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Application of AHP Model and Survey Results in Deciding on a Product Line in Furniture Industry

Upotreba AHP modela i rezultata ankete pri odlučivanju o proizvodnom programu u industriji namještaja

ABSTRACT • *The paper presents a case study in which a potential investor wanted to invest into a furniture store in the part of the Republic of Croatia named Dalmatia. In four Dalmatian counties (Split, Zadar, Šibenik and Dubrovnik counties), 220 randomly selected persons (180 answered) were asked by telephone what kind of furniture they would like to buy in the next two years and how much they were prepared to pay for the purchase. Based on the results of a consumer survey, five possible alternatives (product lines) were selected and the priorities determined, i.e. which product line was the most profitable taking into account criteria of successful business operations using the multi-criteria model.*

Key words: market research, furniture, multi-criteria decision making, AHP model.

SAŽETAK • *U radu je prikazan studij slučaja na osnovi kojega potencijalni ulagači mogu ulagati u prodaj-na mjesta namještaja na području Dalmacije. U četiri dalmatinske županije (Splitsko-dalmatinskoj, Zadarskoj, Šibensko-kninskoj i Dubrovačko-neretvanskoj), 220 anketiranih osoba (180 odgovora) anketirani su telefonom o tome koje skupine namještaja namjeravaju kupiti u sljedeće dvije godine te koliko su spremni platiti za namještaj. Koristeći se rezultatima ankete, određeno je pet mogućih proizvodnih programa. Na temelju kriterija uspješnog poslovanja poduzeća, primjenom višekriterijskog modela, određeni su prioriteti, tj. ustanovljeno je koji je proiz-vodni program najisplativiji.*

Ključne riječi: istraživanje tržišta, namještaj, multikriterijsko odlučivanje, AHP model.

1 INTRODUCTION
1. UVOD

In the period of growing competitiveness of companies on the market, one of the basic prerequisites for successful business is the study and application of different models of planning products and company product lines. In order for a company to utilize market potential successfully, the structure of a product line must correspond to the needs, tastes and purchasing powers of consumers. A suitable choice of a product line is the basic factor of a marketing mix (Szymanovski and Szczepaniak, 1999).

Concerning furniture industry, a research of preferences of potential furniture buyers in Croatia and Slovakia was conducted. Based on questions from the

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questionnaire, cluster analysis was applied, and with the help of the questionnaire, correlation between questions was defined (Motik *et al.,* 2004).

Making decisions is part of business life. Some of the most important business decisions relate to investments. The choice of the best investment (the most profitable) among the proposed or the possible ones is always an important and topical issue. This is a classic problem of multi-criteria decision making (Winston, 1994). Making decisions in marketing can be made easier with the Marketing Decision Support System (Dyer and Forman, 1991), (Šegotić, 2001). The use of a suitable method that takes into account all criteria (both quantitative and qualitative) will make it possible to evaluate and prioritize the alternatives on offer and, consequently, invest into and do business with more certainty.

The most widely used method of marketing research so far in the field of furniture industry was based only on consumer surveys (Drličkova *et al.*, 1999), (Motik *et al.*, 1999). The goal of our paper is to combine the application of the AHP model and the survey results in order to provide guidelines to a potential investor for the choice of the best product line, which will be optimal and at the same time decrease business risks.

2 MATERIAL AND METHODS
2. MATERIJAL I METODE

The paper deals with a case study in which a potential investor wanted to invest into a furniture store in Dalmatia. In four Dalmatian counties (Split, Zadar, Šibenik and Dubrovnik counties), 220 randomly selected persons (180 answered) were asked by telephone what kind of furniture they would like to buy in the next two years and how much they were prepared to pay for the purchase. The furniture was divided into the following categories: kitchen and dining room, living room, nursery, bedroom, study, bathroom and toilet, hall, and other. The price categories included < HRK 5000 (3rd money category), HRK 5000 - 15000 (2nd money category), > HRK 15000 (1st money category) and does not intend to invest into the furniture**. Table 1 shows the frequencies and the total percentage of answers according to the kind of furniture and investment intent. The investor was interested in 5 product lines at the most (the kind of furniture and price categories). The five most represented product lines were selected on the basis of the survey results and they represented five alternatives of the analytical hierarchy model. The model will provide further ranking of profitability of the selected product lines taking into account other criteria as well.

