Sigma J Eng & Nat Sci 36 (1), 2018, 141-160

Sigma Journal of Engineering and Natural Sciences
Sigma Mühendislik ve Fen Bilimleri Dergisi

Review Article

A LITERATURE SURVEY ON LOGISTICS CENTERS' LOCATION SELECTION PROBLEM

Cihan UYANIK[1], Gülfem TUZKAYA[2], Senay OĞUZTİMUR*[3]

[1]*Marmara University, Dept. of Industrial Engineering, Kadıköy-ISTANBUL;* ORCID:0000-0003-2993-5865
[2]*Marmara University, Dept. of Industrial Engineering, Kadıköy-ISTANBUL;* ORCID:0000-0001-7683-4405
[3]*Yıldız Technical University, Department of City and Regional Planning, Beşiktaş-ISTANBUL;* ORCID:0000-0002-8091-9214

Received: 03.05.2017 Revised: 17.07.2017 Accepted: 23.10.2017

ABSTRACT

Logistics centers emerge as a solution for freight transportation which becomes more important both on an intra-urban and regional scale with the reorganization of life areas in the cities. The selection of appropriate locations for these centers is as important as the determination of the need for logistics centers. In order to obtain better solutions, accurate criteria should be determined and a proper methodology should be selected. Considering the importance of the topic, a detailed literature survey has been carried out and articles, conference papers and postgraduate thesis have been classified. During the literature review, the studies about logistics centers were restricted by choosing 35 studies containing the location selection problem. The literature review was examined under two sub-titles; first, the models used in the solution of the problem and second, criteria used in the evaluation process. The frequency of decision-making techniques and decision criteria usage has also been presented.
Keywords: Logistics centers, decision criteria, decision making, MCDM, literature review.

1. INTRODUCTION

Developments in the logistics sector are gaining acceleration with developments in industry and commerce. For this reason, it is a necessity to have a strategy which is globally competitive & responsive to the needs of industry and commerce. Logistics centers which were first seen in the US during the industrial revolution and were founded in Europe in the 1960s constitute an important part of this strategy (Koldemir et al. 2009)

Bringing together logistics activities at a single center – if such a center is founded in tandem with combined and intermodal transport types- has countless benefits, such as decreases in costs, traffic congestion and environmental pollution level, etc.

No names or definitions are made common for the concept of "logistics center" in the literature. Various terms imply a logistics center such as distribution center, freight village, dry port, inland port, load center, logistics node, gateway, central warehouse, freight/transport terminal, transport node, logistics platform, logistics depot, distripark (Higgins and Ferguson, 2011; Rimiené and Grundey, 2007).

* Corresponding Author: e-mail: soguz@yildiz.edu.tr, tel: (212) 383 26 44

The most comprehensive definition of logistics center is enhanced and improved by EUROPLATFORMS which is an association of approximately 80 Transport & Logistics Centers all over Europe. The EUROPLATFORMS definition is also used by EU, UNECE and OECD and various national authorities. EUROPLATFORMS defines logistics center as follows: "*A Logistics Centre is a centre in a defined area within which all activities relating to transport, logistics and the distribution of goods – both for national and international transit, are carried out by various operators on a commercial basis. The operators can either be owners or tenants of buildings and facilities (warehouses, distribution centres, storage areas, offices, truck services, etc.), which have been built here*." (EUROPLATFORMS, www.europlatforms.eu/definition/, 19 September 2016).

Rimiené and Grundey (2007), as the result of their study which tries to build a common approach on the logistics centers and which handles the definition and evolution of the logistics center concept in a comprehensive manner, made the following definition for a logistics center: "*Logistics center (Freight village / Logistics node / Distribution center) is a special intermodal hub (nodal point) in the transportation system, including different logistics facilities, where separate operators are providing number of services, connected to transportation, logistics and distribution in established geographical coverage*."

After deciding on the need for a logistics center, the first question is to determine where the most appropriate location for the logistics center is. Selected solution techniques and decision criteria have critical importance in solving location selection problems. The purpose of this study is to guide researchers or decision makers who are looking for answers to these questions.

In Section 2, publications featuring the logistics center location problem were presented. The distribution of these publications by type, year and country has been examined. In Section 3, publications are classified according to decision making techniques and criteria used. In Section 4, the results of the study were evaluated.

