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A MCDM APPROACH FOR MIDDLEMEN EVALUATION AND SELECTION IN MARKETING

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Abstract

Our aim is to present a MCDM approach to deal with the middlemen selection problem in marketing (distribution channel). During recent years evaluating and selecting appropriate middlemen for the firm has become a strategic issue in marketing. How to select middlemen is a typical multi criteria decision-making problem. To deal with this type of complex and unstructured problems various qualitative and quantitative factors must be taken into consideration. To evaluate these factors a multi criteria decision-making approach will be proposed and shown with an example to highlight the procedure of the proposed method.

Keywords: Middlemen selection; Multiple criteria decision-making (MCDM); Fuzzy TOPSIS

1.INTRODUCTION

In the contemporary world, businesses usually don't sell their products directly to the final consumers. Between them and the final users there may be many independent organizations involved in moving products to consumers and industrial users and making them available. These organizations that are specialized in bridging the geographic, time, information, value and ownership discrepancies between producer and consumer are called marketing middlemen (or intermediaries).(Perreault, 1996)

Even though producers can also accomplish most of these jobs, they usually hand over the firm's destiny and a big portion of the profits to marketing intermediaries by entrusting some of the selling (or trading) job to them. This is done because of certain advantages in using middlemen. Most of the small products have to be sold with others; main business may be more profitable then establishing factory outlets; middlemen may be more efficient in making goods widely available and offer the firm more than it can usually achieve on its

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own; and they may reduce the necessary number of contacts and work in moving goods from producers to consumers.(Kotler, 1991)

In marketing literature several distribution channel models are considered. Firm may prefer to have a direct contact with its customers, if they have enough resources and suitable middlemen are not available or there is a specific need for the concerned product, such as an aggressive selling effort, special technical service, training and motivation. This is the shortest channel possible and called zero-level channel. On the contrary, in a longer model there may be many manufacturers' representatives, brokers, agents, wholesalers, jobbers and retailers. Some of these intermediaries such as brokers and agents do not take title to the products and are named as agent middlemen; others as wholesalers and retailers take the title for reselling and are called merchant middlemen. Between these shortest and longest channels there may be many intermediate choices.

There is no such thing as one best distribution channel. The choice depends on the consumer needs, competition, firm and the firm's products, but in general, industrial and service channels tend to be shorter than consumer channels. This is due to the geographic concentration and smaller number of industrial buyers and special characteristics of the services such as intangibility, inseparability, perishability, customer involvement, variable quality and difficulty of standardization.

In the industrial setting zero-level channels (from producer to consumer) are more common, but if the industrial purchasers are not geographically concentrated, small and numerous utilization of a variety of marketing intermediaries can be more appropriate. In such cases industrial distributors, wholesalers and retailers that take title to the goods and maintain regional stocks can be used. This will accomplish convenience and transportation economies by stockpiling goods and making final small shipments over short distances. Agents are also utilized in the industrial market when small producers try to market their offerings to large wholesalers or when the unit sale is small. These agents represent the manufacturer and act as an independent sales force.

The management's choice of channels deeply affects all the other marketing decisions such as type of market research; identifying market segments and selecting target markets; designing marketing strategies against competitors; product-mix and product-line decisions; pricing strategies and programs; physical distribution; promotion-mix. For this reason, many decision makers are usually involved in the choice of the middlemen.

It is also a relatively long-term commitment to many other independent external firms and their certain markets. It takes long-term relationships to build a distribution system and it is not easily changed. In other words, once a middleman is selected this relationship will have a lasting effect on the competitiveness of the firm. Therefore management must choose middlemen considering the future selling environment and try to avoid "throwing away a market" and "buying trouble" by making the wrong choice.(Kotler, 1991)

The overall objective of middlemen selection process is to reduce financial investment and risk, and have an ideal market exposure.

To do the job of middlemen requires a significant investment in facilities and people. Many firms don't have enough financial resources, or want to retain financial flexibility. Middlemen may reduce a producer's investment and working capital by buying the producer's output in advance and carrying it in inventory until it's sold. Some middlemen provide credit to customers at the end of the channel or inform the producer on the creditability of the customers whom they know locally.

Ideal market exposure is attained when a product is available enough to satisfy target customers' needs but not exceed them. Too much or little exposure increases the total cost of marketing. Ideal distribution may be intensive, selective or exclusive. In intensive distribution the product is sold through all responsible and suitable middlemen who interested to sell it. Selective distribution is selling through middlemen who will give special attention to the product. Exclusive distribution is selling through only one middleman in a particular geographic area.

