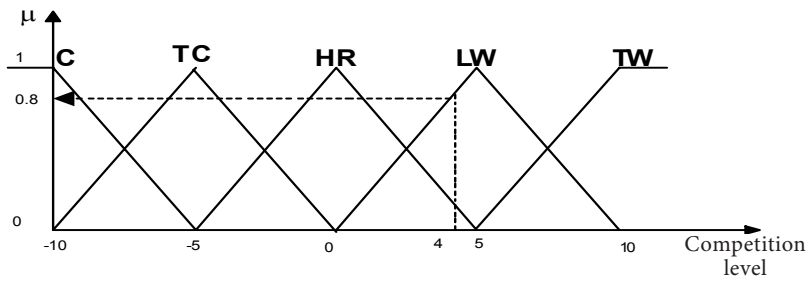

Figure 10. Fuzzification of competition level scale

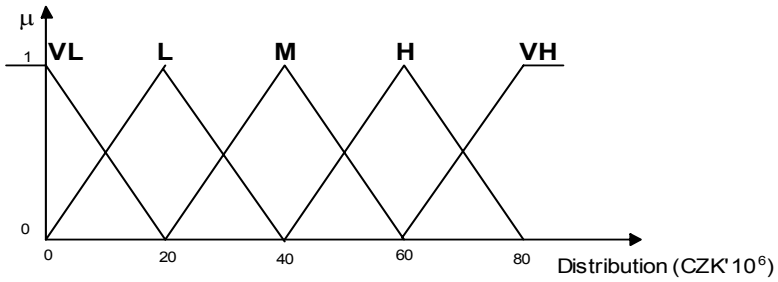

Figure 11. Fuzzification of distribution budget

Table 2. Fuzzy sets and associated membership degrees of current input values

Variable name	Fuzzy set	
	label	μ (degree of membership)
Expected sales (I_1)	Low	1
Forecasted sales (I_2)	Very High (default)*	0.5
Target sales (I_3)	High (default)	0.5
Target profit (I_4)	Medium	0.6
Target customer satisfaction (I_5)	Medium	0.6
Competitor's price (I_6)	High	0.71
Competitor's product quality (I_7)	High	0.6
Competitor's Advertising (I_8)	Very High	0.6
Marginal response (I_9)	Medium	1
Competition level (I_{10})	Limited warfare	0.8

*Default fuzzy set is the next higher

"Low" as L, "Medium" as M, "High" as H, and "Very High" as VH. The spectrum of competition states (Kotler 1972) shown in Figure 9 is specially used to rate and fuzzify the competition level value by the expert. The maximum operator to resolve partial membership in two fuzzy sets is used to determine fuzzy sets for actual current values of variables. For instance, in Figure 3., the value of target profit I_4 = 60 belongs partially in two fuzzy sets "Medium" with degree of membership, μ = 0.6 and "High" fuzzy set with the degree of membership, μ = 0.4. Then, the maximum operator assigns this value to the fuzzy set, which has the maximum degree of membership; here the "Medium" fuzzy set. In case of equal values of degree of membership, such as in Figure 2, the fuzzy set with greater center value is chosen. Figures 2–11 shows the fuzzification of input and output variables as specific to our example. The identified fuzzy sets and associated truth of current period actual values of inputs are determined and shown in Table 2.

Rule-base

The rule-base contains expert's decision rules that govern the translation of input variables into marketing-mix settings; that are the product quality (R), price (P), distribution (D), and advertising (A). The mapping from input variables into output marketing mix model is based on completely adaptive strategy that produce periodic changes in the marketing mix in response to all current development including, passage of time, changes in own and competitor's sales and profit and changes in the competitor marketing mix. In addition, such decision rules structured to ensure consistency between product quality and price, then distribution expenditures with quality and price and then advertising expenditures with quality, price and distribution. This is done through first determining the product quality, according to the affecting factors, then the quality is added as an input variable in determining the price decision, and so on. Below are the ABC company's experts' decision rules tabulated in Tables 3–19.

i **Decision rules determining company's product quality (R) –** Tables 3–8
ii **Decision rules determining company's (product) price (P) –** Tables 9–11
iii **Decision rules determining company's distribution expenditure (D) –** Tables 12–15
iv **Decision rules determining company's advertising expenditure (A) –** Tables 16–19