2. RESEARCH METHODOLOGY

Literature review was started by searching the words "logistics center", "freight village and logistics village" in titles, abstracts and keywords in ResearchGate database, ScienceDirect database, www.dergipark.ulakbim.gov.tr and ww.tez.yok.gov.tr (the web site of the National Thesis Center of the Council of Higher Education of Turkey). Among these studies, facility location studies for logistic centers were specifically selected. By examining the literature sections and references of the studies found, literature research was elaborated.

Table 2.1. Study types and frequencies

Study Types	Frequency	Percentage
Articles	26	72%
Postgraduate Theses	4	11%
Conference Papers	6	16%
Total	**36**	**100%**

In this literature review, 36 studies, which consist of 4 post graduate theses, 6 conference papers and 26 articles, were examined, and can be seen in Table 2.1. The first study presented in this literature review was prepared by Taniguchi et al. in 1999. Taniguchi's paper became a reference in many studies. While the studies intensified between the years 2011-2016, it may be seen in Figure 2.1 that the largest number of the studies were prepared in 2014. In average, almost 1 out of 3 studies (30.5%) examined in the literature research belongs to the year 2014.

As it is not possible to examine the thesis databases of countries except Turkey, 4 postgraduate theses were eliminated during the classification according to country. The share of Turkey is considerably significant with 15 studies with 46,8% (see Figure 2.2). China follows Turkey with 6 studies (18,75%), and Romania ranks 3rd with 2 studies (6,25%). 11 of the studies prepared in Turkey were published after 2014. The ongoing discussion on logistics center establishment and determination of candidate regions encouraged the academic studies.

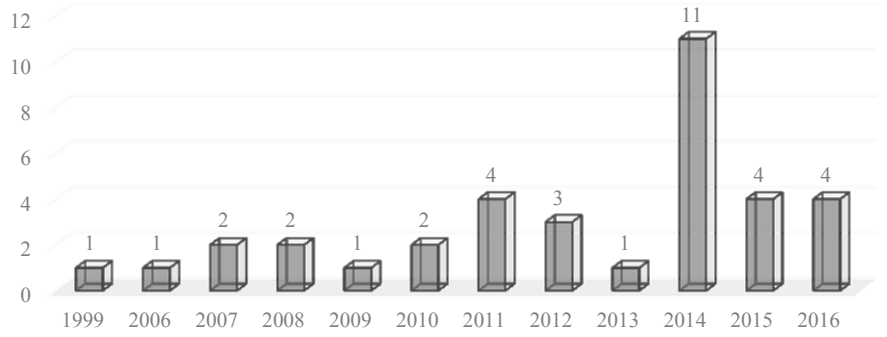

Figure 2.1 Number of annual publications on LCs Location Selection Problem

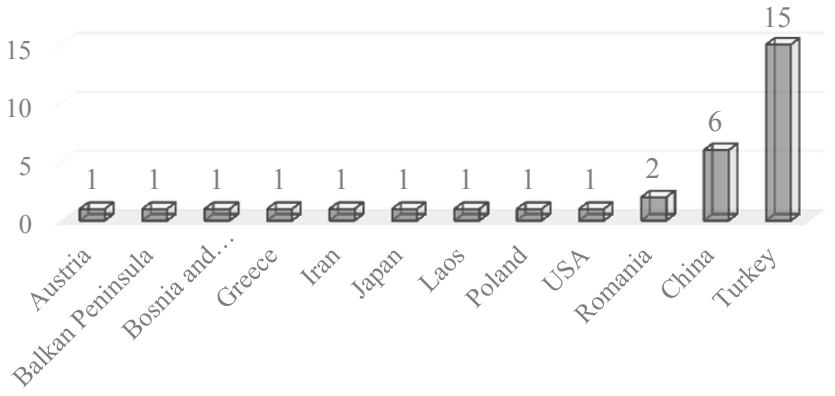

Figure 2.2 Country origins of publications

3. LITERATURE REVIEW

Through the literature review, answers to two questions were sought: (1) Which decision making techniques are used for the logistics center location selection problem? (2) Which decision criteria have been taken into account for the logistics center location selection problem?"