The paper is organized as follows: in the next section we introduce the selection criteria of the middlemen; in section 3 we summarized the multiple-criteria decision-making approach; in section 4 we give the main steps in fuzzy TOPSIS; and in section 5 we give a numerical example about a welding metal electrodes company.

2. SELECTION CRITERIA OF THE MIDDLEMEN COMPANY

In order to attain these general objectives, decision maker has to clarify more specific characteristics of the middlemen such as size, image, management, existing business and requirements.(Joyner, 1977) These attributes, which are briefly explained below are mostly complex and therefore are not easy to quantify precisely. That is they are fuzzy.

Size: Issues associated to size are the number of the employee and the salesmen, and their calls per month; financial position such as capital, funds available and liabilities; (capability to provide such services as promotion, education etc.); facilities such as capacity and convenience of the offices, branch offices, point of sales, warehouse and transport facilities; the amount of investment for market promotion, inventory or servicing equipment; and overall and area sales coverage.

Image: Subjects related to image are date of foundation; age, appearance and experience of the personnel in general; appearance and comfort of the offices, branch offices, point of sales, warehouse and transport facilities; reputation attitudes of the banks, trade associates and associations, and buyers.

Management: Under this topic, legal form and owners; names, age and experience of the senior executives and controllers; conformance and conflict resolution abilities (Length of the association with other principals; agreements that the company obtained or lost during the past year and the reasons behind); the degree of marketing and technical know-how and experiences; and flexibility that is readiness to adapt to new situations can be considered.

Existing Business: The focus here may be annual sales; trends and major obstacles expected in its sales; turnover of the other competing and non competing products and brands that the company holds in the present line; technological capability; and kinds of customers.

Requirements of the middlemen: Things that the middle man may ask from our firm such as rate and/or amount of profit or commission, payment terms; showroom and service facilities; promotions; and sales training are considered here.

Many successful marketers believe that selection of adequate middlemen is one of the biggest barriers to establishing a successful business. This is why the middlemen selection problem has become one of the most important issues for setting up an effective channel system. Middlemen relationships in enterprises have received a great deal of attention. Choosing the right middlemen in marketing-channel of distribution is among the most crucial in getting products to the target market. It requires time, patience and discipline.(Ward, 1984) First you must develop a list of several possible middlemen for the market. Then narrow the list to a few candidates to make a final decision. As this selection can be done by conventional methods, multiple-criteria decision-making (MCDM) approach may also be appropriate.

The potential criteria mentioned above must be considered in selecting an appropriate and a particular middleman. Thus the selection process of the right middlemen can be regarded as multiple-criteria decision-making (MCDM) problem.

3. MULTIPLE-CRITERIA DECISION-MAKING

A MCDM problem in which A1, A2… Am are the possible alternatives among which the decision maker (DM) have to choose and C1, C2, … , Cn are the criteria with which each alternative performance are measured can be expressed in matrix format as

$$D = \begin{array}{c|cccccc} & C_1 & C_2 & . & . & . & C_n \\ \hline A_1 & x_{11} & x_{12} & . & . & . & x_{1n} \\ A_2 & x_{21} & x_{22} & . & . & . & x_{2n} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ A_m & x_{m1} & x_{m2} & . & . & . & x_{mn} \end{array}$$

$$W = [w_1 \quad w_2 \quad . \quad . \quad . \quad w_n]$$

Here xij is the rating of alternative Ai by DM according to criterion cj and wj is the weight of criterion Cj. In some real-world applications the criteria and the weight of criteria may not be rated quantitatively because of incomplete or non-obtainable information. In other words while rating an alternative with respect to criterion Cj the information cannot be assessed precisely in a quantitative form. In such circumstances when attempting to qualify phenomena related to human perception the use of a linguistic approach is necessary.(Herrera, 2000) In this study we assume both the criteria and the weights of the criteria are linguistic variables. Hence the data obtained from the judgments and preferences of the DMs about the criteria and weights are all fuzzy /imprecise. To deal with fuzzy data an extension of TOPSIS method will be used. Besides, many decision-making problems need collaborative effort of experts within organizations. Hence we will extend TOPSIS to a group decision environment.

