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# Multiple Criteria Decision Making on selecting new laminate factory: the case of Turkey

## Donošenje odluke o izboru lokacije za novu tvornicu laminata na temelju više kriterija: primjer Turske

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**ABSTRACT** • Multiple Criteria Decision Making (MCDM) method has used by many decision makers in site selection for many production facilities. This study is indented to demonstrate the application of Electre Technique as an MCDM tool for the selection of decorative laminate factory site. The criteria used to rank alternatives were economic factors including raw material resource, transporting possibilities, market possibilities, operation cost, government policies, establishment cost, suppliers and environmental factors including international economical organizations, military and strategically factors, foreign trade, environmental policy, regional development policy, infrastructure, local service capacity, skilled labor capacity, climatic and natural conditions. The technique was used to select the most suitable factory site among five different alternatives. Corlu was determined as the best place for a new laminate factory site.

**Key words:** Multiple Criteria Decision Making, Electre Technique, laminate industry, selection of factory site

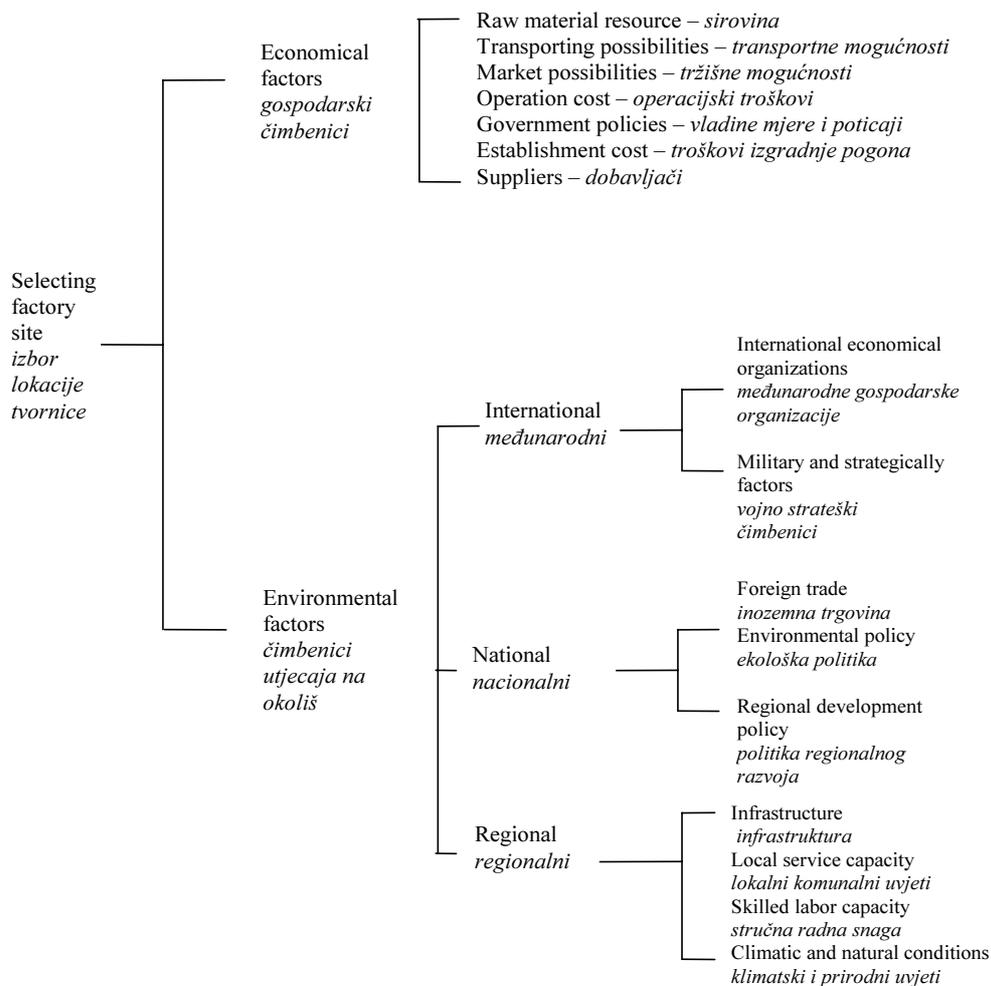
**SAŽETAK** • Metoda za donošenje odluke na temelju više kriterija vrlo često se primjenjuje za izbor najboljeg mjesta za gradnju proizvodnih pogona. U ovom se radu obrađuje primjena metode nazvane Electre (Elimination et Choix Traduisant La Réalité, opisane u odjeljku Metode), koja služi za donošenje odluke na temelju analize više kriterija o izboru mjesta za gradnju pogona za proizvodnju laminata. Kriteriji primjenjeni za rangiranje mogućih mjesta jesu ekonomski čimbenici koji uključuju sirovinske resurse, transportne mogućnosti, tržišne mogućnosti, operacijske troškove, vladine mjere i poticaje, troškove izgradnje pogona, dobavljače i čimbenike vezane uz zaštitu okoliša, koji uključuju i međunarodne ekonomske organizacije, vojne i strateške čimbenike, inozemno tržište, zaštitu okoliša, regionalnu razvojnu aktivnost, infrastrukturu, lokalne uslužne kapacitete, kvalificiranu stručnu radnu snagu, klimatske i prirodne uvjete. Metoda je primjenjena pri izboru najboljeg mjesta za gradnju tvornice od pet mogućih mjesta. Mjesto Corlu određeno je kao najbolje za gradnju tvornice za proizvodnju laminata.