3.1. Decision Making Techniques

In this section, Multi-Criteria Decision Making (MCDM) techniques used for the facility location problem of logistics centers are summarized. Table 3.1 shows the related literature involving techniques such as: Analytic Hierarchy Process (AHP), Analytic Network Process

(ANP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Elimination et Choice Translating Reality (ELECTRE), VlseKriterijumska Optimizacija I Kompromisno Resenjetechnique (VIKOR), The Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE), Analytic Network Process/Benefits, Opportunities, Costs and Risks (ANP/BOCR), Axiomatic Fuzzy Set (AFS), Artificial Neural Network (ANN), DELPHI Method, Fuzzy Graph Theory, and Goal Programming.

Although mathematical models and proper solution techniques were not widespread like MCDM techniques, they are used in an integrated manner with Fuzzy Logic, Linear Programming, Genetic Algorithm, Greedy Heuristic Algorithm and Fuzzy Decision Making Model in some publications.

It was seen that in the publications in which qualitative data or vagueness is considered, AHP, TOPSIS and VIKOR techniques are used in their fuzzy forms, and Analytic Hierarchy Process (AHP) is the mostly preferred MCDM technique. In 16 out of 36 studies AHP or Fuzzy AHP techniques were used. TOPSIS and ELECTRE, among other MCDM techniques, come to the forefront by being used in respectively 7 and 6 studies.

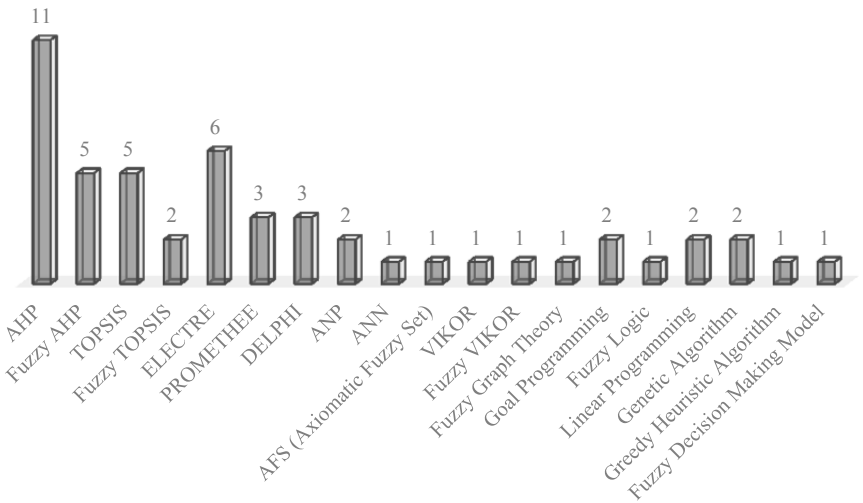

Figure 3.1 Most preferred methods implemented in literature

Table 3.1. An overview of methods used in literature (Postgraduate thesis are shown with "*")

Method	MCDM (Multi Criteria Decision Making)														Mathematical Model Solution Techniques			
	AHP		TOPSIS		ELECTRE	PROMETHEE	DELPHI	ANP	ANN	AFS (Axiomatic Fuzzy Set)	VIKOR		Fuzzy Graph Theory	Fuzzy Decision Making M.	Linear Programming	Genetic Algorithm	Greedy Heuristic Algorithm	Fuzzy Logic
	AHP	F- AHP	TOPSIS	F-TOPSIS							VIKOR	F-VIKOR						
Taniguchi et al., (1999)																x		
Chen, Y., Qu, L. (2006)		x																
Wang, Liu (2007)		x	x															
Ballis and Mavrotas (2007)						x												
Ghoseiri and Lessan (2008)		x			x													
Tanyaş and Bamyacı (2008)	x																	
Yu et al., (2009)														x				
Kayikci, Y. (2010)		x							x									
Boile et al., (2010)							x											
Li, Liu, Chen (2011)			x							x								
Elgün and Elitaş (2011)							x											
Eryürük et al., (2011)	x																	
Erkayman et al., (2011)				x														
Can, A. M. (2012)*	x		x		x													
Arikan, F. (2012)*	x																	
Görgülü, H. (2012)*	x																	
Regmi and Hanaoka (2013)	x																	
Yıldırım and Önder (2014a)	x					x												
Uysal and Yavuz (2014)					x													
Chen, Liao, Wu (2014)			x				x											
Żak, J., Weglinski, S. (2014)					x													
Yıldırım and Önder (2014b)	x										x							
Demiroğlu and Elener (2014)	x					x												
Tomic´ et al., (2014)	x																x	
Bayraktutan and Özbilgin (2014)																		x
Weiqing, Z. (2014)															x	x		
Uysal F., Gülmez, M. (2014)													x					
Zalluhoğlu et al. (2014)												x						
Aksoy and Özyörük (2015)															x			
Stević et al., (2015)	x																	
Fagaraşan and Cristea (2015)					x													
Önden et al,. (2015)		x																
Peker et al., (2016)								x										
Özceylan et al. (2016)			x					x										
Cristea, M., Cristea, C. (2016)					x													
Uyanık, C. (2016)*				x														
	11	5	5	1	6	3	2	2	1	1	1	1	1	2	2	2	1	1