TOPSIS (The technique for order preference by similarity to an ideal solution) which is one of the most attractive and frequently used MCDM approach recently, was first introduced and initiated by Hwang and Yoon (1981)(Hwang, 1981). This technique is based on the concept that the ideal alternative has the best level for all attributes considered, whereas the negative ideal is the one with all the worst attribute values (Chu, 2002). So the best alternative is the one which has the shortest distance from the positive ideal solution (PIS) and farthest distance from the negative-ideal solution (NIS) in some geometrical sense (Triantaphyllou, 2000). In measuring the relative closeness of the alternatives to the ideal point or nadir is done according to the chosen metric. The solution of the decision problem with TOPSIS, is the selection of the alternative which is simultaneously farthest from the negative-ideal solution and closest to ideal alternative.

In a MCDM problem with i = 1,2,…,m, m alternatives and j = 1,2,…,n , n criteria and weight, after constructing the decision matrix D the solution process of the problem with TOPSIS consists the following steps (Chen, 2006; Herrera, 2000; Jahanshahloo, 2006) :

1. Construct the normalized decision matrix, say it R. An element of the

$$r_{ij} = x_{ij} \Big/ \sqrt{\sum_{i=1}^{m} x_{ij}^2}, i = 1,2,\ldots,m, j = 1,2,\ldots,n$$

normalized matrix R is thus calculated as :

2. Construct the weighted normalized decision matrix V. The vector W being the set of weights , W = [w1, w2, …,wn], where

$$v_{ij} = w_j r_{ij}, i = 1,\ldots,m, j = 1,\ldots,n$$

õwi = 1, an element of V is calculated as :

3. Determine the positive ideal and negative ideal solution.

Denoting positive ideal as A+, negative ideal as A- ; I being benefit and J being cost /loss criteria alternatives are defined as follows:

$$A^+ = \{v_1^+, v_2^+, \ldots, v_n^+\} = \{(\max_j v_{ij} \mid i \in I), (\min_j v_{ij} \mid i \in J)\}$$

$$A^- = \{v_1^-, v_2^-, \ldots, v_n^-\} = \{(\min_j v_{ij} \mid i \in I), (\max_j v_{ij} \mid i \in J)\}$$

4. Calculate the separation measure

$$d_i^+ = \left\{ \sum_{j=1}^{n} (v_{ij} - v_j^+)^2 \right\}^{1/2}, i = 1,\ldots,m$$

$$d_i^- = \left\{ \sum_{j=1}^{n} (v_{ij} - v_j^-)^2 \right\}^{1/2}, i = 1,\ldots,m$$

5. Calculate the relative closeness to the PIS. The relative closeness of the alternative Ai with respect to A+ is defined as:

$$R_i = d_i^- / (d_i^+ + d_i^-), i = 1,\ldots,m$$

6. Rank the preference order.

4. STEPS IN FUZZY TOPSIS

Since the criteria and weights are fuzzy then fuzzy set theory must be considered. Fuzzy theory initiated by L. Zadeh dates back to 1965. The preliminary definitions of fuzzy set and the arithmetic operations on fuzzy numbers used throughout the paper is adopted from Chen (Chen, 2000) and Chen et al.(Chen, 2006). Thus we do not repeat the same definitions and operations in this study. As indicated by Chen detailed information on fuzzy set and arithmetic operations on them can be found in J.J. Buckley, A. Kauffman, M.M. Gupta, D.S. Negi, L.A. Zadeh and H.J. Zimmerman. In this paper trapezoidal fuzzy numbers will be used to consider fuzziness of the performance ratings of the alternatives and the weights of criteria by DMs. From the definitions given by Chen if at least one of the entries in decision matrix D is fuzzy then is called a fuzzy matrix. Depending on this definition our decision problem becomes a fuzzy TOPSIS. In this paper we follow the same solution procedure (extended TOPSIS) for the selection of an appropriate middlemen proposed by Chen et al.(Chen, 2006). The procedure and its details are as follows.

We assume the followings:

1. a set of K decision-makers
2. a set of m possible middlemen
3. a set of n criteria
4. a set of performance ratings of Ai (I=1,2,…,m) with respect to criteria Cj(j =1,2,…,n) called X
5. ratings of each decision maker can be represented as positive trapezoidal fuzzy number where

In a group decision making problem under fuzzy environments the importance weights of criteria and ratings of criteria can be expressed as trapezoidal fuzzy numbers as shown in Tables 1 and 2.

