SELECTION OF A DISTRIBUTION CHANNEL USING THE INTEGRATED FUCOM – MARCOS MODEL

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Abstract

The management of manufacturing companies faces a number of decisions, and one of the most important is the selection of distribution channels. A large number of these companies do not sell their products directly to end consumers. For this reason, there are marketing intermediaries between manufacturers and end consumers whose primary function is to connect manufacturers and consumers. Their task is to provide the goods from manufacturers to consumers with the satisfaction of logistics characteristics: at the right time, at the right place and in a form that is convenient to use, and certainly with minimal costs. Distribution is one of four marketing mix instruments without which the optimal combination of the instruments would not be obtained. Thus, the decision on selecting distribution channels is as important as the decisions regarding products, prices and promotion. Based on the set criteria and the evaluation of certain distribution channels by the criteria, the management of the company will be able to make the best decision. The evaluation of distribution channels based on the set criteria was performed by marketing experts and experts in certain markets using an integrated multi-criteria model. The FUCOM method was applied to determine the significance of the criteria, and then the distribution channels were evaluated by applying the new MARCOS method. Thereafter, a sensitivity analysis was performed using other MCDM methods to verify the results previously obtained.

Keywords: distribution, FUCOM, MARCOS, logistics, manufacturing company

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Introduction

All four instruments have to be considered when deciding on the optimal combination of marketing instruments, i.e., the marketing mix. Therefore, decisions about products, prices,

promotion and distribution have to be coordinated since one influence the others. Distribution channels are an instrument of the marketing mix that serves manufacturers as a connection with consumers. Manufacturers come in contact with the consumers of their products through various distribution channels. Distribution encompasses all the activities that allow products to reach from manufacturers to consumers. The name “distribution *channel*” originates from the French word “canal” and represents the path that a product passes from the manufacturer to the consumer, i.e., each product has a channeled flow from the manufacturer to the consumer [1]. Certainly, the easiest way of distribution would be to sell products directly to consumers, however, some manufacturers do not have the possibility to sell their products in that way. The possibility depends on a number of factors, such as product characteristics, consumer habits, costs generated by direct sales, geographic distribution of consumers, i.e., market size, etc. For this reason, manufacturers have several types of distribution channels at their disposal. There are two main groups of distribution channels, i.e., intermediaries that are involved in delivering goods from manufacturers to consumers. The first group consists of intermediaries that take ownership of the goods and they work in their own name and on their own behalf. The second group consists of intermediaries that do not take ownership of the goods and they work in the name and on behalf of others, i.e., they work on commission. In distribution channels, there are also ancillary entities that allow the production process to proceed smoothly. The ancillary entities do not take ownership of the goods nor negotiate with consumers the terms of sale and purchase, but only help to complete the distribution process in the right way and without interruption. The ancillary entities are transport companies, freight forwarders, insurance companies, warehouses, banks and other entities that participate in ancillary activities in the distribution of products.

The successful and competitive performance of a company is the result of good decisions made by the management of the company. The competitiveness of economy and its economic entities in the global market is vital for the development of national economy since it reflects its ability to be involved in the international division of labor [2]. Thus, it is necessary to make the right decision on the selection of distribution channels. All the factors that affect the functioning of distribution channels are a variable category, and therefore once selected distribution channels are not the best option in all cases. Hence, in order to make the right decision on selecting distribution channels, all the factors that affect the functioning of distribution channels have to be constantly monitored.

In this paper, distribution channels were evaluated by marketing and logistics experts on the basis of certain criteria. After the introductory considerations, a review of the literature, i.e., papers on this topic are presented. The following section of the paper refers to the results of the research and the formation of a decision-making model. Based on the model, it will be possible to decide on selecting a distribution channel of a particular company. The company that needs to make this kind of decision has participated in the survey by providing basic information about its business, products and distribution method so far. The data were collected using a questionnaire forwarded to the management of the company. The last section of the paper is related to the concluding considerations.

Literature review

How important the decision on selecting distribution channels is for a company and how much the same decision influences the performance of the company is indicated by the fact that there is a large amount of literature analyzing this topic. Dent [3] analyzes the concept and significance of distribution channels in great detail. In a very clear and precise way, Rosenbloom [4] provides explanations of distribution channels, their relation with other marketing instruments, as well as decision-making about the selection of distribution

channels. Marketing instruments are interconnected and one without the others would not represent the optimal combination of the marketing mix, therefore the decision on one significantly influences the decision on the other instruments. The business success and competitive advantage of a company significantly depends on decisions about how to combine marketing instruments in the best possible way [5].

No matter what business the company is engaged in, it has to decide on how to make the products available to consumers. It is also confirmed by scientific papers referring to distribution channels in various fields of production (McCabe *et al.*, [6]; Schegg *et al.*, [7]; Camilleri, [8]; Vasiliaskas *et al.*, [9]; Atănăsoaie, [10]; Thakran & Verma, [11]).

The factors that influence the selection of distribution channels are most commonly product characteristics, consumer habits, financial situation of the company, price, geographic concentration and width of product assortment. All of these factors determine to some extent which distribution channel a particular business will use for the placement of their products to consumers. Accordingly, certain authors also addressed the factors that influence the selection of distribution channels. Saremi & Zadeh [12] analyzed decision-making regarding distribution on the basis of certain criteria and its impact on the overall marketing system of the company. When selecting a distribution channel, the management of the company have to consider the goals of the company as a whole since the decision on selecting distribution channels has a significant impact on achieving business results as it is directly related to the placement of products and their selling in the market [13]. With the development of science and technology, there have been changes in all spheres of business, as well as in distribution channels. In their research, Watson *et al.*, [14] observe a period of development of distribution channels from 1980 to 2014, where significant changes are noticed in the functioning of distribution channels. Galkin [15] analyzes the influence of factors on the selection of distribution channels by specific regions, and he has proved that all factors that may influence the selection of distribution channels should be considered for each region individually since their influence varies from region to region. Sabote *et al.*, [16] state that consumer behavior, consumer habits and culture can significantly influence the selection of distribution channels.