3.1.1. Individual AHP or Fuzzy-AHP Implementation

In 4 publications, AHP is used in its crisp form and in 2 publications it is used in its fuzzy form for the evaluation process. In the remaining 10 studies, criteria weights are found by AHP and Fuzzy-AHP methods and then selections/evaluations are made among the alternatives by implementing the other techniques. Criteria weights can be calculated in an easy way by using AHP, and it may be the reason of its widespread usage.

Görgülü (2012) preferred to use AHP in order to find the appropriate location among 5 alternatives for the logistics village that is planned in Konya. The criteria weights are calculated by referring to the opinions of 3 experts.

Arıkan (2012) evaluated 3 alternatives in Bursa, close to the freight production and attraction centers and which provide opportunity for transportation types by using the AHP technique.

Tanyaş and Bamyacı (2008) evaluated the locations for Organized Logistics Regions on the west side of Istanbul by using the AHP method and the SAW technique (Simple Additive Weighting). Both methods generated the similar results.

The objective of the paper of Eryürük et al (2011) was to find the best place for a logistics center for the clothing industry in the Marmara Region. The Analytic Hierarchy Process (AHP) method was implemented in order to evaluate the questionnaire survey results which were gathered from 55 clothing companies.

Stević et al. (2015) used the AHP method for selecting the potential location of a logistics center in Bosnia and Herzegovina. The AHP method was carried out to find criteria weight and rank the Doboj, Banja Luka and Šamac alternatives.

Both Önden et al., (2015a) and Chen and Qu (2006) proposed a technique based on Fuzzy-AHP in order to select the optimal logistics center location. Önden et al., (2015a) combined GIS (Geographic Information Systems) and F-AHP to find the appropriate location among 19 locations where TCDD (Turkish State Railways) had built or planned a logistics center.

Chen and Qu (2006) proposed a fuzzy AHP method based on entropy weight. Fuzzy AHP was handled to obtain the fuzzy criteria weights. Then, obtained fuzzy weights were evaluated by entropy weight.

3.1.2. AHP and PROMETHEE Implementation

Yıldırım and Önder (2014b) and Demiroğlu and Elener (2014) proposed a freight village analysis methodology by using integrated AHP and PROMETHEE methods in their publications. In Yıldırım et al. (2014), criteria weights are evaluated via AHP and the PROMETHEE technique was used for ranking the alternatives. Demiroğlu et al. (2014) also applied AHP to obtain criteria weights. Differently, Demiroğlu et al. (2014) proposed independent use of AHP and PROMETHEE for ranking and comparing 7 alternative harbor locations for logistics centers and similar ranking results were obtained.

3.1.3. AHP - Fuzzy AHP and Other MCDM Methods Implementation (TOPSIS – ELECTRE - ANN- VIKOR)

Ghoseiri and Lessan (2008) evaluated 5 candidate locations by using the Fuzzy-Analytic Hierarchy Process and the ELECTRE method. The Fuzzy AHP method was used to obtain criteria weights and decisional judgment matrix. Following this, weights were used by ELECTRE to compute the evaluation values of 5 alternative locations.

Can (2012) applied the AHP, ELECTRE and TOPSIS methods respectively to select optimal locations for 5 alternative locations in Samsun. All 3 methods ranked the alternatives in the same order. The TOPSIS method was proven to give the most reliable outcome compared to the other methods in the Method Convenience Test at the assessment stage.