Table 3. Relationship between last sales and competition and the consequent product quality

	Then R	If last sales				
		VL	L	M	H	VH
And if competition level	Collusion	M	M	M	M	M
	Tacit coop.	M	M	M	M	M
	Healthy rival.	H	H	H	H	H
	Limited war.	VH	VH	VH	VH	VH
	Total warfare	VH	VH	VH	VH	VH

Table 4. Target profit and the consequent product quality

Then R	If target profit				
	VL	L	M	H	VH
	L	L	M	H	H

Table 5. Relationship between forecasted and target sales and the consequent product quality

	Then R	If forecasted sales				
		VL	L	M	H	VH
And if target sales	VL	M	M	L	L	L
	L	M	M	L	L	L
	M	M	M	M	M	M
	H	H	H	H	H	H
	VH	VH	VH	H	H	H

Table 6. Target customer satisfaction and the consequent product quality

Then R	If target customer satisfaction				
	VL	L	M	H	VH
	L	M	M	VH	VH

Table 7. Relationship between competitor price and product quality, and the consequent company's product quality

	Then R	If competitor price				
		VL	L	M	H	VH
And if competitor product quality	VL	L	L	L	L	L
	L	M	M	M	L	L
	M	H	H	H	M	M
	H	VH	VH	VH	H	H
	VH	VH	VH	VH	VH	VH

Table 8. Marginal response and the consequent product quality

Then R	If marginal response				
	VL	L	M	H	VH
	VH	H	M	M	L

Table 9. Relationship between company's product quality and target sales and the consequent company price

	Then P	If target sales				
		VL	L	M	H	VH
And if R	VL	VL	VL	VL	VL	VL
	L	L	L	L	VL	VL
	M	M	M	M	L	L
	H	H	H	H	M	M
	VH	VH	VH	VH	H	H

Table 10. Relationship between company's product quality and target profit, and the consequent company price

	Then P	If target profit				
		VL	L	M	H	VH
And if R	VL	VL	VL	VL	L	L
	L	L	L	L	M	M
	M	M	M	M	H	H
	H	H	H	H	VH	VH
	VH	VH	VH	VH	VH	VH

Table 11. Competitor price and the consequent company's price

Then P	If competitor price				
	VL	L	M	H	VH
	VL	L	M	M	H

Table 12. Company product quality and the consequent distribution expenditure

Then D	If R				
	VL	L	M	H	VH
	H	H	L	VH	VH

Table 13. Target sales and the consequent company's distribution expenditure

Then D	If target sales				
	VL	L	M	H	VH
	VL	L	M	H	VH

Table 14. Competitor's advertising expenditures and the consequent company distribution expenditure

Then	If competitor advertising				
D	VL	L	M	H	VH
	L	M	M	M	H

Table 15. Marginal response and the consequent company distribution expenditure

Then	If marginal response				
D	VL	L	M	H	VH
	L	L	M	H	H

Table 16. Competitor's advertising and the consequent company advertising expenditure

Then	If competitor advertising				
A	VL	L	M	H	VH
	L	H	M	H	VH

Table 17. Marginal response and the consequent company distribution expenditure

Then	If marginal response				
A	VL	L	M	H	VH
	L	L	M	H	VH

Table 18. Company's product quality and the consequent company advertising expenditure

Then	If R				
A	VL	L	M	H	VH
	L	M	H	M	L

Table 19. Competition level and the consequent company advertising expenditure

Then	If competition level				
A	Collu-sion	Tacit coop.	Healthy rival.	Limited war.	Total warfare
	M	M	M	H	VH

Inference and defuzzification

As the experts' decision rules are built so as to ensure consistency among company product quality, price, distribution and advertising expenditures, the company product quality (R) is determined first through matching its relevant rules, inferring rules' consequents and then defuzzifying to obtain a crisp value of product quality to be adopted for the current period. The crisp value of product quality is utilized then as an input to determination of remaining marketing decision variables. So, defuzzification of product quality inferred sets must be obtained prior to matching rules for other marketing-mix setting. The Center of Area COA (Composite moment) defuzzification method is used. The procedure is as follows:

i. The crisp value of company's product quality (R):

Matched rules: (these rules are fired in the sense that, the actual values of input variables are matched with the premises of all rules; the applicables rules are shown below):

