

SELECTION OF LOGISTICS COMPANY IN FACILITY MANAGEMENT SECTOR WITH TOPSIS AND ELECTRE FROM MULTI-SIZE DECISION MAKING METHODS

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ABSTRACT

In this study, it is discussed selection of a logistics company for a firm operating in the facility management sector and aimed to make contribution to Facility Management Sector with scientific methods which has gained importance in recent years in Turkey. Since many qualitative and quantitative criteria must be taken into account to make a correct and reliable selection of logistics company, multi-criteria decision making techniques TOPSIS and ELECTRE have been implemented in an integrated way. 9 different criteria have been taken into account to be able to choose among 5 companies to present the solution method of the decision problem. Criteria regarding to the problem are weighted by competent people from different sectors working with logistics companies. Optimal company selection with TOPSIS method is provided, order of preference is determined and with the ELECTRE method, both the results were confirmed and the companies were ranked according to their superiority.

Keywords—Electre, Facility Management, TOPSIS

I. INTRODUCTION

Companies that move with the motive of survival in competitive markets are obliged to have zero errors in order to ensure that every step they take is correct and effective. Customer satisfaction is strayed from the departments which are in contact with the customers and appeared in every aspect of production and service. One of the modules that affect this situation is logistics.

Logistics is one of the cornerstones in the production of high quality products in time and at a lower cost. This study is the consequence of attempts to make the right decision under different criteria in order to ensure effective production. In the business processes that complexed with industrial revolutions, companies started to make money by not only selling products but also saving from the services they purchased. Logistics is also one of the most important saving items if rational decisions are made.

The aim of this study is to choose the right logistics companies for the firms and to make verbal facts into mathematical expressions and to get a real conclusion with the aim of making efficient and effective decisions with the help of scientific methods.

II. LITERATURE REVIEW

2.1. Logistics

The word logistic comes from the French word “logistique”. It was integrated into English as “logistics” in the 19th century. Logistics, which entered the literature as a military term, has a wide perspective and is one of the concepts that cannot be understood in our country. It is defined as “The activities carried out, in order to provide necessary service support and supplies which are suitable with the strategy and tactics to the combatants.” in the military sources. Transportation activities of armed forces such as materials, weapons, soldiers, shelter, food and beverage are made with the integration of elements. Contrary to the usual beliefs, today freightage is not only seen as the transportation of the products but also evaluated in the logistic framework [1]. The definition and scope of logistics services have been transformed over the years with technological and economic developments [2]. In the 1950s, when the term of logistics was unrequited for industry, logistics was used as a military term. In the 1970s logistics was an activity which is carried out inside of the production-related businesses and in this period, it has become an independent field of activity carried out by specialized firms [3]. In parallel with the developments in management theory and information systems,

the scope and impact of logistics in the private sector has started to be seen [4]. At the heart of successful logistics are the use of new information technologies and new approaches of trans- portation and warehousing activities. Many entrepreneurs are seeing the competitive advantages of new logistics systems and ways to implement them [5].

In the sense of civilian, logistics is the transportation of the materials, services and information flow in the supply chain effectively and efficiently from the starting point of the raw material to the last point where the product is consumed in order to meet the needs of the customers.

The definition of freight forwarder and logistics, FIATA (Fédération Internationale des Associations de Transitaires et Assimilés- International Federation of Freight Forwarders Associations) and CLECAT (European Association for Forwarding, Transport, Logistics and Customs Services) have reached a settlement are as follows:

“Freight Forwarder and Logistics Services are customs declaration and insurance of the goods, preparation of the negotiable documents and payment, as well as consolidation, storage, handling, packaging or distribution related to transportation carried out using one or more transportation types. Freight Forwarder services also include logistics services and modern IT and communications technologies and that are actually related to supply chain management practices, transportation, handling or storage. Outsourcing may be used to ensure the flexibility of the services provided.” [6].

Outsourcing in logistics varies between 10 and 30 percent according to the level of development of countries. Logistics expenditures of countries are estimated to be 1.5-2% of their GNP and logistics market grows 7-9 percent in Europe, 15 percent in North America and 20 percent in Asia every year.

Modern logistics is based on the principle of carrying out all activities in a planned, feasible and auditable manner. The companies providing logistics services take all these activities and give companies opportunity to focus on their main activity area. These firms reduce the burden of companies in terms of follow-up, storage, traffic and security by preventing them bearing the high investment and depreciation costs. The logistics sector derives from the idea of fulfilling the activities within the supply chain through outsourcing and make producing companies focusing on their own subjects.