Liu & Cui [17] analyzed the impact of product line length on distribution channels.

Stoddard *et al.*, [18] determine a link between consumer habits, distribution channels, and products. The way in which a particular product or service can influence the selection of distribution channels is explained in the research by Kim *et al.*, [19].

In order for a company to be always prepared for a competitive response, it has to consider any changes in the factors affecting distribution channels and, accordingly, change the decision on the selection of distribution channels [20].

The FUCOM method is widely used as proved by numerous scientific papers where the method has been used. The FUCOM method assists managers in prioritizing criteria using simple algorithms, as well as in assessing phenomena according to current requirements of decision-makers [38]. Sofuoğlu [22] notes that the FUCOM method in combination with other methods provided successful results when making decisions in a manufacturing company engaged in the manufacture and processing of newly developed high strength parts.

Durmić [23] uses the FUCOM method to evaluate the criteria when selecting suppliers.

Prentkovskis *et al.*, [24] use the FUCOM method to determine the weight coefficients of quality dimensions when measuring service quality. The FUCOM method is used in various decision-making fields and when evaluating certain alternatives Nunić, [25]; Pamučar, [38]; Fazlollahtabar *et al.*, [26]; Badi & Abdulshahed, [27]; Bozanic *et al.*, [28]; Ibrahimović *et al.*, [29]; Erceg & Mularižević, [30]; Nenadić, [31].

Methods

The methodology for deciding on the selection of a distribution channel used in this paper consists of three phases (Figure 1). In the first phase, data from a particular company are collected. In this phase, the current state of distribution in the company has been defined.

Based on the current state of distribution and the intention of the company to improve the distribution of its products, the criteria for selecting distribution channels as well as potential alternatives are determined. Subsequently, the second phase is approached, where the FUCOM method is applied. By the application of the FUCOM method, the weight coefficients of the criteria are defined. The third phase consists of the application of the MARCOS method. By applying the steps of this method, the ideal and anti-ideal solution and the values of utility functions of alternatives are obtained. Then the alternatives are ranked from the best to the worst. The best-ranked alternative will be the one with the value of utility function closest to the value of the ideal solution, and the worst will be the alternative with the value of utility function closest to the value of the anti-ideal solution. Thus, the choice of the company should be the alternative that is ranked best.

Fig. 1. Methodology for deciding on selecting a distribution channel

The FUCOM method is based on the principles of pairwise comparison and validation of results through deviation from maximum consistency [21]. Benefits that are determinative for the application of FUCOM are a small number of pairwise comparisons of criteria (only $n-1$ comparison), the ability to validate the results by defining the deviation from maximum consistency (DMC) of comparison and appreciating transitivity in pairwise comparisons of criteria. The FUCOM model also has a subjective influence of a decision-maker on the final values of the weights of criteria. This particularly refers to the first and second steps of FUCOM in which decision-makers rank the criteria according to their personal preferences and perform pairwise comparisons of ranked criteria.

However, unlike other subjective models, FUCOM has shown minor deviations in the obtained values of the weights of criteria from optimal values [21], [28], [23], [32], [26].

Additionally, the methodological procedure of FUCOM eliminates the problem of redundancy of pairwise comparisons of criteria, which exists in some subjective models for determining the weights of criteria. Figure 2 presents the FUCOM algorithm [33].

Fig. 2. Steps of FUCOM method

In Figure 2, we can see that the algorithm consists of five steps that are clearly explained.

Here we assume that there are n evaluation criteria which are denoted as w_j , $j = 1, 2, \dots, n$ and that their weight coefficients should be determined. The FUCOM method requires decision-makers to determine the impact of criterion i on criterion j .

The MARCOS method is based on defining the relationship between alternatives and reference values (ideal and anti-ideal alternatives). On the basis of the defined relationships, the utility functions of alternatives are determined and compromise ranking is made in relation to ideal and anti-ideal solutions. Decision preferences are defined on the basis of utility functions. Utility functions represent the position of an alternative with regard to an ideal and anti-ideal solution. The best alternative is the one that is closest to the ideal and at the same time furthest from the anti-ideal reference point. The MARCOS method is performed through the following steps [34]:

Step 1: Formation of an initial decision-making matrix. Multi-criteria models include the definition of a set of n criteria and m alternatives. In the case of group decision-making, a set of r experts should be formed to evaluate alternatives according to the criteria. In the case of group decision-making, expert evaluation matrices are aggregated into an initial group decision-making matrix.

Step 2: Formation of an *extended* initial matrix. In this step, the extension of the initial matrix is performed by defining the ideal (*AI*) and anti-ideal (*AAI*) solution.

$$X = \begin{matrix} & \begin{matrix} C_1 & C_2 & \dots & C_n \end{matrix} \\ \begin{matrix} AAI \\ A_1 \\ A_2 \\ \dots \\ A_m \\ AI \end{matrix} & \begin{bmatrix} x_{aa1} & x_{aa2} & \dots & x_{aan} \\ x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \\ x_{ai1} & x_{ai2} & \dots & x_{ain} \end{bmatrix} \end{matrix} \quad (1)$$

The anti-ideal solution (AAI) is the worst alternative, while the ideal solution (AI) is an alternative with the best characteristic. Depending on the nature of the criteria, AAI and AI are defined by applying Equations (2) and (3):

$$AAI = \min_i x_{ij} \quad \text{if } j \in B \quad \text{and} \quad \max_i x_{ij} \quad \text{if } j \in C \quad (2)$$

$$AI = \max_i x_{ij} \quad \text{if } j \in B \quad \text{and} \quad \min_i x_{ij} \quad \text{if } j \in C \quad (3)$$

where B represents a benefit group of criteria, while C represents a group of cost criteria.