Kayikci (2010) integrated the Fuzzy-AHP and ANN techniques to select the most appropriate location. The Fuzzy-AHP method assessed the criteria weights based on the results of the survey made with stakeholders. After an assessment of criteria weights, unnecessary criteria were eliminated. The proper intermodal freight logistics center location was selected by using the ANN method. Wang and Liu (2007) used the Fuzzy-AHP and TOPSIS methods to handle the location decision problem within given selection alternatives.

Yıldırım and Önder (2014b) made a logistics village evaluation analysis by combining the AHP and VIKOR methodologies. Experts' opinions were transformed into tangible criteria weights by AHP. AHP's weights were set as the input of the VIKOR method. 11 alternative logistics centers in Turkey (İstanbul-Halkalı, Balıkesir-Gökköy, Eskişehir-Hasanbey, İzmit-Köseköy, Uşak, Denizli-Kaklık, Samsun-Gelemen, Mersin-Yenice, Kayseri-Boğazköprü, Konya-Kayacık and Erzurum-Palandöken) were ranked by VIKOR.

3.1.4. AHP and Mathematical Model Implementation

Tomić et al. (2013) searched for the convenient logistics center locations in the capital cities of the Balkan Peninsula by incorporating the Greedy heuristic algorithm and AHP.

Regmi et al. (2013) compared the results of AHP and combined the AHP-GP methods' solution to rank alternatives. The models were developed based on location models and they were evaluated based on the opinion of public and private sector stakeholders. Thanaleng and Laos were selected as the best location in both cases.

3.1.5. TOPSIS or TOPSIS Integrated Methods Implementation

Erkayman et al., (2011) proposed a fuzzy TOPSIS approach to a logistics center location selection problem in the Eastern Anatolian region of Turkey.

Li et al. (2011) proposed an approach combining the Axiomatic Fuzzy Set (AFS) clustering method and the TOPSIS method to select the best location among fifteen alternatives. Alternative locations were evaluated by the AFS clustering method and they were selected by using the TOPSIS method.

Özceylan et al., (2016) proposed a methodology based on a combination of the GIS, ANP and TOPSIS methods for LC location selection in Ankara. 20 candidate locations were clustered based on geographic data by using GIS. ANP was used to obtain the criteria weights. Then, the current logistics center (CLC) in Ankara was evaluated with 20 candidate locations by using the TOPSIS method. As a result, CLC was ranked as the worst location in the publication.

Chen et al., (2014) introduced an analysis combining the Delphi, TOPSIS and Multi-Choice Goal Programming (MCGP) -Mathematical Model- models/methods to obtain a proper LC location for the airline industry. The Delphi method was implemented to determine selection criteria based on 3 experts' opinions. Criteria weights were computed by TOPSIS. Finally, a MCGP model was developed to find the optimal solution.

Uyanık (2016) evaluated 4 alternative LC locations in the Istanbul Metropolitan area. First, the relationship between selected criteria was determined and redundant criteria were eliminated by using DEMATEL. Then, the most appropriate candidate location was obtained by using the Intuitionistic Fuzzy TOPSIS method.

3.1.6. ELECTREE Methods Implementation

Uysal and Yavuz (2014) focused on selecting the best location in the Western Black Sea region by using the ELECTRE method. 11 decision criteria were determined and six candidate regions were ranked by ELECTRE. Ultimately, Çaycuma district of Zonguldak city was stated as the most convenient location for LC.

Żak and Weglinski (2014) used a MCDM methodology based on ELECTRE III/IV to find an appropriate location for the LC among 10 alternatives across Poland.

Fagaraşan and Cristea (2015) and Cristea and Cristea (2016) considered Romania for the selection of a convenient logistics center location with ELECTRE III which is distinct from the other ELECTRE methods due to the fact that it permits the use of inaccurate, indefinite, imprecise and uncertain data. Those publications differed from each other at the implementation phase. Fagaraşan et al. (2015) investigated the regions of Romania for LC and identified The Center Region as the most appropriate region. Cristea et al. (2016) evaluated Fagaraşan's publication results as input location and evaluated the 6 counties of the Center Region in Romania.