[R1]: If ***last sales*** **(I_1)** is **L(1)** and ***competition level*** **(I_{10})** is **LW(0.8)** then ***R*** is **VH(0.8).**

[R2]: If ***forecasted sales*** **(I_2)** is **VH(0.5)** and ***target sales*** **(I_3)** is **H(0.5)** then ***R*** is **H(0.5).**

[R3]: If ***target profit*** **(I_4)** is **M(0.6)** then ***R*** is **M(0.6).**

[R4]: If ***target customer satisfaction*** **(I_5)** is **M(0.6)** then ***R*** is **M(0.6).**

[R5]: If ***competitor's price*** **(I_6)** is **H(0.71)** and ***competitor's product quality*** **(I_7)** is **H(0.6)** then ***R*** is **H (0.6).**

[R6]: If ***marginal response*** **(I_9)** is **M(1)** then ***R*** is **M(1).**

Defuzzification

COA method is used. The general formula is as follows:

$$F_{Crisp} = \frac{\sum \mu_i \cdot F_i}{\sum \mu_i}$$

where:

F_{Crisp} = the crisp value of the variable

F_i = the center value of the variable

μ_i = the membership value of the implied fuzzy set

We shall substitute R_i, P_i, D_i, A_i for F_i in the general formula at the following particular cases.

For the product quality output variable, the COA formula is applied is follows:

$$R_{Crisp} = \frac{\sum \mu_i \times R_i}{\sum \mu_i}$$

$$R_{Crisp} = \frac{2(0.8) + 1.5(0.5) + 1(0.6) + 1(0.6) + 1.5(0.6) + 1(1)}{0.8 + 0.5 + 0.6 + 0.6 + 0.6 + 1}$$

R = 1.33 ≈1.5*(next valid)(unit manufacturing cost CZK 20)

This value can be approximated into nearest valid value ≈1.5 of product quality (Refer to Table 1) for which the corresponding manufacturing cost is known, or the maximum operator can be used to assign this value to nearest valid quality rating, or if it is possible, unit manufacturing cost for quality 1.33 can be interpolated. Now, this crisp quality rating is used, with truth equal 1 belongs to High, in subsequent determination of remaining marketing mix settings. (All marketing decision variables should be integrated, in the sense that, they should exhibit mutual consistency. This means that, the price should be consistent with offered quality, here 1.5, with certainty 1, and advertising and distribution should be consistent with the offered duality and associated price. Advertising also should be consistent with distribution, ... and this is one advantage of the proposed model).

ii. The crisp value of company's price (P):

Matched rules

[P1]: If ***target sales*** **(I_3)** is **H(0.5)** and ***R*** is **H(1)** then ***P*** is **M(0.5).**

[P2]: If ***target profit*** **(I_4)** is **M(0.6)** and ***R*** is **H(1)** then ***P*** is **H(0.6).**

[P3]: If ***competitor's price*** **(I_6)** is **H(0.71)** then ***P*** is **M(0.71).**

Defuzzification

The (COA) method is used as follows:

$$P_{Crisp} = \frac{\sum \mu_i \times P_i}{\sum \mu_i}$$

$$P_{Crips} = \frac{22(0.5) + 29(0.6) + 22(0.71)}{0.5 + 0.6 + 0.71}$$

P = CZK 24.3

iii. The crisp value of company's distribution expenditure (D):

Matched rules

[D1]: If ***R*** is **H (1)** then ***D*** is **VH (1).**

[D2]: If ***target sales*** **(I_3)** is **H(0.5)** then ***D*** is **H(0.5).**

[D3]: If ***competitor's advertising*** **(I_8)** is **VH(0.6)** then ***D*** is **H(0.6).**

[D4]: If ***marginal response*** **(I_9)** is **M(1)** then ***D*** is **M(1).**

Defuzzification

COA method is used:

$$D_{Crisp} = \frac{\sum \mu_i \times D_i}{\sum \mu_i}$$

$$D_{Crisp} = \frac{\left[80(1) + 60(0.5) + 60(0.6) + 40(1)\right](1000)}{1 + 0.5 + 0.6 + 1}$$

D = CZK 60 000

iv. The crisp value of company's advertising expenditure (D):

Matched rules

[A1]: If ***competitor's advertising*** **(I_8)** is **VH(0.6)** then ***A*** is **VH(0.6).**