Step 3: Normalization of the extended initial matrix (X). The elements of the normalized matrix $N = [n_{ij}]_{m \times n}$ are obtained by applying Equations (4) and (5):

$$n_{ij} = \frac{x_{ai}}{x_{ij}} \quad \text{if } j \in C \quad (4)$$

$$n_{ij} = \frac{x_{ij}}{x_{ai}} \quad \text{if } j \in B \quad (5)$$

where elements x_{ij} and x_{ai} represent the elements of the matrix X .

Step 4: Determination of the weighted matrix $V = [v_{ij}]_{m \times n}$. The weighted matrix V is obtained by multiplying the normalized matrix N with the weight coefficients of the criterion w_j , Equation (6).

$$v_{ij} = n_{ij} \times w_j \quad (6)$$

Step 5: Calculation of the utility degree of alternatives K_i . By applying Equations (7) and (8), the utility degrees of an alternative in relation to the anti-ideal and ideal solution are calculated.

$$K_i^- = \frac{S_i}{S_{aa1}} \quad (7)$$

$$K_i^+ = \frac{S_i}{S_{ai}} \quad (8)$$

where S_i ($i=1, 2, \dots, m$) represents the sum of the elements of the weighted matrix V , Equation (9).

$$S_i = \sum_{j=1}^n v_{ij} \quad (9)$$

Step 6: Determination of the utility function of alternatives $f(K_i)$. The utility function is the compromise of the observed alternative in relation to the ideal and anti-ideal solution. The utility function of alternatives is defined by Equation (10).

$$f(K_i) = \frac{K_i^+ + K_i^-}{1 + \frac{1 - f(K_i^+)}{f(K_i^+)} + \frac{1 - f(K_i^-)}{f(K_i^-)}}; \quad (10)$$

where $f(K_i^-)$ represents the utility function in relation to the anti-ideal solution, while $f(K_i^+)$ represents the utility function in relation to the ideal solution. Utility functions in relation to the ideal and anti-ideal solution are determined by applying Equations (11) and (12).

$$f(K_i^-) = \frac{K_i^+}{K_i^+ + K_i^-} \quad (11)$$

$$f(K_i^+) = \frac{K_i^-}{K_i^+ + K_i^-} \quad (12)$$

Step 7: Ranking the alternatives. Ranking the alternatives is based on the final values of utility functions. It is desirable that an alternative has the highest possible value of the utility function.

Case study

This paper considers making the best decision on selecting a distribution channel for a particular company. The research for the purpose of this paper has been carried out in a company classified as a small business since it employs 26 workers. The company was founded in 1956 and it has not changed the main activities of its business since then. The company carries out production, classified as mixed agricultural production, where the products are divided into three groups. The first group consists of four products in the field of crop production (wheat, corn, soybeans and rapeseed), the second group also consists of four products in the field of seed production (maize seed, wheat seed, barley seed and triticale seed) and the third group consists of one product in the field of animal husbandry (beef cattle). Crop production is carried out on approximately 500 ha, which represents a large land surface and a large annual crop yield. At any moment, the company has about 400 head of beef cattle, which is also a large amount of production. The company also processes 1000 tons of small grain seeds over one production period, which covers a period of one year.

Production is carried out on the territory of the municipality of Derventa, while products are marketed both domestically and abroad. Therefore, the company represents one of the major exporters of these agricultural products. So far, the company has been selling its products exclusively directly to consumers. This type of selling causes distribution costs reaching their maximum, i.e., the company has no additional funds to invest in distribution.

For this reason, the company intends to find a new distribution method to reduce the costs and invest that money in improving the production.

Forming a Multi-Criteria Model

In order for the company to make the best decision on selecting a distribution channel, it was formed a team of experts that consisted of three executives from a company for distribution of agricultural products, all three from BiH, and three foreign professors in the field of marketing specifically engaged in distribution as a narrow field of their interest. They evaluated alternatives by all criteria based on the following scale of values shown in Table 1.

Table 1. Linguistic scale for the evaluation of alternatives depending on the type of criteria

For Criteria	Linguistic Scale
1	Very Poor – VP
2	Poor – P
3	Medium – M
4	Good – G
5	Very Good – VG

All members of the expert team are familiar with the current situation in the company, as well as its needs and requirements, and based on that, they evaluated the criteria and alternatives presented in Tables 2 and 3. Table 2 defines the criteria by which the experts evaluated the alternatives.

Table 2. The criteria for selecting a distribution channel

Criteria	Characteristics and description of the criteria
C ₁ Product characteristics	The basic features and characteristics of the products; durable products – longer distribution channels, less durable products – shorter distribution channels.
C ₂ Financial situation of the company	The number of financial resources that the company is ready to allocate to the distribution channels and the funds determine the channels; more money – shorter distribution channels, less money – longer distribution channels.
C ₃ Consumer habits	The practice of purchasing certain products; consumer goods – longer distribution channels; special products – shorter distribution channels.
C ₄ Costs	The price per unit of distributed product; high price – shorter distribution channels, low price – longer distribution channels.
C ₅ Geographic concentration	The geographic locations where the company sells its products; higher concentration – shorter distribution channels, lower concentration – longer distribution channels.
C ₆ Width of the product assortment	The number of various product lines offered by the manufacturer for sale to consumers; wide assortment – shorter distribution channels, narrow assortment – longer distribution channels.

