

An Integrated Approach to the Purchase Problem of Businesses with DEMATEL and AHP Methods: A DSLR Camera Example

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Extensive Summary

1. Introduction

Organizational purchasing decisions are shaped by the consumers' purchasing decisions. The generally accepted purchasing decision process has five stages, which are; problem recognition, information search, evaluation, buying decision and post-purchase behavior (Comegys, Hannula and Väisänen, 2006, pp. 337-338). However, the purchasing decision process for businesses also consists of five stages, namely; identification of needs, establishment of specifications, identification of alternatives, evaluation of alternatives and selection of suppliers (Webster and Wind, 1972, p. 16). Moreover, purchasing decisions include choosing offers from varied suppliers apart from different properties as price, product quality, and delivery reliability of supplier (Morssinkhof, Wouters and Warlop, 2011). Making decision gets harder while number of technical specifications of product, other criteria and alternatives increase. Hence, more models are being developed for purchasing decisions (Water and Peet, 2006).

2. Purpose and Scope

Purpose of this study is to find a solution for selection problem of decision makers who purchase equipment for their company, with the assistance of an integrated model. Decision makers can evaluate multi-criteria and can make better decisions by this proposed model. In addition, multiple decision makers can participate in finding a solution to the problem. Thus, the ability to persuade people with high demands and wishes of the decision makers will affect the result equally. The application of the model we propose of an SME business (that operates in the photography industry in Ankara) is applied to the problems faced in making equipment replacement decisions.

3. Method

The first thing to do in these types of studies is to determine the criteria for decision-making. The experts' opinions, literature review or market study may be used to determine the criteria. In this study, the importance of the criteria for the business will be calculated using the AHP method, after criteria weights from the experts'

opinions are calculated utilizing the DEMATEL method. As a result of these calculations, there will be two coefficients for the criteria which have equal weights. The multiplication of these coefficients will show the criteria weights. Then, the criterion scores of each alternative will be calculated. Finally, the alternative options will be evaluated using their technical scores and these criteria weights. Final scores will demonstrate each alternative's priority.

4. Findings

In this study, seven experts are asked open-ended questions for the purpose of determining the criteria, and eight different criteria which are deemed important in selecting a camera are acquired based on their answers. The relevant criteria we found based on our research and the experts' opinions can be seen in Table-1. In this table, one of the eight criteria, the criterion of "Compatibility", is not included due to the fact that the business does not change its brand name during this purchasing process.

The criteria in Table-1 are evaluated by four experts (a photography blogger, a professional photographer, a photography artist and an administrator of a photography association) in a 0-4 interval scale. Then, a "Direct Relationship Matrix" is produced using the arithmetic mean of the scores given by the experts. Afterwards, the s value is obtained. The s value of 17.00 for this study is found by the sum of the "Cost" criterion row, which is the maximum value among the row and column sums of the Matrix.

"Normalized Direct Relationship Matrix", "Total Relationship Matrix" and "Total Effects and Net Effects for Each Factor" are produced respectively by applying steps of the DEMATEL method.

Threshold value 0.475 that will be used for drawing "The Impact-direction Map" is obtained by calculating the average of the "Total Relationship Matrix". Finally, the criteria weights according to the experts' opinions are calculated with the DEMATEL method and the criteria priorities are presented in Table-1.

Table 1: Criteria Weights According to the Experts' Opinions

Criteria	$\sqrt{[(D+R)^2 + (D-R)^2]}$	Criterion Weight (W)	Criterion Priority
Cost	8.009	0.172	1
Technical	6.832	0.146	4
Video	6.387	0.137	5
Durability	5.613	0.120	6
Performance	7.919	0.170	2
Image	6.864	0.147	3
Dimensions	5.023	0.108	7
Total	46.648	1.000	

The weights given in Table-1 are evaluated with criteria weights that are obtained using the AHP method of which the steps are given below.

Decision makers of the company made a pairwise comparison for each criterion. Then, "Pairwise Comparison Matrix" is obtained. After that, the matrix is normalized and eigenvector is calculated. In the next step, the $\lambda_{\max}$ value is found as 7.171 for calculating a "Consistency Ratio". The consistency ratio is calculated as 0.022 using the value of 1.3417 from Alonso and Lamata's (2006) Random Index Table. Model is consistent since the consistency ratio is smaller than 0.1.

Once the criteria weights are obtained via the DEMATEL and AHP methods, the candidates' scores are calculated based on the cameras' technical data. The scores received for the criteria by the three cameras (D1, D2 and D3) are provided in Table-2.

Table 2: Criteria Weights and Alternatives Criterion and Final Scores

Criteria	DEMATEL	AHP	D1	D2	D3
Cost	0.172	0.054	1.000	0.822	0.570
Technical	0.146	0.229	0.767	1.000	1.000
Video	0.137	0.026	0.500	1.000	1.000
Durability	0.120	0.102	0.563	0.769	1.000
Performance	0.170	0.259	0.275	0.650	1.000
Image	0.147	0.293	0.521	0.521	1.000
Dimensions	0.108	0.038	0.942	1.000	0.722
Final Score			3.554	5.092	6.745
Final Score (%)			23.09%	33.09%	43.82%

At the final step, the alternatives' criterion scores are multiplied by the criterion scores obtained from the experts' opinions and the preferences of business for each criterion. Final score is obtained by the sum of scores that are calculated for each criterion. Thus, the DSLR cameras' final scores for D1, D2 and D3 respectively are calculated as 23.09%, 33.09% and 43.82%.

5. Result

The criteria that affect equipment-purchasing decisions have different priorities for each individual business and they also differ according to the experts' opinions. Also it might differ because of the experts' opinions. Our proposed model does not only evaluate the experts' opinions but also considers the company needs. Using the DEMATEL method, the relations in the system can be measured beside the influence levels of the criteria, and the "Performance" criterion is found to have the highest influence degree. According to the results, the most and the least important criteria are "Cost" and "Dimensions" respectively according to the expert's opinion, and "Image Properties" and "Video" according to the company. The results point to the camera D3 as appropriate for purchasing.

Multiple Criteria Decision Methods, such as VIKOR, TOPSIS, and MOORA can be used for evaluating alternatives. The alternatives are evaluated using these three methods as well, and the results are the same as our proposed model.