[A2]: If ***marginal response*** **(I_9)** is **M(1)** then ***A*** is **M(1).**

[A3]: If ***R*** is **H(1)** then ***A*** is **M(1).**

[A4]: If ***competition level*** **(I_{10})** is **LW(0.8)** then ***A*** is **H(0.8).**

Defuzzification

COA method is used as follows:

$$A_{Crisp} = \frac{\sum \mu_i \times A_i}{\sum \mu_i}$$

$$A_{Crisp} = \frac{\left[200(0.6) + 100(1) + 100(1) + 150(0.8)\right](1000)}{0.6 + 1 + 1 + 0.8}$$

A = CZK 129 400

The resultant current-period marketing-mix and marketing allocation

The fuzzy marketing-mix model gives the final crisp value of company's marketing decision variables for current period t, and for i^{th} product, $(P, A, D, R)_{i,t}$ as follows:

P = CZK 24.3

A = CZK 129 000

D = CZK 60 000 (sales force and delivery costs)

R = 1.5 (CZK 20 unit cost)

Profit margin = CZK 4.3/unit

This marketing-mix is to be used as a guide in establishing marketing allocation, since the fuzzy model can be used to separately identify the marketing-mix for each product, for each customer type and for each sales area through processing the relevant input variables that express each relevant factor. Then, the available budget is allocated in the same proportion. The marketing-mix decision produced by the proposed fuzzy model can be evaluated periodically based on the results and performance, and decision rules can

be re-adapted and re-developed based on new updates to impose the dynamic effect into the model.

THE ECONOMIC IMPACT OF THE PROPOSED METHOD

The economic impact of utilizing the method is implied through determining the marketing effort that most accurately and approximately reflect the requirement of all affecting factors within the marketing environment, and consequently realize economic revenue through the resultant competitive advantage. The model determines an expert-based consistent mix of each product to realize the target sales and profit and to cope with the economic changes and competitor effort, so the chosen quality level along with its consistent price and marketing effort in form of advertising and distribution costs are determined according to experts' opinions and consequently to attain a competitive advantages and hence economic success. The model avoid other approaches based decisions that may lead to inconsistent values of decision variables and then prevent misleading, economic loss and strategic failures.

CONCLUSION

A practical, comprehensive, and dynamic model to set the marketing-mix has been described. The model is based on the fuzzy decision-making systems for the purpose of dealing with the vague, uncertain, subjective, treating the dynamic nature of the input variables and modeling non-linear relationships involved in the marketing problems, which are agreed upon and obviously proven. The main purpose of the article is to illustrate how fuzzy methodology can ably deal with such marketing problems. The fuzzy methodology has demonstrated how efficiently human experts' knowledge expressed in natural language and in form of If-Then decision rules is conveniently utilized to solve complex problems for which the use a conventional quantitative approaches is unfeasible. The model can handle any types of input variables, subjective or objective, and permit sany arbitrary quantification of qualitative variables, the inclusion of which is essential for obtaining realistic solutions. In addition, the proposed model can accept conflicting opinions of a group of experts, and give finally a compromising solution for them. Finally, the proposed method has efficiently dealt with multiple issues described above and hence it can be considered an adequate to deal with such marketing problem. The achievement of the model is summarized as follows:

(1) Developing a model that handles uncertain, input variables values, like forecasts.., etc.

(2) Developing a model that deals with vague and inexact input variables values such as quality, marginal response, ...etc.

(3) Developing a model that efficiently handles subjective variables like company competitive strength, competition level, and product quality, the inclusion of which is necessary to provide a realistic solutions or decisions.

(4) Developing a model that quantifies and combines the effect of non-homogenous mix of both quantitative variable and qualitative factors as well regardless of unit or dimensions of such variables through expressing their values in natural language (high, low, very strong, ... etc).

(5) Developing a model that effectively utilizes expertise, intuition, and knowledge of company's experts expressed conveniently in natural language and in form of logical If-then rules.

(6) Developing a dynamic, adaptable model that handles different values at different time periods and finding a flexible solutions to such dynamic changes through higher fault tolerance associated with utilizing fuzzy sets instead of exact values. The rule-base can be also redesigned to reflect changes in relationships.

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Arrived on 11th November 2004

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