Table 3 provides a description of the alternatives that were evaluated by the experts according to the criteria set out in Table 2. Each alternative is defined individually in the table for the purpose of their easier review.

Table 3. Defining the alternatives

Alternatives	Characteristics and description of the alternatives
A ₁ Manufacturer-Consumer	The manufacturer sells the product directly to the consumer.
A ₂ Manufacturer-Retailer-Consumer	The manufacturer sells the goods to a retailer and the retailer sells the goods to end consumers.
A ₃ Manufacturer-Wholesaler-Retailer-Consumer	The manufacturer sells the goods to a wholesaler, the wholesaler to a retailer and the retailer eventually sells the goods to end consumers.
A ₄ Manufacturer-Agent-Consumer	Agents do not take ownership of the goods but sell the goods to the buyers on behalf of the manufacturer, so they work in their own name and on behalf of others.
A ₅ Manufacturer-Broker-Consumer	Brokers work for a fixed period of time until an agreement is reached between the manufacturer and the consumer, they do not take any risks, work on the commission from the sales price. They work in the name and on behalf of others.
A ₆ Manufacturer-Auction House-Consumer	Auction houses have the task of bringing together the manufacturer and the buyer in one place and arranging public bidding. They work on the commission from the sales price.
A ₇ Manufacturer-Commissioner-Consumer	The commissioners take the goods from manufacturers and sell the goods at the best price to consumers; they work on commission and settle their costs.

The evaluation of the alternatives by the criteria was performed based on the scale previously presented in Table 1. Ratings of the alternatives are shown in Tables 4 and 5.

Table 4 shows the ratings of the alternatives by the criteria using the scale from 1 to 5 from Table 1.

Table 4. Evaluation of the alternatives by criteria

	E ₁						E ₂					
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
A ₁	4	3	3	4	3	3	4	2	2	2	3	2
A ₂	3	2	3	3	2	3	4	4	5	4	3	4
A ₃	4	3	2	2	3	4	5	4	3	5	4	3
A ₄	3	2	3	2	3	2	3	3	2	2	2	2
A ₅	5	4	4	4	4	4	2	3	1	4	3	4
A ₆	5	5	3	4	3	5	3	2	2	4	2	4
A ₇	5	5	4	5	5	5	2	2	1	3	3	3
	E ₃						E ₄					
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
A ₁	3	1	1	1	2	1	5	4	1	3	5	2
A ₂	3	4	5	4	4	5	3	5	2	4	3	2
A ₃	4	4	4	5	3	4	4	5	2	5	2	2
A ₄	2	2	1	2	2	2	4	5	3	5	2	3
A ₅	3	2	1	4	2	3	4	5	3	5	2	3
A ₆	2	2	1	4	2	3	5	4	3	5	1	2
A ₇	3	2	1	4	2	3	4	4	2	5	1	3
	E ₅						E ₆					
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
A ₁	3	5	1	4	2	3	4	5	2	4	3	1
A ₂	3	3	4	3	4	2	4	4	2	5	2	3
A ₃	4	3	1	3	4	5	3	4	1	5	1	2
A ₄	2	5	4	5	2	1	3	4	2	5	1	2
A ₅	2	5	4	5	1	3	3	4	1	5	2	2
A ₆	4	4	3	4	1	4	4	5	2	5	2	3
A ₇	4	4	4	4	3	3	3	5	3	5	2	1

Table 5 shows the ratings of the alternatives according to the criteria set by the decision-makers using the linguistic scale from Table 1. Table 5, therefore, represents the ratings from Table 4, but in this case, the ratings are presented descriptively.

Table 5. Evaluation of the alternatives by criteria using the linguistic scale

	E ₁						E ₂					
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
A ₁	G	M	M	G	M	M	G	P	P	P	M	P
A ₂	M	P	M	M	P	M	G	G	VG	G	M	G
A ₃	G	M	P	P	M	G	VG	G	M	VG	G	M
A ₄	M	P	M	P	M	P	M	M	P	P	P	P
A ₅	VG	G	G	G	G	G	P	M	VP	G	M	G
A ₆	VG	VG	M	G	M	VG	M	P	P	G	P	G
A ₇	VG	VG	G	VG	VG	VG	P	P	VP	M	M	M
	E ₃						E ₄					
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
A ₁	M	VP	VP	VP	P	VP	VG	G	VP	M	VG	P
A ₂	M	G	VG	G	G	VG	M	VG	P	G	M	P
A ₃	G	G	G	VG	M	G	G	VG	P	VG	P	P
A ₄	P	P	VP	P	P	P	G	VG	M	VG	P	M
A ₅	M	P	VP	G	P	M	G	VG	M	VG	P	M
A ₆	P	P	VP	G	P	M	VG	G	M	VG	VP	P

A₇	M	P	VP	G	P	M	G	G	P	VG	VP	M
	E₅						E₆					
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
A₁	M	VG	VP	G	P	M	G	VG	P	G	M	VP
A₂	M	M	G	M	G	P	G	G	P	VG	P	M
A₃	G	M	VP	M	G	VG	M	G	VP	VG	VP	P
A₄	P	VG	G	VG	P	VP	M	G	P	VG	VP	P
A₅	P	VG	G	VG	VP	M	M	G	VP	VG	P	P
A₆	G	G	M	G	VP	G	G	VG	P	VG	P	M
A₇	G	G	G	G	M	M	M	VG	M	VG	P	VP

Evaluation of the Criteria by the Steps of the Fucom Method

The members of the expert team compared the criteria by significance. Then, they rated how much the significance of the best criterion was greater compared to the others by applying a scale of 1-9. The ratings of the criteria by the expert team members are shown in Table 6.