The Analytical Hierarchy Process (AHP) is a decision making tool for multi-criteria decision analysis. The AHP mathematical theory was developed by T. Saaty in the 1970s. The AHP is a method of breaking down a complex, unstructured situation into its component parts; arranging these parts, or variables, into hierarchic order; assigning numerical values to subjective judgments on the relative importance of each variable; and synthesizing the judgments to determine which variables have the highest priority and should be acted upon to influence the outcome of a situation.

The application of the AHP method can be explained in four steps:
1) The hierarchy model of the decision problem is developed in such a way that the goal is positioned at the top with criteria and sub-criteria at lower levels and finally, the alternatives at the bottom of the model.

Table 1 Survey results – the frequency and the total percentage of answers according to the kind of furniture and investment intention
Tablica 1. Rezultati istraživanja – učestalost i ukupan postotak odgovora s obzirom na skupine namještaja te namjeru ulaganja

Count / total percentage *Broj / ukupni postotak*		Investment intention, HRK / *Namjera ulaganja, HRK*				
		<5000	5000-15000	>15000	No intend *Bez namjere*	Total *Ukupno*
Kind of furniture *Skupina namještaja*	Kitchen and dining room *kuhinja i blagovaonica*	15 ***8.33%***	21 ***11.67%***	6 3.34%	5 2.78%	47 26.11%
	Living room *dnevni boravak*	12 6.67%	13 ***7.22%***	13 ***7.22%***	1 0.56%	39 21.67%
	Nursery *dječja soba*	3 1.67%	10 5.56%	4 2.22%	1 0.56%	18 10.00%
	Bedroom *spavaća soba*	7 3.89%	17 ***9.44%***	4 2.22%	1 0.56%	29 16.11%
	Study *radna soba*	3 1.67%	3 1.67%	7 3.89%	0 0.00%	13 7.22%
	Bathroom and toilet *kupaonica i zahod*	2 1.11%	3 1.67%	3 1.67%	3 1.67%	11 6.11%
	Hall *predsoblje*	3 1.67%	5 2.78%	0 0.00%	1 0.56%	9 5.00%
	Other *ostalo*	1 0.56%	3 1.67%	2 1.12%	8 4.44%	14 7.78%
	Total *ukupno*	46 25.56%	75 41.67%	39 21.67%	20 11.11%	180

2) At each hierarchy structural level, pairwise comparisons should be made with all possible pairs of the elements of this level. The decision-maker's preferences are expressed by verbally described intensities and the corresponding numerical values on the 1-3-5-7-9 scale (Saaty, 1980).

3) On the basis of pairwise comparisons, relative significance (weights) of elements of the hierarchy structure (criteria, sub-criteria and alternatives) are calculated, which are eventually synthesized into an overall alternatives priority list. Pairwise comparisons and weightings within the AHP methodology are performed using the software "Expert Choice".

4) A sensitivity analysis is carried out. AHP method enables a detailed analysis of sensitivity of the end ranking list to the changes in values which are subject to individual assessment.

Our AHP model is aimed at selecting an optimal product line among the five lines on offer:

K2 - Kitchen and dining room 2nd money category

D2 - Living room 2nd money category

K3 - Kitchen and dining room 3rd money category

D1 - Living room 1st money category

S2 - Bedroom 2nd money category

The criteria to assess optimality include Financial efficacy, Risk and Competition. With regard to companies dealing with furniture production and trade, these criteria were considered as the most important. This is because, based on previous experiences, these criteria have proved to be the most relevant (Stutely, 2009).
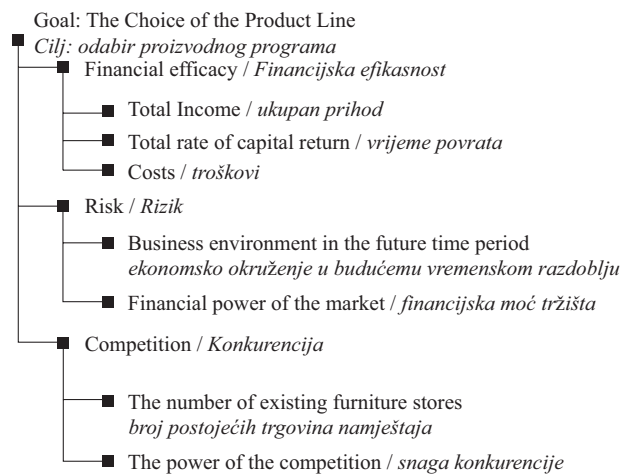
Financial efficacy is the ability of a company dealing with the sale of furniture to achieve positive financial results during its performance on a certain market. It is calculated on the basis of several parameters, but a few parameters have been singled out that were considered to be the most significant for investing sales. These are:

• Total income - the total value of money made on the basis of products sold over a certain period.

• The rate of capital return - denotes a net return in kuna per year for every kuna of invested capital.

• Costs - the total value that a company has to pay for the purchase of a given product to be resold later. This item also includes costs of investment, rent, insurance, salaries of sales staff, stocks, etc. The goal of a company is definitely to achieve the highest total income with the least total costs in order for the profit to be as high as possible.

Business risk is defined as a threatening possibility of unforeseen contingencies in terms of time and space arising from subjective or objective circumstances, due to which damage can occur. Risk can be assessed through a business environment in the future time period and the financial power of the market.

Competition was assessed on the basis of the number of existing furniture stores and the power of competition.

Hierarchy has been constructed as shown in Figure 1.

Goal: The Choice of the Product Line
Cilj: odabir proizvodnog programa
Financial efficacy / *Financijska efikasnost*
Total Income / *ukupan prihod*
Total rate of capital return / *vrijeme povrata*
Costs / *troškovi*
Risk / *Rizik*
Business environment in the future time period
ekonomsko okruženje u budućemu vremenskom razdoblju
Financial power of the market / *financijska moć tržišta*
Competition / *Konkurencija*
The number of existing furniture stores
broj postojećih trgovina namještaja
The power of the competition / *snaga konkurencije*

Alternatives: K2 - Kitchen and dining room 2nd money category, D2 - Living room 2nd money category, K3 - Kitchen and dining room 3rd money category, D1 - Living room 1st money category, S2 - Bedroom 2nd money category
Alternative: K2 - kuhinja i blagovaonica 2. kategorije, D2 - dnevna soba 2. kategorije, K3 - kuhinja i blagovaonica 3. kategorije, D1 - dnevna soba 1. kategorije, S2 - spavaća soba 2. kategorije

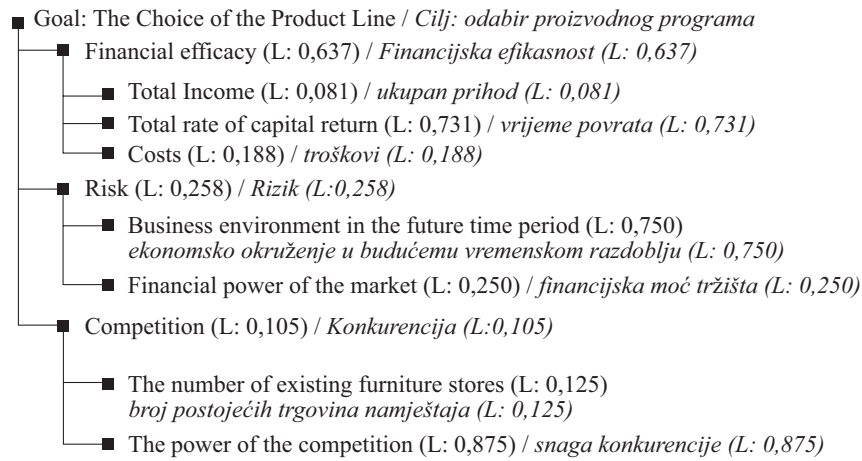**Figure 1** Hierarchical structure for the Choice of the Product Line
Slika 1. Hijerarhijska struktura za odabir proizvodnog programa

The programs Expert Choice and Statistica were used to obtain the result.