Logistics, is keeping the products and services needed at the right time in required places. The process of logistics has begun with channel management and has gone through many stages from channel management to the present, and has evolved into structures that focus on demand management and minimizing cost.

The aim of logistics is to create “Integrated Supply Chain” with low cost. In other words, to contribute to the creation of integrated values in the “Procurement-Production-Marketing / Sales” triangle. The value of the integrated values means values that the customer considers as the criteria of satisfaction.

2.2. Logistics Sector in Turkey

The logistic sector which all the developed countries in the world are integrated into has developed day by day, and it formed its infrastructure with the air, sea, rail and combined transport investments in Turkey, between the years 1980-1990. In the 1990s, sector made a move. The logistics sector in Turkey which diversified and specialized its services, has become a dynamic sector, leaving behind the crawling cycle, cooperating with domestic and international companies, and continuously increasing the quality of its services and opening overseas offices at the beginning of 2000s [7].

Turkey is a bridge between Europe at its west which holds 40% of world trade and where 7% of the world's population live and Asia at its east where the 5% of world trade is realized and 50% of the world's population live. The region where Turkey is located has average of 350 million people, is a region where countries have already entered or are in the phase of entering the market economy. Turkey is in the rapidly developing market due to this location. The advanced market will undoubtedly trigger the development of the logistics sector in the region. Turkey is also an important bridge between the EU and the US which have significant share in world's oil consumption and Middle East and Central Asian countries, which own 71% of the world oil reserves and 73% of the world natural gas reserves [8].

According to the evaluation results based on EU and US data, the share of logistics in the GNP is around 10%. Our country, as of 2017, has 3 trillion 104 billion 907 million TL Gross Domestic Product (GDP) (TÜİK) [9]. The size of Turkish Logistics Sector is estimated to be approximately 372 billion TL (12 percent of GDP)

(PwC). Half of this amount is realized by the logistics sector and the other half by production/trading companies.

Turkey's place was announced as 47 with 3.15 points according to the 2018 Logistics Performance Index (LPI) which is a report on the logistics performance of 160 countries published by the World Bank [10]. In the 2016 report, Turkey was in 34th place with 3.42 points.

2.3. Facility Management

The transfer of certain business units to specialized firms is becoming widespread in parallel with the increasing complexity of service and production activities due to developing technology. Thus, it is possible to benefit from economies of scale in providing the required specialization. This trend, which shows itself in all industry, trade and service sectors, stands the professional facility management firms out in managing high-rise buildings, shopping centers and housing projects.

In terms of history, it is seen that facility management activities started in the form of transfer of cleaning and security services to specialized firms in almost all over the world. Most of the major facility management companies that have a say on the global scale today were established as cleaning and security firms at the first stage. The new needs uncovered by the changes in the properties of buildings and facilities with the effect of the developing technology lead to developments in the management approach [10].

The scope of facility management, which is a relatively new concept, continues to expand in parallel with changing conditions. IFMA (Internal Facility Management Association), the most important umbrella organization of facility management globally, defines this concept as "a multidisciplinary profession branch that takes care of the integration between people, spaces, processes and technological components in order to ensure the functionality of the constructed structures and facilities. In the current approach, facility management means managing all resources subject to management in an effective and efficient manner and aiming to increase the value provided to stakeholders in the extent of optimization achieved.

When the sub-branches of the management activities are examined, starting from the architectural planning and construction stages, the creation of project master plans, budgeting, leasing and real estate management, supply chain and stock management, energy planning and management, automation, information and technical services, maintenance and repair activities, environment and landscaping, cleaning and waste management, fire planning, security, crisis management, transportation and parking lots, catering services, human resources practices, occupational health and safety activities are all considered within the scope of modern facility management. Therefore, it is the primary duty of the facility management to ensure the maximum value through optimizing all kinds of processes and elements that can be considered during the entire life cycle of the facility, starting from the investment decision stage [11].

2.4. Facility Management Market in Turkey

The development of the sector in Turkey, was started with subcontracting of cleaning and security services. The plaza and shopping center constructions started in Istanbul in the early 1990s accelerated and spread to other cities in the last 20 years. It became suitable for a market to ensue in Turkey with the increased number of quality housing projects.