Table 6. Evaluation of the criteria

	C2	C1	C4	C6	C3	C5
DM1	1	2	2.1	3	4	4.3
	C2	C4	C6	C1	C3	C5
DM2	1	1.2	2	2.6	3	3
	C1	C6	C2	C4	C5	C3
DM3	1	1.5	2.2	2.2	4.3	6.8
	C2	C4	C1	C3	C6	C5
DM4	1	1.5	2	3	4	4.6
	C4	C2	C1	C3	C6	C5
DM5	1	1	3	3.1	4	5
	C4	C2	C1	C6	C3	C5
DM6	1	2	4	4.5	5	6

Table 6 shows that the first decision-maker identified Criterion 2, i.e., the financial situation of the company, as the most significant criterion, and C5, i.e., geographic concentration, as the least significant. Further, the table shows that the second decision-maker also marked the financial situation of the company as the most significant criterion, and the geographic concentration as the least significant, as well as the first decision-maker. The third decision-maker indicated that product characteristics as the criterion for selecting a distribution channel are the most significant criterion, and that consumer habits are the least significant criterion. The fourth and fifth decision-makers, as well as the first and second decision-makers, considered that the most significant criterion for selecting a distribution channel was the financial situation of the company, but the fifth decision-maker also indicated that the costs were as significant as the financial situation of the company. According to them, the least significant criterion was geographic concentration. The sixth decision-maker identified costs as the most significant criterion and geographic concentration as the least significant criterion for selecting a distribution channel.

After all the steps of the FUCOM method, the results of the evaluation of the criteria are obtained, as shown in Table 7. The table is accompanied by a graphic representation of the results where it is easier to see which criterion is the most significant and the least significant for the decision-makers.

Table 7. Results of the evaluation of the criteria by the FUCOM method

		DM1	DM2	DM3	DM4	DM5	DM6	W _j
C1	Product characteristics	0.179	0.114	0.338	0.168	0.107	0.107	0.169
C2	Financial situation of the company	0.358	0.295	0.154	0.337	0.322	0.214	0.280
C3	Consumer habits	0.090	0.098	0.050	0.112	0.104	0.086	0.090
C4	Costs	0.171	0.246	0.154	0.225	0.322	0.428	0.257
C5	Geographic concentration	0.083	0.098	0.079	0.073	0.064	0.071	0.078
C6	Width of product assortment	0.119	0.148	0.226	0.084	0.080	0.095	0.125
							SUM	1.000

Fig. 3. A graphic representation of the evaluation results of the criteria by the FUCOM method

Table 7, as well as Figure 3, shows that the first decision-maker estimates that the financial situation of the company is the most important in selecting a distribution channel (0.358). The first decision-maker considers geographic concentration to be the least significant criterion when selecting a distribution channel (0.83). The second decision-maker also rates the financial situation of the company as the most significant criterion when selecting a distribution channel (0.295). The second decision-maker rates consumer habits and geographic concentration equally, and considers the two criteria to be the least significant when selecting a distribution channel (0.98). The third decision-maker considers product characteristics to be the most significant criterion when selecting a distribution channel (0.338). The third decision-maker considers consumer habits to be the least significant criterion (0.050). The fourth decision-maker rates that the financial situation of the company is the most significant criterion when selecting a distribution channel (0.337). The least significant criterion for the fourth decision-maker when selecting a distribution channel is geographic concentration (0.073). The fifth decision-maker considers the financial situation of the company and the costs to be the most significant criteria compared to other criteria (0.322), while the width of product assortment is the least significant criterion when selecting a distribution channel (0.080). According to the sixth decision-maker, the most significant criterion when selecting a distribution channel is the costs (0.428). The least significant criterion when selecting a distribution channel according to the sixth decision-maker is geographic concentration (0.071). The table and the graph show that, according to the decision-makers, the financial situation of the company is the most significant criterion when selecting a distribution channel; four decision makers (DM1, DM2, DM4 and DM5) rated this criterion as the most important (0.280). The costs as a criterion are in the second position with a slightly lower score (0.257). The least significant criterion, when considering the overall

score, is geographic concentration, and even five members of the expert team (DM1, DM2, DM4, DM5 and DM6) rated it as the least significant (0.079).

Table 8. Extended initial decision matrix

CRITERIA	C11	C12	C13	C14	C15	C16
Anti-ideal	2.749	2.904	1.513	2.798	1.698	1.817
A1	3.772	2.904	1.513	2.798	2.854	1.817
A2	3.302	3.525	3.260	2.040	2.884	2.994
A3	3.957	3.772	1.906	1.513	2.570	3.141
A4	2.749	3.260	2.289	2.000	1.906	1.906
A5	2.994	3.659	1.906	1.414	2.140	3.086
A6	3.659	3.420	2.182	1.587	1.698	3.360
A7	3.360	3.420	2.140	1.513	2.376	2.720
Ideal	3.957	3.772	3.260	1.414	2.884	3.360

Applying Equation (4), the normalized values of the cost criterion are obtained, for example:

$$n_{ij} = \frac{x_{ai}}{x_{ij}} \text{ if } j \in C \Rightarrow n_{14} = \frac{1.414}{2.798} = 0.505$$

The normalized values of the benefit criterion are obtained by applying Equation (5):

$$n_{ij} = \frac{x_{ij}}{x_{ai}} \text{ if } j \in B \Rightarrow n_{11} = \frac{3.772}{3.957} = 0.953$$

and a complete normalized matrix is shown in Table 9.