3.1.7. Delphi Method Implementation

Boile et al., (2010) proposed a Delphi model based on the qualitative and quantitative assessment of the six candidate locations in the USA.

Elgun and Elitaş (2011) tried to find a proper location of a LC among 7 cities in Turkey by using the Delphi method 30 experts' opinions were taken into consideration in order to obtain criteria weight during the evaluation phase.

Ballis and Mavrotas (2007) compared three alternative areas by using PROMETHEE method. Significant criteria were chosen and alternative locations were ranked by PROMETHEE.

Peker et al., (2016) proposed an Analytic Network Process/Benefits, Opportunities, Costs and Risks model to designate the convenient LC location in Trabzon. The study mainly contributes to the literature by using the ANP/BOCR method for the logistics center selection problem for the first time.

Uysal and Gülmez (2014) developed a MCDM model, Fuzzy Graph Theory and Matrix Approach to find the optimal LC location among 8 cities in the Mediterranean Region of Turkey. Fuzzy Graph Theory was preferred for its' shorter methodological steps compared to the other MCDM methods.

Zalluhoğlu et al., (2014) carried out focus group interview with 6 logistics service providers and obtained data evaluated by the Fuzzy-VIKOR method to select a LC location among 4 districts in Izmir.

Yu et al., (2009) introduced a fuzzy decision-making model (FDMM) based on the Engineering Fuzzy Set Theory (EFST) as a distinctive method.

3.1.8. Mathematical Models Implementation

Taniguchi et al., (1999) set a mathematical model comprised by a vehicle routing and scheduling model and the dynamic traffic simulation model for optimal size and location of public logistics terminals. Genetic algorithms were implemented to find a road network of the central area in Kobe City, Japan.

Aksoy and Özyörük (2015) introduced a mathematical model for selection of proper locations among 12 LCs which are currently established or planned by Turkish State Railways (TCDD). In compliance with the mathematical model, Istanbul, Bilecik, Kayseri, Mersin and Samsun were selected as appropriate LC locations.

Bayraktutan and Özbilgin (2014) introduced a model and compared crisp and fuzzy versions. The foreign trade volume, highway, seaway and airway freight traffic, transportation types of all cities in Turkey were determined by using both the classic and the fuzzy logic methods. Though both methods produced nearly the same ranking, the results did not match the current plan of Turkish State Railways.

Weiqing (2014) evaluated the location selection problem based on a 0-1 nonlinear programming model. The selection problem has an objective function which minimizes the total

expenses including the investment for the logistics center, operation management expenses and transportation expenses.

3.2. Decision Criteria

As seen in the literature review for decision criteria, the location selection problems of the logistics centers are mainly handled by using Multi-Criteria Decision Making Models, and, this makes it more important to select proper decision criteria for better solutions of the proposed methodology.

Decisions on the need for logistics centers and establishment of such centers are mainly based on the opinions of the governments', ministries', and local administrators' representatives and expert opinions from private sector. It is seen in various publications that during the identification of the criteria and determining their criteria weight, opinions of experts are taken. As establishment decisions regarding logistics centers are based on a strategy, it affects the service region in various respects. For instance, although in general, establishment costs are determined as the priority, as the transportation network changes over time, its influence over variable costs must also be assessed. Selected criteria are also important considering their long term effects (Önden et al., 2015b).

Four publications which took part in the previous section and which contain mathematical models were omitted since they don't include a multi-criteria evaluation phase and 32 publications were examined. Figure 3.2 shows the steps of literature review process according to the decision criteria.

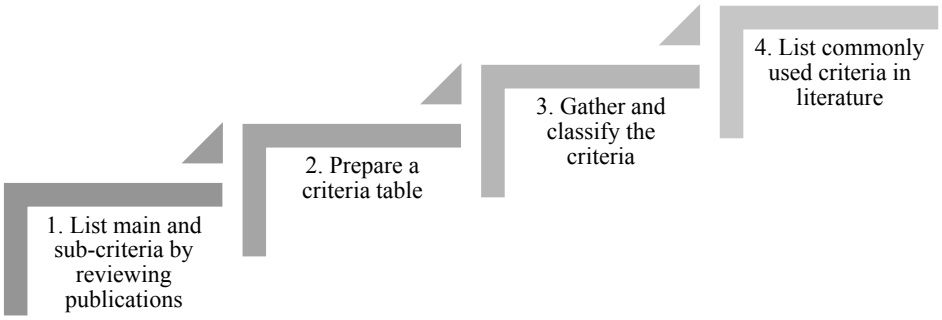

Figure 3.2 Steps of literature review according to decision criteria

As seen in Table 3.2, at the first step, all main and sub-criteria used in the studies are listed.