3 RESULTS AND DISCUSSION
3. REZULTATI I RASPRAVA

After the hierarchy was constructed, all pairwise comparisons were made with the help of experts in the marketing of the furniture industry using a 9-point scale. These evaluations resulted in reciprocal matrices of the components of each level against the items at the level above. All the evaluations provided an input to the *eingenvalue analysis*. It is to be noted that evaluations were made quite consistently, which can be seen from the total consistency index, which is less than 0.1. The result can be seen in Figure 2, which shows the priority of our alternatives (product lines).

The sensitivity analysis was used to investigate the sensitivity of the alternatives to the changes in the priorities of the criteria. Figure 3 presents the Gradient Mode for the sensitivity analysis. The linear presentation of the alternatives against a single criterion, Financial Efficacy, emphasizes how the alternatives relate to any priority assigned to the criterion shown on the x-axis. In the Differences graph, Figure 4, the alternative K2 (the highest percentage of demand - the survey result) is compared against the alternative D1 (the highest priority in the AHP model). A bar appears on the graph for each criterion. The bar extends to the left if the selected alternative is best on that criterion and to the right if the varying alternative is best. The bat at the bottom is the composite difference.

Goal: The Choice of the Product Line / *Cilj: odabir proizvodnog programa*
- Financial efficacy (L: 0,637) / *Financijska efikasnost (L: 0,637)*
  - Total Income (L: 0,081) / *ukupan prihod (L: 0,081)*
  - Total rate of capital return (L: 0,731) / *vrijeme povrata (L: 0,731)*
  - Costs (L: 0,188) / *troškovi (L: 0,188)*
- Risk (L: 0,258) / *Rizik (L:0,258)*
  - Business environment in the future time period (L: 0,750)
    ekonomsko okruženje u budućemu vremenskom razdoblju (L: 0,750)
  - Financial power of the market (L: 0,250) / *financijska moć tržišta (L: 0,250)*
- Competition (L: 0,105) / *Konkurencija (L:0,105)*
  - The number of existing furniture stores (L: 0,125)
    broj postojećih trgovina namještaja (L: 0,125)
  - The power of the competition (L: 0,875) / *snaga konkurencije (L: 0,875)*

Alternatives / *Alternative*:

K2 – Kitchen and dining room 2nd money category / *kuhinja i blagavaonica 2. kategorije*	0.191
D2 – Living room 2nd money category / *dnevna soba 2. kategorije*	0.179
K3 – Kitchen and dining room 3rd money category / *kuhinja i blagavaonica 3. kategorije*	0.188
D1 – Living room 1st money category / *dnevna soba 1. kategorije*	0.269
S2 – Bedroom 2nd money category / *spavaća soba 2. kategorije*	0.173