Table 9. Normalized matrix

CRITERIA	C11	C12	C13	C14	C15	C16
Anti-ideal	0.117	0.216	0.042	0.130	0.046	0.068
A1	0.161	0.216	0.042	0.130	0.077	0.068
A2	0.141	0.262	0.090	0.179	0.078	0.112
A3	0.169	0.280	0.053	0.241	0.070	0.117
A4	0.117	0.242	0.063	0.182	0.052	0.071
A5	0.128	0.272	0.053	0.257	0.058	0.115
A6	0.156	0.254	0.060	0.229	0.046	0.125
A7	0.143	0.254	0.059	0.241	0.064	0.102
Ideal	0.169	0.280	0.090	0.257	0.078	0.125

The next step is to extend the normalized matrix using Equation (6) by multiplying all the values of the normalized matrix by the values of the criteria. The extended normalized matrix is shown in Table 10.

Table 10. Extended normalized matrix

CRITERIA	C11	C12	C13	C14	C15	C16
Anti-ideal	0.695	0.770	0.464	0.505	0.589	0.541
A1	0.953	0.770	0.464	0.505	0.989	0.541
A2	0.834	0.935	1.000	0.693	1.000	0.891
A3	1.000	1.000	0.585	0.935	0.891	0.935
A4	0.695	0.864	0.702	0.707	0.661	0.567
A5	0.757	0.970	0.585	1.000	0.742	0.918
A6	0.925	0.907	0.669	0.891	0.589	1.000
A7	0.849	0.907	0.656	0.935	0.824	0.809
Ideal	1.000	1.000	1.000	1.000	1.000	1.000

Using Equations (7), (12), the final results in Table are obtained by the MARCOS method.

The results are obtained as follows:

Applying Equation (10), all values (by rows) for the alternatives are summed as follows:

$$S_{AAI} = 0.117 + 0.216 + 0.042 + 0.130 + 0.046 + 0.068 = 0.619$$

The values for the remaining alternatives are obtained similarly.

Using Equation (8), the utility degrees in relation to the ideal solution are calculated.

Example:

$$K_1^- = \frac{0.694}{0.619} = 1.121$$

while applying Equation (9), the utility degrees in relation to the ideal solution are obtained, e.g.:

$$K_1^+ = \frac{0.694}{1.000} = 0.694$$

The utility function in terms of the anti-ideal solution is obtained by applying Equation (12) as follows:

$$f(K_1^-) = \frac{K_1^+}{K_1^+ + K_1^-} = \frac{0.694}{0.694 + 1.121} = 0.382$$

While the utility function in terms of the ideal solution is obtained by applying Equation (13) as follows:

$$f(K_1^+) = \frac{K_1^-}{K_1^+ + K_1^-} = \frac{1.121}{0.694 + 1.121} = 0.618$$

Finally, the utility function of alternative A1 is obtained by applying Equation (11):

$$f(K_1) = \frac{K_1^+ + K_1^-}{1 + \frac{1-f(K_1^+)}{f(K_1^+)} + \frac{1-f(K_1^-)}{f(K_1^-)}} = \frac{0.694 + 1.121}{1 + \frac{1-0.618}{0.618} + \frac{1-0.382}{0.382}} = \frac{1.815}{1 + 0.618 + 1.619} = \frac{1.815}{3.237} = 0.561$$

The final results obtained by the MARCOS method are shown in Table 11.

Table 11. Ranking the alternatives

Ai	Si						
AAI	0.619	Ki-	Ki+	f(K ⁻)	f(K ⁺)	f(Ki)	Rank
A ₁	0.694	1.121	0.694	0.382	0.618	0.561	7
A ₂	0.861	1.392	0.861	0.382	0.618	0.696	5
A ₃	0.929	1.502	0.929	0.382	0.618	0.751	1
A ₄	0.727	1.176	0.727	0.382	0.618	0.588	6
A ₅	0.883	1.427	0.883	0.382	0.618	0.714	2
A ₆	0.871	1.408	0.871	0.382	0.618	0.705	3
A ₇	0.863	1.395	0.863	0.382	0.618	0.698	4
AI	1.000						

In Table 11, the alternatives are ranked using all seven steps of the MARCOS method.

Ideal and anti-ideal solutions are obtained, the values of 1.000 and 0.619, respectively. The alternative with the utility function value closest to the ideal solution value is the best alternative and is ranked first. In this research, it is alternative A3, i.e., Manufacturer-Wholesaler-Retailer-Consumer, with the utility function value of 0.751. The worst-ranked alternative is the alternative with the utility function value closest to the value of the anti-ideal solution, and here it is alternative A1, i.e., Manufacturer-Consumer, with the utility function value of 0.561.

Sensitivity analysis

In order to verify the results, we compared the results obtained by the MARCOS method with the results obtained by other multi-criteria decision-making methods. Therefore, in this section of the paper, a sensitivity analysis of the obtained results is performed by the MARCOS method. The results of the analysis are shown in Table 12 and Figure 4.

