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ABSTRACT

Brisa is one of the leading tire companies in Turkey and Europe. They work with several suppliers and choosing the best one among the alternatives might be challenging. In order to overcome this difficulty, we conducted our project with the Purchasing and Logistics departments.

Determining the best supplier is a difficult process. Having more than one alternative and criterion complicates the selection of the best supplier. The offers are evaluated based on cost, maturity, coverage, performance and satisfaction. Each of these criteria had an approximate significance in the eyes of the company, but the lack of a numerical equivalent of this importance was one of the main problematic factors.

In this project, we used Analytical Hierarchy Process and Sensitivity Analysis to solve this problem.

OBJECTIVES

The main objective of this project was to provide a system that evaluates the offers and selects the best one according to the criteria which is set by the company. While doing this, it was also important to make this system sustainable, user-friendly, open to change and able to meet the company's demands.

PROJECT DETAILS

The project consists of two main parts. The first part is the implementation of Analytical Hierarchy Process (AHP), and the second part is a sensitivity analysis for chosen two criteria.

Analytical Hierarchy Process

This part consists of three steps which are deciding the weights of each criterion, calculating the suppliers' points for each criterion and deciding the best supplier.

In the first step, the user enters the pairwise comparisons among the criteria into the upper triangle of the pairwise comparison matrix and the system checks the consistency rate.

1	Pairwise comparison matrix among five criteria				
	Cost	Maturity	Performance	Coverage	Satisfaction
Cost	1.00	5.00	3.00	1.00	5.00
Maturity	0.20	1.00	2.00	0.50	3.00
Performance	0.33	0.50	1.00	1.00	3.00
Coverage	1.00	2.00	1.00	1.00	5.00
Satisfaction	0.20	0.33	0.33	0.20	1.00

Figure 1: Pairwise comparison matrix among the five criteria

For the second step, we created five matrices for cost, maturity, performance, coverage, and satisfaction. The offers should be entered to the matrix and the system automatically transforms these values into AHP fundamental scale. In addition, we added a *Subjective Point* column and by this way, Brisa can reflect their previous experiences into transformed values.

2	Suppliers' points for the maturity criterion			
Offer	Transformed Point	Subjective Point	Supplier	
60.00	5.00	4.00	Firm A	
30.00	3.00	3.00	Firm B	
60.00	5.00	5.00	Firm C	
30.00	3.00	3.00	Firm D	
45.00	4.00	4.00	Firm E	

3	Suppliers' points for the cost criterion			
Offer	Transformed Point	Subjective Point	Supplier	
12,531,966.00	3.00	3.00	Firm A	
12,561,459.09	3.00	3.00	Firm B	
11,684,361.80	7.00	7.00	Firm C	
12,914,955.24	1.00	1.00	Firm D	
11,253,722.00	9.00	9.00	Firm E	

4	Suppliers' points for the performance criterion				
Number of shipments	Complaint	Transformed Point	Subjective Point	Supplier	
1,485.00	20.00	9.00	9.00	Firm A	
1,638.00	136.00	6.00	6.00	Firm B	
300.00	30.00	5.00	5.00	Firm C	
48.00	8.00	3.00	3.00	Firm D	
307.00	40.00	4.00	4.00	Firm E	

5	Suppliers' points for the coverage criterion			
Coverage Point	Transformed Point	Subjective Point	Supplier	
3,678	8.00	8.00	Firm A	
3,531	2.00	2.00	Firm B	
3,678	8.00	8.00	Firm C	
3,499	1.00	1.00	Firm D	
3,677	8.00	8.00	Firm E	

6	Suppliers' points for the satisfaction criterion	
Satisfaction Point	Supplier	
1.00	Firm A	
6.00	Firm B	
7.00	Firm C	
8.00	Firm D	
9.00	Firm E	

Figure 2: Pairwise comparison matrices among the alternatives

The third step is deciding the best supplier. In this step, the model combines these weights in the criteria-based matrix and multiplies this matrix with the criteria weights in order to calculate the weighted scores of each alternative. Moreover, the model shows a tableau that shows the suppliers' points for each criterion.