Table 3.2 Main and Sub-Criteria used in logistics centers location problem

Author / Authors	Main / Sub-Criteria
Chen, Y., Qu, L. (2006)	**Environment** (weather, geology, hydrology), **Transportation condition** (the distance between freeway exit, load establishment), **Public establishment** (communication, garbage dispose, water supply, power supply, air feed), **Candidate land** (acreage, land value), **Management environment** (management condition, commodity feature, service level), **Social benefit** (environment protection, all round effect)
Wang, Liu (2007)	Natural resource, economic benefit, social benefit, transportation, development potential

Ballis, A., Mavrotas, G. (2007)	Total warehouse area, conformity with the ideal standards, percentage of warehouse area allocated, road-road cross-docking, rail-road cross docking, direct railway access, length of rail dock, travel distance from/to external road network, traffic density in internal road network, number of road rail crossings
Ghoseiri, K., Lessan J. (2008)	Natural resource, Economic benefit, Social benefit, Transportation, Development potential
Tanyaş, M., Bamyacı M. (2008)	**Geographical** (Land Size, Suitability to enlargement, Land infrastructure, Land physical condition), **Proximity** (Proximity to highway, Proximity railroad system, Prox. airports, Prox. seaports, Prox. to center of city, Prox. to industrial zone, Prox. to inland waterways), **Socio-Economic** (Environmental effects, The effects on traffic, Effects on economic life, The effects on disaster logistics), **Costs** (Land Cost, Facility Cost, Cost for users)
Yu , X., Zhang, X., My, L. (2009)	**Natural environment** (weather conditions, geological conditions, hydrological conditions, terrain conditions), **Business environment, Candidate infrastructure** (water supply, electricity supply, gas supply, waste treatment, solid waste disposal, communication, transportation), **Surrounding conditions** (area, shape, surrounding route, land-value)
Kayikci, Y. (2010)	**Environmental effect** (Accident, Emissions, Land Use, Hazardous Materials, Energy Use), **International market location** (Customs, Accessibility, International consumption market, International manufacturing market, Border crossing, European Corridors), **Intermodal operation and management** (Information technology infrastructure, Transportation cost, Transportation time, Service availability, Quality, Coordination, Connectivity, Congestion, Interoperability), **National stability** (Political stability, Economic stability, Social stability), **Economical scale** (Socio-economic development, Spatial development, Transshipment volume, Import/Export Volume, Mobility),
Boile, M., Theofanis, S., Gilbert, P. (2010)	**Site suitability** (Acreage, Topography and Configuration, Potential for further expansion, Utility infrastructure, Environmental conditions, Developable acreage, Security)**, Background activities & facilities** (Existing activities that can be incorporated, Existing facilities that can be incorporated)**, Access and transportation networks connections & infrastructure** (Road access, Rail access, Water access, Air access, Ease of commuting access)**, Property conditions** (Property price and ownership, Land use zoning, Covenants running with the land that restrict its free use, Land uses of neighboring sites and conflicts, Recurring costs, Attitude of neighboring communities, Pressures from existing uses)**, Interconnected business activities** (Centrality of site in relation to important consuming areas, Proximity to major retailers & logistics providers, Location in relation to interstate / regional freight transshipment, Availability of local trucking, Availability of suitable workforce)
Li, Liu, Chen (2011)	Weather Condition, Landform Condition, Water Supply, Power Supply, Solid Castoff Disposal, Communication, Traffic, Candidate Land Area, Candidate Land Shape, Candidate Land Circumjacent Main Line, Candidate Land Land Value, Freight Transport, Fundamental Construction Investment.
Elgün, M. N., Elitaş, C. (2011)	**Transportation connection** (Proximity to highway, Proximity to railroad system, Proximity airports, Proximity to seaports)**, Land properties** (Location, Suitability to enlargement)**, Location and business activities** (Proximity to regional transportation systems, Prox. to international transportation systems, Proximity to consumption resources**, Physical** (Infrastructure, Safety, Social Facilities, Environment, Technical possibilities)
Eryürük, S., H., Kalaoğlu, F., Baskak, M. (2011)	**Physical analysis** (Land Size, Expansion of Physical Facilities, The Geological Status), **Location analysis** (Promotion opportunities in the region,