Table 12. A sensitivity analysis of the results obtained by the MARCOS method

	MARCOS		SAW		ARAS		WASPAS	
A1	0.561	7	0.694	7	0.686	7	0.681	7
A2	0.696	5	0.861	5	0.862	4	0.857	5
A3	0.751	1	0.929	1	0.921	1	0.925	1
A4	0.588	6	0.727	6	0.724	6	0.724	6
A5	0.714	2	0.883	2	0.877	2	0.877	2
A6	0.705	3	0.871	3	0.867	3	0.867	3
A7	0.698	4	0.863	4	0.859	5	0.861	4

Fig. 4. A graph of the sensitivity analysis

A sensitivity analysis compared the ranking results obtained by the new MARCOS method and three other methods: SAW MacCrimmon [35], ARAS, Zavadskas & Turskis [36] and WASPAS, Zavadskas *et al.*, [37]. The first column of Table 12 lists the ranking results of the alternatives obtained by the MARCOS method. The second column contains the ranking results obtained by the SAW method. The third column contains the results obtained by the ARAS method. The fourth column contains the results obtained by the WASPAS method.

Comparing the results obtained by the last three methods it can be noticed that the results are generally the same, which means that we can with high probability claim that the results obtained are accurate. The table and figure show that there is a slight deviation in ranking by

the ARAS method compared to the other three methods. By this method, alternatives A2 and A7 has changed their positions, i.e., alternative A2 is ranked fourth by this method and alternative A7 as fifth. It is the only difference we can see using all four methods. All other methods show identical ranking results. Thus, by applying all four methods, A1 alternative, i.e., direct sales to consumers, is ranked as the worst alternative, i.e., it is in the seventh place.

Alternative A3, i.e., sales via a wholesaler and then retailer, is the best alternative according to the results obtained by all four methods. That is, alternative A3 is ranked first according to all the methods. Therefore, the results obtained by the MARCOS method represent accurate and reliable results. If the company wants to make the best decision about selecting a distribution channel, it can rely on the results obtained by this method. According to the results of this research, the best decision of the company on selecting a distribution channel would be the decision to use alternative A3 as the distribution channel.

Conclusion

The research in this paper was carried out in a company engaged in mixed agricultural production, i.e., crop production, seed production and animal husbandry. The company performs its production at one place, while marketing the products domestically and abroad.

So far, the company has used only one distribution channel and it is direct sales to consumers. However, this method of selling creates huge costs. At present, the company has no additional funds to invest in this distribution channel, and the current budget for this activity has reached their maximum. The company expressed the need and request to conduct the research that would contribute to decide on selecting the best distribution channel. In order to reach the best decision, experts in this field were hired. The expert team consisted of six experts who, on the basis of a questionnaire sent to each of them, evaluated the criteria for the selection of a distribution channel and ranked distribution channels according to each criterion.

Based on the application of the FUCOM method, the criteria were evaluated, and using the MARCOS method, the alternatives, i.e., distribution channels, were ranked according to experts' rates. Applying the method, the worst-ranked alternative was alternative A1, i.e., direct sales to consumers. The method showed that alternative A3, i.e., the sale of products via a wholesaler and a retailer, is the best-ranked method. This channel of distribution would be a much better alternative than the current way of selling products directly to consumers.

Therefore, the company should replace direct sales by selling through intermediaries, in this case wholesale and retail trade. In this way, the company would sell its products to end consumers with some financial savings. This method of selling would also provide other benefits that this channel of distribution brings in relation to direct sales.

In regard to this paper, it remains for future researchers to address the savings that the company would make if it decides on selecting the recommended distribution channel. Certainly, future research may also refer to investing the savings in the development of production and further growth of the company.

REFERENCES

- [1] Macura, P. (2009). Osnove marketinga. Ekonomski fakultet. Banja Luka.
- [2] Talijan, M., Tatić, V., & Lojić, R. (2015). The impact of the economy condition on the economic and national security. *Vojno delo*, 67(1), pp. 200-215.
- [3] Dent, J. (2011). *Distribution channels: Understanding and managing channels to market*. Kogan Page Publishers.
- [4] Rosenbloom, B. (2012). *Marketing channels*. Cengage Learning.