7	Suppliers' points for each criterion				
	Cost	Maturity	Performance	Coverage	Satisfaction
Firm A	13%	25%	33%	30%	3%
Firm B	13%	15%	22%	7%	19%
Firm C	30%	25%	19%	30%	23%
Firm D	4%	15%	11%	4%	26%
Firm E	39%	20%	15%	30%	29%

8	Deciding the best supplier with the final scores			
	Weights of Criterion	Suppliers	Final Scores	Final Scores with subjective points
Cost	39.08%	Firm A	21.52%	20.93%
Maturity	14.88%	Firm B	13.53%	13.65%
Performance	14.35%	Firm C	27.27%	27.46%
Coverage	26.12%	Firm D	7.93%	8.05%
Satisfaction	5.58%	Firm E	29.75%	29.91%
Total	100%		100%	100%

Result: Supplier with the highest score = Firm E
Subjective Result: Supplier with the highest score = Firm E

Figure 3: Calculation of weighted scores of each alternative

Sensitivity Analysis

To see the effects of changes in weights of chosen two criteria, we used What-if-Analysis in Excel. The user should decide the lower and upper bounds for the first independent variable and the resolution. Subsequently, the user should click on the "Run" button and the model generates the sensitivity table and the graph of final scores of the alternatives according to the What-if-Analysis. Also, this analysis shows the best two alternatives for each resolution.

1	Coefficient of criterion					Total	Resolution	Lower Bound	Upper Bound
	39.08%	14.88%	14.35%	26.12%	5.58%	1	6%	1%	60%
Fixed criteria choice	0	1	1	0	1				

Figure 5: Deciding the resolution, lower bounds and upper bounds

Supplier / Criterion	Cost	Maturity	Performance	Coverage	Satisfaction	Total
Firm A	13.04%	25.00%	33.33%	29.63%	3.23%	21.52%
Firm B	13.04%	15.00%	22.22%	7.41%	19.35%	13.53%
Firm C	30.43%	25.00%	18.52%	29.63%	22.58%	27.27%
Firm D	4.35%	15.00%	11.11%	3.70%	25.81%	7.93%
Firm E	39.13%	20.00%	14.81%	29.63%	29.03%	29.75%

Figure 4: Decision of temporarily fixed criteria weights

2	Cost	Coverage	Firm A	Firm B	Firm C	Firm D	Firm E	3	First Best	Second Best
	59.20%	6.00%	18.18%	14.67%	27.43%	8.06%	31.66%		Firm E	Firm C
	53.20%	12.00%	19.18%	14.33%	27.38%	8.02%	31.09%		Firm E	Firm C
	47.20%	18.00%	20.17%	13.99%	27.33%	7.98%	30.52%		Firm E	Firm C
	41.20%	24.00%	21.17%	13.65%	27.29%	7.95%	29.95%		Firm E	Firm C
	35.20%	30.00%	22.16%	13.31%	27.24%	7.91%	29.38%		Firm E	Firm C
	29.20%	36.00%	23.16%	12.97%	27.19%	7.87%	28.81%		Firm E	Firm C
	23.20%	42.00%	24.15%	12.64%	27.14%	7.83%	28.24%		Firm E	Firm C
	17.20%	48.00%	25.15%	12.30%	27.09%	7.79%	27.67%		Firm E	Firm C
	11.20%	54.00%	26.14%	11.96%	27.04%	7.75%	27.10%		Firm E	Firm C
	5.20%	60.00%	27.14%	11.62%	27.00%	7.71%	26.53%		Firm A	Firm C