Table 1. Linguistic variables for the importance weight of each criterion

Very low (VL)	(0,0,0.1,0.2)
Low (L)	(0.1,0.2,0.2,0.3)
Medium low (ML)	(0.2,0.3,0.4,0.5)
Medium (M)	(0.4,0.5,0.5,0.6)
Medium high (MH)	(0.5,0.6,0.7,0.8)
High (H)	(0.7,0.8,0.8,0.9)
Very high (VH)	(0.8,0.9,1.0,1.0)

Table 2. Linguistic variables for performance ratings of alternatives

Very poor (VP)	(0,0,1,2)
Poor (P)	(1,2,2,3)
Medium poor (MP)	(2,3,4,5)
Fair (F)	(4,5,5,6)
Medium good (MG)	(5,6,7,8)
Good (G)	(7,8,8,9)
Very good (VG)	(8,9,10,10)

The aggregated fuzzy rating can be defined as $\tilde{R} = (a, b, c, d), k = 1,2,..$
where:

$$a = \min_k \{a_k\} \qquad b = \frac{1}{K}\sum_{k=1}^{K} b_k$$

$$c = \frac{1}{K}\sum_{k=1}^{K} c_k \qquad d = \max_k \{d_k\}$$

Having K decision makers and assuming $\tilde{w}_{jk} = (w_{jk1}, w_{jk2}, w_{jk3}, w_{jk4})$ importance weighting $\tilde{x}_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk}, d_{ijk})$ andrating of alternatives of the kth decision maker aggregated fuzzy ratings of $(\tilde{x}_{ij})$ alternatives with respect to each criterion can be calculated as

$$\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}, d_{ij})$$

where

$$a_{ij} = \min_k \{a_{ijk}\} \qquad b_{ij} = \frac{1}{K}\sum_{k=1}^{K} b_{ijk}$$

$$c_{ij} = \frac{1}{K}\sum_{k=1}^{K} c_{ijk} \qquad d_{ij} = \max_k \{d_{ijk}\}$$

and the aggregated fuzzy weights $(\tilde{w}_j)$ of each criterion can be calculated as $\tilde{w}_j = (w_{j1}, w_{j2}, w_{j3}, w_{j4})$ where

$$w_{j1} = \min_k \{w_{jk1}\} \qquad w_{j2} = \frac{1}{K}\sum_{k=1}^{K} w_{jk2}$$

$$w_{j3} = \frac{1}{K}\sum_{k=1}^{K} w_{jk3} \qquad w_{j4} = \max_k \{w_{jk4}\}$$

Since the performance ratings and the importance weights of criteria are fuzzy the decision matrix: $\tilde{D}$
and the weight vector: $\tilde{W}$
can be stated as

$$\tilde{D} = \begin{array}{c|cccccc} & C_1 & C_2 & . & . & . & C_n \\ \hline A_1 & \tilde{x}_{11} & \tilde{x}_{12} & . & . & . & \tilde{x}_{1n} \\ A_2 & \tilde{x}_{21} & \tilde{x}_{22} & . & . & . & \tilde{x}_{2n} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ A_m & \tilde{x}_{m1} & \tilde{x}_{m2} & . & . & . & \tilde{x}_{mn} \end{array}$$

$\tilde{W} = [\tilde{w}_1 \quad \tilde{w}_2 \quad . \quad . \quad . \quad \tilde{w}_n]$ and where the entries of matrix: $\tilde{D}$ and vector: $\tilde{W}$ can be approximated by positive trapezoidal fuzzy numbers. The next step is to normalize the decision matrix, which can be represented $\tilde{R} = [\tilde{r}_{ij}]_{mxn}$ aswhere B and C are the benefit and cost sets respectively.

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{d_j^*}, \frac{b_{ij}}{d_j^*}, \frac{c_{ij}}{d_j^*}, \frac{d_{ij}}{d_j^*} \right), j \in B$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{d_{ij}}, \frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right), j \in C$$

$$d_j^* = \max_i d_{ij}, j \in B$$

$$a_j^- = \min_i a_{ij}, j \in C$$

In considering the different weights of criteria the weighted normalized fuzzy decision matrix can be calculated as:

$$\tilde{V} = [\tilde{v}_{ij}]_{mxn}, i = 1,2,..., m, j = 1,2,..., n$$

$$\tilde{v}_{ij} = \tilde{r}_{ij}(.)\tilde{w}_j$$

In the next step we calculate the fuzzy positive-ideal solution (FPIS) and fuzzy negative-ideal solution (FNIS) designated as A* and A- respectively where:

$$\tilde{v}_j^* = \max_i \{v_{ij4}\} \text{and} \tilde{v}_j^- = \min_i \{v_{ij1}\},$$

$$i = 1,..., m, j = 1,..., n$$

$$A^* = (\tilde{v}_1^*, \tilde{v}_2^*,..., \tilde{v}_n^*) \quad A^- = (\tilde{v}_1^-, \tilde{v}_2^-, \ldots, \tilde{v}_n^-)$$