**Key words:** donošenje odluke na temelju više kriterija, metoda Electre, industrija laminata, izbor mjesta za gradnju tvornice

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**Figure 1**  
Factors that affect the selection of a factory site  
**Slika 1.**  
Čimbenici koji utječu na izbor sjedišta tvornice

### 3.2 Definition of the factors

#### 3.2 Definicija čimbenika

The factors that affect the selection of the factory site for a laminate factory were defined as follow: Economical Factors, international and regional factors from Environmental Factors (Figure 1). These factors were then subdivided into raw material resources, market possibilities, transporting possibilities, establishment cost, operation cost, government policies, suppliers, infrastructure, public society, skilled labor capacity, energy and pollution.

### 3.3 Evaluation of the alternatives based on the factors

#### 3.3 Procjena alternativa s obzirom na čimbenike

##### 3.3.1 Weighting the factors

##### 3.3.1 Pridjeljivanje težina čimbenicima

One of the crucial points of Electre Technique is weighting the factors. The experts ranked the factors according to their

importance by "weighting" each factor. In this study, the weighting values ranged from 1 to 8.

##### 3.3.2 Defining the scales

##### 3.3.2 Definiranje ljestvica

In this step, each factor was scored according to its weight. The critical point during scoring is to keep the class width of the high weight scale wider compared to the low weight scale. The aim of this is to treat the low weighted factor unjustly compared to the high weighted one. The weights and scales of this study are given in Table 1.

##### 3.3.3 Scoring the factors

##### 3.3.3 Bodovanje čimbenika

In this step, the alternatives were scored among each other and defined by concordance and discordance matrixes. The scoring table formed by the experts is given in Table 2. These qualitative scores converted to the quantitative scores by the weights and scales are shown in Table 3.



	Gebze	Corlu	Izmir	Kayseri	Duzce	Weights
Raw material – sirovina	8.6	8.6	7.7	2.3	8.0	7
Market – tržište	8.0	8.0	8.0	9.0	5.0	8
Transport – transport	9.5	8.6	8.6	7.7	7.7	7
Establishment cost – troškovi izgradnje pogona	7.4	8.2	7.4	7.4	7.4	6
Operation cost operacijski troškovi	7.4	8.2	6.6	7.4	5.8	6
Government policy – vladine mjere i poticaji	7.1	7.8	5.0	7.1	7.1	5
Suppliers – dobavljači	7.8	7.8	7.8	7.1	7.1	5
Public society – društvena zajednica	6.6	6.6	6.6	5.8	5.8	2
Climatic condition – klimatski uvjeti	7.4	7.4	7.4	7.4	7.4	6
Infrastructure – infrastruktura	9.5	9.5	9.5	8.6	7.7	7
Technological conditions – tehnološki uvjeti	8.0	8.0	7.4	7.4	6.8	4
Skilled labor – stručna radna snaga	7.0	7.0	7.0	6.5	6.5	3
Energy – energija	7.8	7.8	7.8	7.8	7.1	5
Pollution - onečišćenje	5.0	6.2	5.0	6.6	6.6	2