Figure 7: What-if-Analysis of two criteria and the best two of the alternatives

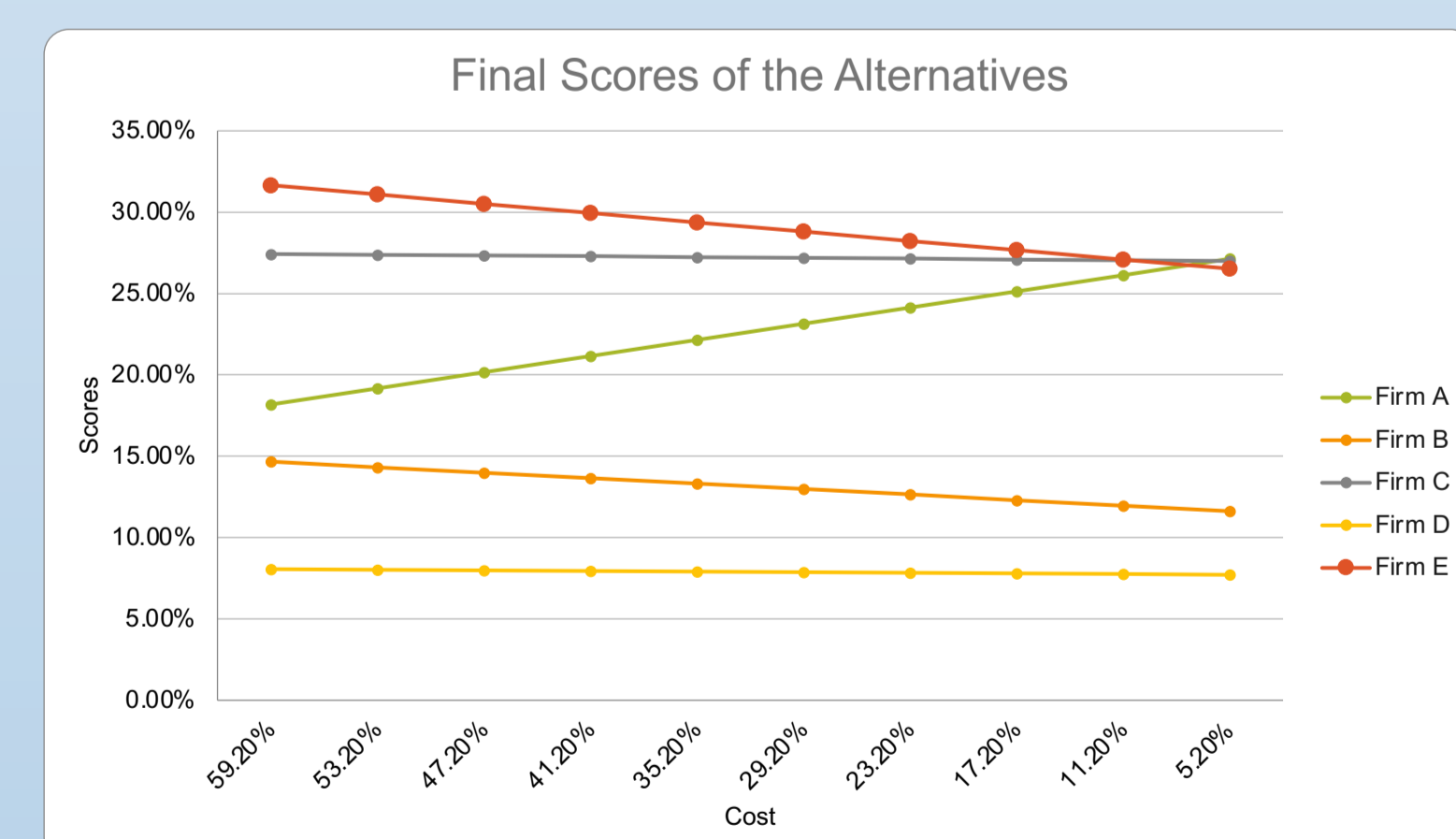


Figure 8: Scatter plot of the What-if-Analysis

CONCLUSIONS

In this project, we created a new systematic and user-friendly model for supplier selection. With this model, the company can easily decide which supplier is the best according to their criteria. Also, the model is sustainable and open to change so that the company can use it for their future tenders too.

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