Next the distance (separation measure) of each alternative from FPIS and FNIS is calculated as:

$$d_i^* = \sum_{j=1}^{n} d_v(\tilde{v}_{ij}, \tilde{v}_j^*), i = 1, \ldots, m$$

$$d_i^- = \sum_{j=1}^{n} d_v(\tilde{v}_{ij}, \tilde{v}_j^-), i = 1, \ldots, m$$

In the final step the closeness coefficient s calculated. As stated before this coefficient represents the closeness to the FPIS and FNIS and can be calculated for each alternative (middlemen in our case) as follows:

$$CC_i = \frac{d_i^-}{d_i^* + d_i^-}, i = 1,..., m$$

Ranking the alternatives according to the closeness coefficients in descending order is the conclusion step of the method in selecting the desired alternative. The higher the closeness coefficient the better is the alternative.

5. NUMERICAL EXAMPLE: A CASE OF WELDING METAL ELECTRODES IN TURKEY

The numerical example we are going to present in this paper is about a company producing welding electrodes. It is one of the biggest companies in this field in Turkey.

Metallic-arc welding using manually operated equipment is still a widely used fusion-welding process in Turkey. In this process the metal electrode, which is used, serves both to carry the arc and to act as a filler rod, which deposits molten metal into the joint. In order to prevent the oxidation of the weld metal, coated electrodes known as flux are used. The process is flexible and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work, and therefore very small business and independent craftsmen are among the important buyers. Weld times are rather slow, since the consumable electrodes must be frequently replaced and because slag, the residue from the flux, must be chipped away after welding.

Gas metal arc welding, also known as metal inert gas welding, is a semi-automatic or automatic process that uses a continuous wire feed as an electrode and an inert or semi-inert gas mixture to protect the weld from contamination. The equipment required to perform the process is more complex, expensive and not so versatile. However, owing to the higher average rate at which welds can be completed, it is well suited to industrial welding. In recent decades, in order to minimize labor and metal electrode costs in high production manufacturing, a swift move to this process was observed. Nowadays more then half of metal electrodes are demanded for gas metal arc-welding process.

We contacted with the decision makers and present marketing channel was described as in the following figure (Figure 1.).

The problem at hand was selection of a new wholesaler (middlemen) in a territory with lately expending sales due to the political and military turbulences in Iraq.. After talking over the channel and selection problem of the appropriate middlemen with the management we participated with a group to get the necessary information to evaluate the candidate middlemen. It was a group of experts from financial, production and marketing departments. First they are asked to evaluate the importance weight of each criterion according to Table 1 and to rate the candidate middlemen under the criteria determined before. The evaluations they made is shown in Table 3 and Table 4 respectively.

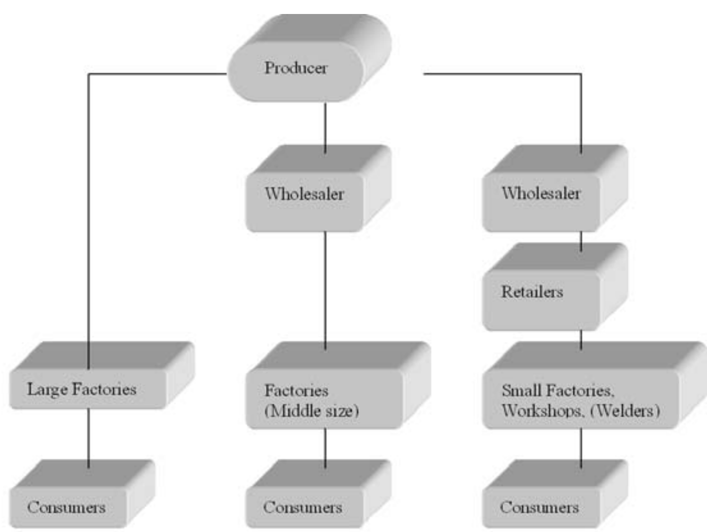

Figure 1. Marketing channel

Table 3. Weight of criteria from the group

Criteria	Opinion of experts: Marketing	Production	Finance
C_1(Size)	MH	H	H
C_2(Image)	H	MH	MH
C_3(Management)	H	M	MH
C_4(Existing Business)	VH	M	MH
C_5(Requirements)	VH	VH	VH