In parallel with the examples in the world, on the one hand the building stock expanded with the rapid development of the real estate sector, while on the other hand, significant changes in the qualities of the buildings began to emerge. The proliferation of mixed projects where shopping malls, offices and residences coexist and growth of intelligent buildings where automation stands out; increased the need for professional approaches in measuring and managing costs. Accordingly, the advantages of technical components, human resources, legal obligations, and the practices of managing financing of these elements from a single source have become visible.

It has been observed that the companies serving as subcontractors in the security and cleaning sector since 1990s have expanded their range of services by adapting to changing conditions and some of them have been transformed into organizations that can be evaluated under "facility management" in time. Multinational facility management companies which entered in the Turkish market with developments in the economy, increased their market share through partnerships and company acquisitions [12].

The most important places in terms of facility management in Turkey, where developments in the residential and commercial real estate sector made it a very important market, are shopping malls, high-rise buildings and quality residential areas. The market segment where the holistic approach dominated most in the facility management is shopping malls, especially the mixed projects. Shopping malls are followed by office buildings. Although housing projects have an important role in the activities of the facility management companies in terms of scale, but it is a segment where penetration is relatively low when considering total housing stock and market potential.

When we look at companies operating in the market in Turkey, service firms with poor organizational structure are prevalent and facility management firms, which need to be positioned between investors and service firms, are still in minority. The needs of the buildings and facilities are being provided one by one through service companies without the coordination of a facility manager company. Companies with a high level of security and cleaning, but with low management quality, may occasionally increase the number of projects due to wrong and low pricing, but may have to end their activities due to problems resulting from uncontrolled growth and cash management problems. Therefore, there are problems in the accumulation of competencies in the sector and problems are experienced in the provision of educated human resources.

On the other hand, the companies that can make plant management in a holistic sense and the solution partners they work with have strengthen their market presence. The fact that investments are being made more consciously especially in big cities, especially in Istanbul, enables the understanding of facility management in real estate projects to be put into operation at the architectural stage. The positive returns created by the consultancy activities in this direction also ease the dissemination of the concept of facility management in the market. With the continuation of this trend, it is expected that the service delivery applications which are not properly projected from the sub-contracting firms which cannot coordinate with each other, will expire over time and the integrated facility management approach is expected to become more prominent.

III. CONCEPTUAL MODEL AND HYPOTHESES

The conceptual model study of the application is shown in Figure 1. The process of selecting the best among the alternatives against multiple criterion sets is quite complex. Within these difficulties, there is a need to create a method of mathematical solution.