Figure 2 Synthesis of data for the Choice of the Product Line
Slika 2. Sinteza podataka za odabir proizvodnog programa
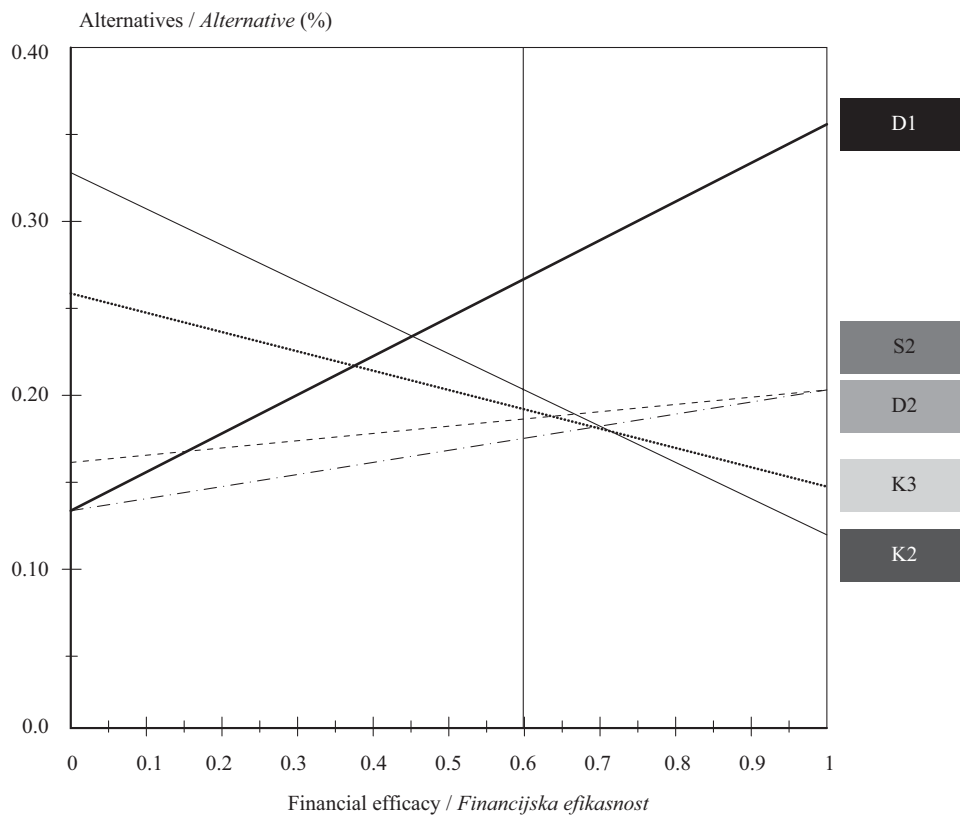
Figure 3 Sensitivity Analysis (Gradient Mode) for the Financial Efficacy (K2 - Kitchen and dining room 2nd money category, D2 - Living room 2nd money category, K3 - Kitchen and dining room 3rd money category, D1 - Living room 1st money category, S2 - Bedroom 2nd money category)
Slika 3. Analiza osjetljivosti (*gradient mode*) za financijsku efikasnost (K2 - kuhinja i blagovaonica 2. kategorije, D2 - dnevna soba 2. kategorije, K3 - kuhinja i blagovaonica 3. kategorije, D1 - dnevna soba 1. kategorije, S2 - spavaća soba 2. kategorije)
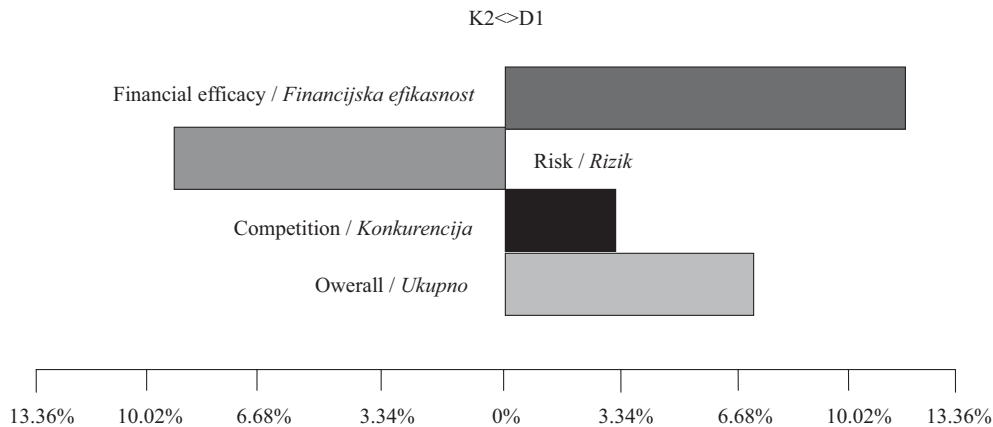
K2<>D1

Figure 4 Comparison of K2 and D1
Slika 4. Usporedba kuhinja i blagovaonica 2. kategorije s dnevnom sobom 1. kategorije

4 CONCLUSION
4. ZAKLJUČAK

According to the market research results in the Dalmatian area, the highest interest was shown in the purchase of kitchen and dining room furniture in the 2nd money category (11.67%). However, taking into consideration criteria that are important for a successful company business, such as: Financial efficiency, Risk and Competition, the AHP method showed that the living room in the 1st money category had priority. Figure 3 shows that by changing the priorities of the criterion of financial efficacy (the most important criterion), the ranking of the alternatives is also changed. In other words, by decreasing the importance of financial efficacy from 0.637 to 0.4, the kitchen and dining room in the 2nd money category take priority.

A developed model can be successfully used in solving similar problems in furniture industry that are dependent on several qualitative and quantitative criteria.

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