Table 4. Ratings of the experts for the five middlemen candidate

Criteria	Middlemen	Opinion of experts: Marketing	Production	Finance
C_1	A_1	VG	G	VG
	A_2	MG	G	G
	A_3	G	G	MG
	A_4	VG	G	G
	A_5	G	MG	G
C_2	A_1	VG	G	G
	A_2	G	G	VG
	A_3	MG	MG	MG
	A_4	MG	MG	G
	A_5	MG	MG	VG
C_3	A_1	G	G	MG
	A_2	VG	MG	G
	A_3	G	G	MG
	A_4	G	G	G
	A_5	G	G	G
C_4	A_1	G	MG	MG
	A_2	G	VG	VG
	A_3	VG	VG	VG
	A_4	VG	G	G
	A_5	G	VG	VG
C_5	A_1	G	VG	G
	A_2	VG	G	G
	A_3	VG	MG	G
	A_4	MG	G	G
	A_5	MG	G	MG

Table 5. Fuzzy Decision Matrix ($\tilde{D}$)

A_1	(7,8.7,9.3,10)	(7,8.3,8.7,10)	(5,7.3,7.7,9)	(5,6.7,7.3,9)	(7,8.3,8.7,10)
A_2	(5,7.3,7.7,9)	(7,8.3,8.7,10)	(5,7.7,8.3,10)	(7,8.7,9.3,10)	(7,8.3,8.7,10)
A_3	(5,7.3,7.7,9)	(5,6,7,8)	(5,7.3,7.7,9)	(8,9,10,10)	(5,7.7,8.3,10)
A_4	(7,8.3,8.7,10)	(5,6.7,7.3,9)	(7,8,8,9)	(7,8.3,8.7,10)	(5,7.3,7.7,9)
A_5	(5,7.3,7.7,9)	(5,7,8,10)	(7,8,8,9)	(7,8.7,9.3,10)	(5,6.7,7.3,9)

Table 6. Fuzzy Weights ($\tilde{W}$)

	C1	C2	C3	C4	C5
Weight	(.5,0.73,0.77,.9)	(.5,0.67,0.73,.9)	(.4,0.63,0.67,.9)	(.4,0.67,0.73,1)	(.8,.9,1,1)

Table 7. Normalized Fuzzy Decision Matrix ($\tilde{R}$)

	C1	C2	C3	C4	C5
A_1	(.7,.87,.93,1)	(.7,.83,.87,1)	(.5,.73,.77,.9)	(.5,.67,.73,.9)	(.7,.83,.87,1)
A_2	(.5,.73,.77,.9)	(.7,.83,.87,1)	(.5,.77,.83,1)	(.7,.87,.93,1)	(.7,.83,.87,1)
A_3	(.5,.73,.77,.9)	(.5,.6,.7,.8)	(.5,.73,.77,.9)	(.8,.9,1,1)	(.5,.77,.83,1)
A_4	(.7,.83,.87,1)	(.5,.67,.73,.9)	(.7,.8,.8,.9)	(.7,.83,.87,1)	(.5,.73,.77,.9)
A_5	(.5,.73,.77,.9)	(.5,.7,.8,1)	(.7,.8,.8,.9)	(.7,.87,.93,1)	(.5,.67,.73,.9)

The evaluation of the weights and ratings of the candidates constitutes the first and second step of the proposed method detailed in section x. The remaining steps of the method to solve the problem can be summarized as follows:

Step 3: Linguistic evaluations made by the experts for the weight of criteria and ratings for the candidates are converted into trapezoidal fuzzy numbers. The conversion results are shown in Table 5 and Table 6.

Step 4: Normalized fuzzy decision matrix $\widetilde{R}$. Shown in Table 7.