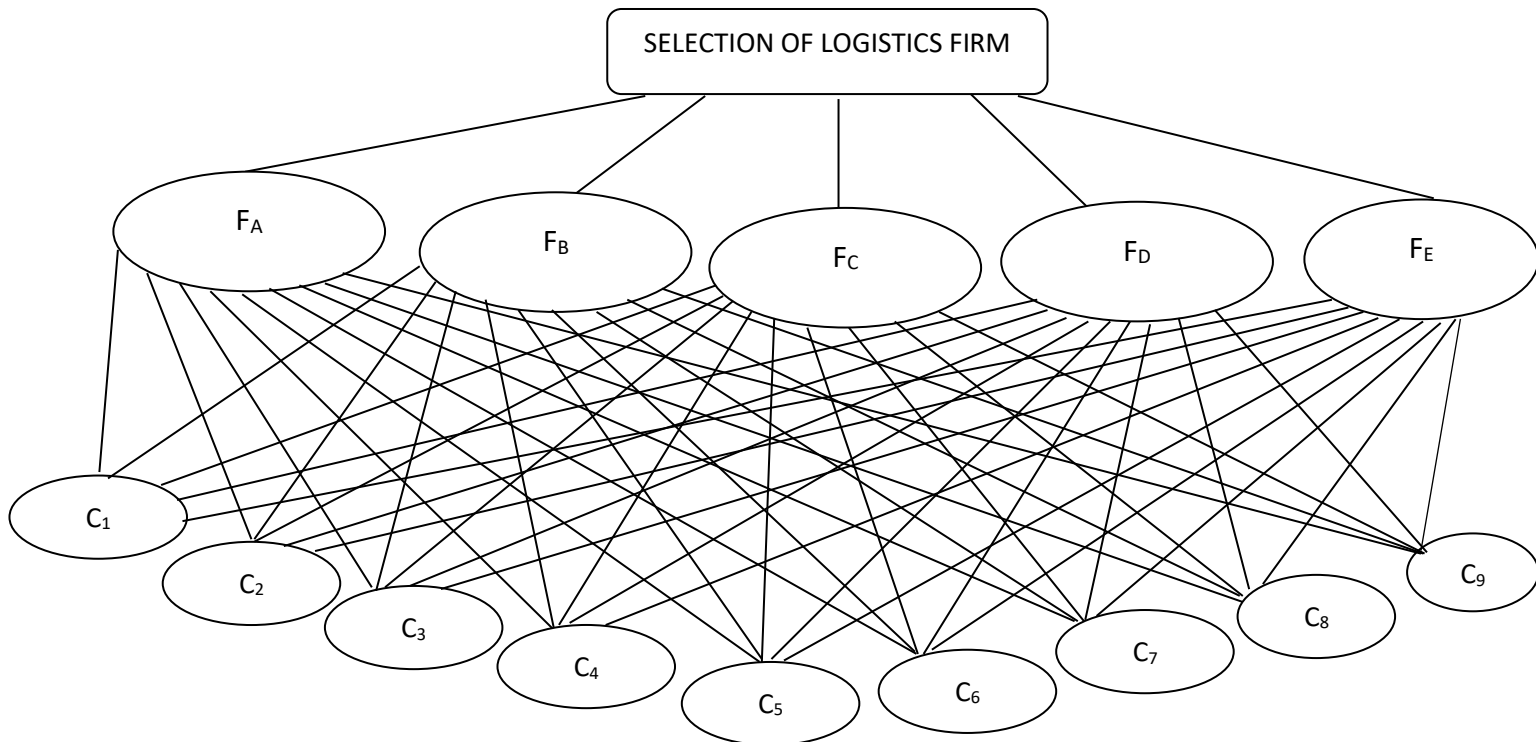


Figure 1: Selection of logistics

Criteria and selection alternatives are shown in Table 1 and Table 2, respectively.

Table 1: Definition of Criteria

*C ₁ : Criteria 1
C ₁ : The power of communication between the logistics company and the service provider
C ₂ : The appropriate pricing policy offered by the logistics company to the service company
C ₃ : The service quality offered by the logistics company to the service company
C ₄ : The quality, adequacy or safety of vehicles and equipment of the logistics company
C ₅ : Ease of service in the market / at competitive prices logistics company offers to the company it serves
C ₆ : Security of warehouse and storage areas of logistics company
C ₇ : Market reliability of logistics company
C ₈ : Approach and competence of logistics company personnel
C ₉ : Ease of tracking and traceability of the goods carried by the logistics company

Table 2: Alternatives

*F _A : Firm A				
F _A	F _B	F _C	F _D	F _E

IV. TOPSIS SOLUTION

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) developed by Hwang & Yoon [13] is a technique to evaluate the performance of alternatives through the similarity with the ideal solution. According to this technique, the best alternative would be one that is closest to the positive-ideal solution and farthest from the negative-ideal solution. The positive-ideal solution is one that maximizes the benefit criteria and minimizes the cost criteria. The negative-ideal solution maximizes the cost criteria and minimizes the benefit criteria. In summary, the positive-ideal solution is composed of all best values attainable of criteria, and the negative-ideal solution consists of all the worst values attainable of criteria. The interested reader shall refer to [14] for a broad survey about the TOPSIS.

Table 3: Decision matrix

	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉
F _A	0.5575	0.505	0.555	0.535	0.57	0.625	0.585	0.545	0.59
F _B	0.625	0.565	0.605	0.646666667	0.626666667	0.615	0.57	0.595	0.65
F _C	0.9075	0.82	0.95	0.865	0.895	0.885	0.93	0.93	0.905
F _D	0.6	0.53	0.55	0.615	0.575	0.58	0.59	0.585	0.595
F _E	0.3425	0.385	0.33	0.325	0.42	0.37	0.32	0.37	0.355

* The Decision Matrix was created according to the average of the survey results which is made with facility management firm employees (a total of 8 persons from different departments).

Table 4: Weights

C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉
0.12084063	0.105954466	0.119964974	0.112084063	0.106830123	0.114711033	0.113835377	0.098949212	0.106830123

* Weights were determined according to the results of the survey of 16 experts participated working with logistics companies from different sectors.