**Table 3**  
Conversion of qualitative scores to quantitative scores by weights and scales  
**Tablica 3.**  
Pretvorba kvalitativnih bodova u kvantitativne s pomoću težina i ljestvica

	Gebze	Corlu	Izmir	Kayseri	Duzce
<b>Gebze</b>	//////////	0.904	0.603	0.521	0.233
<b>Corlu</b>	0.740	//////////	0.589	0.288	0.110
<b>Izmir</b>	0.973	1.000	//////////	0.575	0.322
<b>Kayseri</b>	0.863	0.863	0.712	//////////	0.590
<b>Duzce</b>	0.973	0.973	0.808	0.890	//////////

**Table 4**  
Concordance matrix  
**Tablica 4.**  
Matrica podudarnosti

	Gebze	Corlu	Izmir	Kayseri	Duzce
<b>Gebze</b>	//////////	0.012	0.029	0.086	0.041
<b>Corlu</b>	0.016	//////////	0.038	0.086	0.041
<b>Izmir</b>	0.000	0.000	//////////	0.074	0.041
<b>Kayseri</b>	0.022	0.005	0.070	//////////	0.055
<b>Duzce</b>	0.022	0.005	0.029	0.078	//////////

**Table 5**  
First discordance matrix  
**Tablica 5.**  
Prva matrica nepodudarnosti

	Gebze	Corlu	Izmir	Kayseri	Duzce
<b>Gebze</b>	//////////	0.000	0.012	0.012	0.025
<b>Corlu</b>	0.011	//////////	0.022	0.012	0.033
<b>Izmir</b>	0.000	0.000	//////////	0.012	0.025
<b>Kayseri</b>	0.000	0.000	0.029	//////////	0.022
<b>Duzce</b>	0.000	0.000	0.022	0.000	//////////

**Table 6**  
Second discordance matrix  
**Tablica 6.**  
Druga matrica nepodudarnosti

### 3.3.5 Formation of discordance matrix

#### 3.3.5 Izrada matrice nepodudarnosti

There are two discordance matrixes in the Electre Technique: first discordance matrix shows the non-dominated degrees of the alternative factory sites with the help of

the scores and weights of the factors. In this matrix, the alternatives are compared in pairs and the highest difference is proportioned to the total weight (Table 5). In the second discordance matrix, the alternatives are re-compared in pairs and the second highest difference is proportioned to the total weight (Table 6).



- Press, Istanbul, Turkey.
7. Ilhan, R.; Burdurlu E. 1993: Plant Layout in Woodworking Industry. Ankara. 366 pp.
8. Kobu, B. 1999: Production Management. Istanbul University, Faculty of Business Administration Publication, Istanbul, 607 pp.
9. Kurtoglu, A.; Tanritanir E. 1991: Physical Planning in Furniture Industry. Review of the Faculty of Forestry, Istanbul University, Series A, 41, (3-4), 47-60, Istanbul.
10. Kurtoglu, A.; Tanritanir E. 1995: Selection of Factory Site in Furniture Industry. Furniture Decoration magazine, (6), 82-84, Istanbul.
11. Mucuk, I. 1985: Modern Administrating. Der Press, Istanbul.
12. Rockstroh, W. 1981: Betriebsgestaltung in Der Holzindustrie. VEB Fachbuchverlag Leipzig.
13. Roy, B. 1968: Classement Et Choix En Présence De Points De Vue Multiples. Revue D'Informatique Et De Recherche Operationelle. No:8, France.
14. Tumer, M. 1978: Product, Production and Management. Sermet Press, Press, Istanbul.
15. Tanritanir, E. 1989: Design of Production System. (seminar notes) Istanbul University, Business Administration Faculty, Dept. of Production Management, Istanbul.
16. Turker, A. 1989: Multi-Scale Decisions in Tree Plantation. Review of the Faculty of Forestry, Istanbul University, Series A, Vol 39, No: 2, pp. 139-163, Istanbul.
17. Wild, R. 1987: Production and Operation management. Holt, Rinehart and Winston, New York.

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