Table 8. Normalized Fuzzy Decision Matrix ($\tilde{V}$)

	C1	C2	C3	C4	C5
A_1	(.35,.64,.71,.9)	(.35,.55,.64,.9)	(.2,.46,.51,.81)	(.2,.45,.54,.9)	(.56,.76,.87,1)
A_2	(.25,.54,.59,.81)	(.35,.55,.64,.9)	(.2,.49,.55,.9)	(.28,.58,.68,1)	(.56,.75,.87,1)
A_3	(.25,.54,.59,.81)	(.25,.4,.51,.72)	(.2,.46,.51,.81)	(.32,.6,.73,1)	(.4,.69,.83,1)
A_4	(.35,.61,.67,.9)	(.25,.45,.54,.81)	(.28,.51,.53,.81)	(.28,.55,.64,1)	(.4,.66,.77,.9)
A_5	(.25,.54,.59,.81)	(.25,.47,.59,.9)	(.28,.51,.53,.81)	(.28,.58,.68,1)	(.4,.6,.73,.9)

Table 9. FPIS and FNIS

	C1	C2	C3	C4	C5
A^*	(.9,.9,.9,.9)	(.9,.9,.9,.9)	(.9,.9,.9,.9)	(1.,1.,1.,1.)	(1.,1.,1.,1.)
A^-	(.25,.25,.25,.25)	(.25,.25,.25,.25)	(.20,.20,.20,.20)	(.20,.20,.20,.20)	(.40,.40,.40,.40)

Step 5: Weighted Normalized fuzzy decision matrix $\widetilde{V}$

Table 10. Distance from FPIS

	C_1	C_2	C_3	C_4	C_5
$d(A_1,A^*)$	0.32	0.35	0.46	0.54	0.26
$d(A_2,A^*)$	0.41	0.35	0.44	0.45	0.26
$d(A_3,A^*)$	0.41	0.46	0.46	0.42	0.35
$d(A_4,A^*)$	0.33	0.44	0.41	0.46	0.37
$d(A_5,A^*)$	0.41	0.42	0.41	0.45	0.39

Step 6: Determination of FPIS and FNIS as shown in Table 9.

Step 7: Calculation of separation measure of each middlemen with respect to each criterion from FPIS and FNIS. Results are shown in Table 10 and Table 11 respectively.

Table 11. Distance from FNIS

	C_1	C_2	C_3	C_4	C_5
$d(A_1,A^-)$	0.45	0.41	0.37	0.42	0.43
$d(A_2,A^-)$	0.36	0.41	0.42	0.51	0.43
$d(A_3,A^-)$	0.36	0.28	0.37	0.53	0.40
$d(A_4,A^-)$	0.43	0.33	0.38	0.50	0.34
$d(A_5,A^-)$	0.36	0.38	0.38	0.51	0.32

Table 12. Further calculations

	d^*	d^-	d^*+d^-	Cci
A_1	1.93	2.07	4.00	0.52
A_2	1.91	2.13	4.03	0.53
A_3	2.09	1.93	4.02	0.48
A_4	2.01	1.98	3.99	0.50
A_5	2.07	1.95	4.02	0.48

Step 8: Calculation of d_i^+ and d_i^- as in Table 12

Step 9: Calculate the closeness coefficients of the middlemen as shown on the last column of Table 12.

Decision step: Selection of the middlemen according to the closeness coefficient. According to closeness coefficients the ranking order of the five middlemen is (A2 > A1 > A4 > (A3 = A5).

6. CONCLUSIONS

Selecting proper middlemen, and then building and maintaining a close and long-term relationship with them are critical in today's competitive business environment. Many practitioners and researchers have mentioned the advantages and importance of selecting appropriate middlemen.

The choice of a new middleman deeply affects all the other business functions and departments as well as marketing.

For these reasons, many decision makers from different departments such as production, finance are also involved in the choice of the middlemen and a committee decision setting is confronted. When such committees are composed of managers from different departments, due to their experience, feel and other subjective estimates often appear in the meaning and importance attached to various functions and related words may differ greatly and agreement takes long and sturdy negotiations. This is especially true when the decision problem adhere to uncertain and imprecise data that cannot be expressed by means of numerical values, but only by linguistic variables. Fuzzy-set theory seems to be ideal for such situations.

Our cares study on welding metal electrodes distribution in Turkey turned out to support this idea. All the participants were thankful to have a way of handling this committee decision problem, which they expected to take several days, just in few hours.

We believe that fuzzy set theory is applicable and can be extended to the analysis and solution of other marketing decision problems as well.

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