Table 5: TOPSIS results

	Si*	Si-	Ci*
F _A	0.08050	0.05049	0.38544
F _B	0.06946	0.06152	0.46972
F _C	0.00000	0.13001	1.00000
F _D	0.07660	0.05444	0.41542
F _E	0.13001	0.00000	0.00000

* Si* : Separation measure from Ideal Solution.

* Si- : Separation measure from Negative Ideal Solution.

* Ci* : Relative Closeness to Ideal Solution

For TOPSIS Solution, ideal ranking is F_C > F_B > F_D > F_A > F_E

VI. ELECTRE SOLUTION

ELECTRE was conceived by Bernard Roy [15] in response to deficiencies of existing decision making solution methods. ELECTRE is more than just a solution method; it is a philosophy of decision aid - the philosophy is discussed at length by Roy .It is important to note that ELECTRE is not being presented as the "best" decision aid. It is one proven approach. Simpson [16] has compared both SMART and ELECTRE and she concludes that, "There are obvious differences between the methods, but it is not obvious that one method is stronger than the other."

Table 6: Decision matrix

	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉
F _A	0.5575	0.505	0.555	0.535	0.57	0.625	0.585	0.545	0.59
F _B	0.625	0.565	0.605	0.646666667	0.626666667	0.615	0.57	0.595	0.65
F _C	0.9075	0.82	0.95	0.865	0.895	0.885	0.93	0.93	0.905
F _D	0.6	0.53	0.55	0.615	0.575	0.58	0.59	0.585	0.595
F _E	0.3425	0.385	0.33	0.325	0.42	0.37	0.32	0.37	0.355

* The Decision Matrix was created according to the average of the survey results which is made with facility management firm employees (a total of 8 persons from different departments).

C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉
0.12084063	0.105954466	0.119964974	0.112084063	0.106830123	0.114711033	0.113835377	0.098949212	0.106830123

Table 7: Weights

* Weights were determined according to the results of the survey of 16 experts participated working with logistics companies from different sectors.

Table 8: Total dominance matrix

	F _A	F _A	F _A	F _A	F _A
F _A	-	0	0	0	0
F _B	0	-	0	0	0
F _C	0	0	-	0	0
F _D	1	0	0	-	0
F _E	0	0	0	0	-

* There is only one constraint according to the Total Dominance Matrix. This constraint is that the FD is preceded by the FA.

Table 9: Net compliance index

C _A	1.463222417	2.536777583	-1.073555166
C _B	2.657618214	2.114711033	0.54290718
C _C	4	0	4
C _D	2.651488616	2.12084063	0.530647986
C _E	0	4	-4

Table 10: Net non-compliance index

D _A	3	1.683674346	1.316325654
D _B	1.479259123	2.346000619	-0.866741496
D _C	0	4	-4
D _D	1.896416461	2.346000619	-0.449584158
D _E	4	0	4

Table 11: Ranking

Ranking for Cp	Ranking for Dp	Constraints
3	3	
2	2	
4	4	4 -> 1
1	1	
5	5	

For ELECTRE Solution, ideal ranking is $F_C > F_B > F_D > F_A > F_E$

VII. CONCLUSION

In this study, the selection of the most optimal under the criteria determined from the 5 logistics companies that have been quoted in the distribution of the required products to the facilities in a way, in specific to winter preparation materials, in general that will cover all the purchasing activities of a company serving in the Facility Management sector, is made. Firstly, the criteria mentioned in the literature are examined. The opinions that will disclose the differences of the criteria within the questionnaire were discussed with the experts working in the purchasing, planning, accounting and business development departments in the company and were rated with verbal expressions. Criteria weights were also scored by experts in their field and working with logistics companies. Following the studies expressed, mathematical calculations, multi-criteria decision-making methods, TOPSIS and ELECTRE were used in an integrated manner to determine the optimal selection alternative and these alternatives were listed in positive opinions.

When the data were analyzed, criteria weights are listed as: communication power (0,121), price (0,106), service quality (0,120), equipment modernization (0,112), flexibility (0,107), security (0,115), market reliability (0,114), personnel qualification (0,099) and follow-up and traceability (0,101). When the logistic companies are listed, the most optimal option is determined as C logistics company. The fact that the weight of quality criteria takes place in the first place in our study coincides with the studies conducted in different sectors by Sari and Timor (2015)

[17], Manap Davras and Karaatlı (2014) [18], Tayyar (2012) [19], Supçiller and Çapraz (2011) [20] and Ecer and Küçük (2008) [21].

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