- [5] Singh, M. (2012). Marketing mix of 4P's for competitive advantage. *IOSR Journal of Business and Management*, 3(6), pp. 40-45.
- [6] McCabe, A., Seiter, A., Diack, A., Herbst, C. H., Dutta, S., & Saleh, K. (2011). Private sector pharmaceutical supply and distribution channels in Africa: a focus on Ghana, Malawi and Mali
- [7] Schegg, R., Stangl, B., Fux, M., & Inversini, A. (2013). Distribution channels and management in the Swiss hotel sector. In *Information and Communication Technologies in Tourism 2013* (pp. 554-565). Springer, Berlin, Heidelberg.
- [8] Camilleri, M., Camilleri, M. A., & Acocella. (2018). *Travel marketing, tourism economics and the airline product*. Springer International Publishing.
- [9] Vasiliauskas, A. V., Vilkelis, A., Zinkevičiūtė, V., & Batarliene, N. (2010). Development of automobile distribution networks on the basis of multi-criteria evaluation of distribution channels. *Transport*, 25(4), pp. 361-367.
- [10] Atănașoae, G. (2011). Distribution channels on the organic foods market. *Journal of Horticulture, Forestry and Biotechnology*, 15(3), pp. 19-25.
- [11] Thakran, K., & Verma, R. (2013). The emergence of hybrid online distribution channels in travel, tourism and hospitality. *Cornell Hospitality Quarterly*, 54(3), pp. 240-247.
- [12] Saremi, H., & Zadeh, S. M. M. (2014). Management of distribution channels. *Indian J. Sci. Res*, 5(3), pp. 452-456.
- [13] Kozlenkova, I. V., Hult, G. T. M., Lund, D. J., Mena, J. A., & Kekec, P. (2015). The role of marketing channels in supply chain management. *Journal of Retailing*, 91(4), pp. 586-609.
- [14] Watson IV, G. F., Worm, S., Palmatier, R. W., & Ganesan, S. (2015). The evolution of marketing channels: Trends and research directions. *Journal of Retailing*, 91(4), pp. 546-568.
- [15] Galkin, A. (2015). Distribution Channels Management in Different Regions. *Management*, 1(2), pp. 92-96.
- [16] Sabiote, C. M., Frías, D. M., & Castañeda, J. A. (2012). Culture as a moderator of the relationship between service quality and the tourist's satisfaction with different distribution channels. *Journal of Travel & Tourism Marketing*, 29(8), pp. 760-778.
- [17] Liu, Y., & Cui, T. H. (2010). The length of product line in distribution channels. *Marketing Science*, 29(3), pp. 474-482.
- [18] Stoddard, J. E., Evans, M. R., & Shao, X. (2012). Marketing arts and crafts: Exploring the connection between hedonic consumption, distribution channels, and tourism. *International journal of hospitality & tourism administration*, 13(2), pp. 95-108.
- [19] Kim, H. B., Ham, S., & Moon, H. Y. (2012). The impact of hotel property size in determining the importance of electronic distribution channels. *Journal of Hospitality and Tourism Technology*.
- [20] Banytė, J., Gudonavičienė, R., & Grubys, D. (2011). Changes in marketing channels formation. *Inžinerinė ekonomika*, pp. 319-329.
- [21] Pamučar, D., Stević, Ž., & Sremac, S. (2018). A new model for determining weight coefficients of criteria in mcdm models: Full consistency method (fucm). *Symmetry*, 10(9), p. 393.
- [22] Sofuoğlu, M. A. Fuzzy applications of FUCOM method in manufacturing environment. *Politeknik Dergisi*, 23(1), pp. 189-195.
- [23] Durmić, E. (2019). Evaluation of criteria for sustainable supplier selection using FUCOM method. *Operational Research in Engineering Sciences: Theory and Applications*, 2(1), pp. 91-107.
- [24] Prentkovskis, O., Erceg, Ž., Stević, Ž., Tanackov, I., Vasiljević, M., & Gavranović, M. (2018). A new methodology for improving service quality measurement: Delphi-FUCOM-SERVQUAL model. *Symmetry*, 10(12), p. 757.
- [25] Nunić, Z. (2018). Evaluation and selection of Manufacturer PVC carpentry using FUCOM-MABAC model. *Operational Research in Engineering Sciences: Theory and Applications*, 1(1), pp. 13-28.
- [26] Fazlollahtabar, H., Smailbašić, A., & Stević, Ž. (2019). FUCOM method in group decision-making: Selection of forklift in a warehouse. *Decision Making: Applications in Management and Engineering*, 2(1), pp. 49-65.
- [27] Badi, I., & Abdulshahed, A. (2019). Ranking the Libyan airlines by using full consistency method (FUCOM) and analytical hierarchy process (AHP). *Operational Research in Engineering Sciences: Theory and Applications*, 2(1), pp. 1-14.
- [28] Bozanic, D., Tešić, D., & Kočić, J. (2019). Multi-criteria FUCOM-Fuzzy MABAC model for the selection of location for construction of single-span bailey bridge. *Decision Making: Applications in Management and Engineering*, 2(1), pp. 132-146.
- [29] Ibrahimović, F. I., Kojić, S. L., Stević, Ž. R., & Erceg, Ž. J. (2019). Making an investment decision in a transportation company using an integrated FUCOM-MABAC model. *Tehnika*, 74(4), pp. 577-584.

- [30] Erceg, Ž., & Mularifović, F. (2019). Integrated MCDM model for processes optimization in supply chain management in wood company. *Operational Research in Engineering Sciences: Theory and Applications*, 2(1), pp. 37-50.
- [31] Nenadić, D. (2019). Ranking dangerous sections of the road using MCDM model. *Decision Making: Applications in Management and Engineering*, 2(1), pp. 115-131.
- [32] Puška, A., Stojanović, I., & Maksimović, A. (2019). Evaluation of sustainable rural tourism potential in Brcko district of Bosnia and Herzegovina using multi-criteria analysis. *Operational Research in Engineering Sciences: Theory and Applications*, 2(2), pp. 40-54.
- [33] Stević, Ž., Durmić, E., Gajić, M., Pamučar, D., & Puška, A. (2019). A Novel Multi-Criteria Decision-Making Model: Interval Rough SAW Method for Sustainable Supplier Selection. *Information*, 10(10), p. 292.
- [34] Stević, Ž., Pamučar, D., Puška, A., & Chatterjee, P. (2020). Sustainable supplier selection in healthcare industries using a new MCDM method: Measurement of alternatives and ranking according to COMpromise solution (MARCOS). *Computers & Industrial Engineering*, 140, 106231.
- [35] MacCrimmon, K. R. (1968). Decisionmaking among multiple-attribute alternatives: a survey and consolidated approach (No. RM-4823-ARPA). Rand Corp Santa Monica Ca.
- [36] Zavadskas, E. K., & Turskis, Z. (2010). A new additive ratio assessment (ARAS) method in multicriteria decision-making. *Technological and Economic Development of Economy*, 16(2), pp. 159-172.
- [37] Zavadskas, E. K., Turskis, Z., Antucheviciene, J., & Zakarevicius, A. (2012). Optimization of weighted aggregated sum product assessment. *Elektronika ir elektrotechnika*, 122(6), pp. 3-6.
- [38] Pamučar, D., Lukovac, V., Božanić, D., & Komazec, N. (2018). Multi-criteria FUCOM-MAIRCA model for the evaluation of level crossings: case study in the Republic of Serbia. *Operational Research in Engineering Sciences: Theory and Applications*, 1(1), pp. 108-129.

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