	Proximity to Supply Point)**, Infrastructure services** (Communication infrastructure, Electricity, Gas and Water Networks, Sewage and waste treatment plant)**, Transportation opportunities** (Proximity to the motorway, Proximity to the airport)**, Labor force supply** (Labor supply, Labor cost), **Fixed cost and capital supply** (Cost of land, Construction costs, Cost of usage)
Erkayman, B., Gündoğar, E., Akkaya, G., Ipek, M. (2011)	**Geographical** (Land Size, Suitability to enlargement, Land infrastructure, Land physical condition), **Proximity** (Proximity to highway, Proximity railroad system, Prox. airports, Prox. seaports, Prox. to center of city, Prox. to industrial zone, Prox. to inland waterways), **Socio-Economic** (Environmental effects, The effects on traffic, Effects on economic life, The effects on disaster logistics), **Costs** (Land Cost, Facility Cost, Cost for users)
Can, A. M. (2012)	Proximity to highway, Prox. to railroad system, Prox. to airports, Prox. to seaports, Land cost, Cost of construction, Prox. to industrial zone, Prox. to center of city, Land enlargement suitability, Topographic condition, Height difference between railroad system
Arikan, F. (2012)	Proximity to highway, Prox. to railroad system, Prox. to seaports, Land cost, Suitability for land enlargement, Prox. to freight hub, Topography
Görgülü, H. (2012)	Size, Location, Ownership (Land), Prox. to center of city, Prox. to freeway, Land cost, Land zone status, Prox. to freeway interchanges, Prox. to freeway
Regmi, M. B., Hanaoka, S. (2013)	**Development and operation costs** (Land acquisition costs, Construction costs, Transportation costs)**, Transportation time** (Total transport time from Seaport)**, Intermodal transport connectivity** (Proximity to highways, Prox. to Railways, Prox. to inland waterways, Prox. to seaports)**, Environmental impacts** (Impacts from construction, Impacts from transport operation)**, Regional economic development** (Freight demand**,** Prox. to market, production centers and consumers, Government policies to develop special economic zone or free trade area nearby)
Yıldırım, F., Önder, E. (2014)	Opportunities for possible site expansion, Cost of land, Proximity to industrial zone, Proximity to airport, Proximity to harbor, Proximity to railroad system and Proximity to highway system.
Uysal, T., Yavuz, K. (2014)	Closeness to harbor, Closeness to airport, Distance to residential areas, Accessibility to labor, Environment security, Traffic density, Accessibility to highways and linking roads, Substructure, Air pollution, Building site – permit, Regional incentive
Chen, Liao, Wu (2014)	Resource availability, Location resistance, Expansion possibility, Investment cost, Information abilities
Żak, J., Weglinski, S. (2014)	Condition of transportation infrastructure, Economic development, Investment cost, Level of transportation and logistics competitiveness, Investment attractiveness, Transportation and logistics attractiveness, Safety and Security, Social attractiveness, Environmental-friendliness
Yıldırım, F., Önder, E. (2014)*2	Initial size of the land, Cost of land, Proximity to industrial zone, Proximity to airport, Proximity to harbor, Proximity to railroad system, Proximity to highway system, Effects on economy
Demiroğlu, Ş., Elener, A. (2014)	**Regional** (Dock length, dock area, maximum depth, free-zone size)**, Capacity** (Ship loading capacity, total handling capacity, dock capacity, dock container capacity, commodity storage capacity, container storage capacity), **Commercial** (handled freight in 2011, handled container in 2011, free zone 2011 export amount, free zone company number), **Transport** (Proximity to free zone, Prox. to airport), **Demography** (Population, Population density, incentive area includes the port)

Tomic, V., Marinkovic, D., Markovic, D. (2014)	**Physical flow** (Quality of railway infrastructure, development and number of airports, Geographical position, Road infrastructure, Development of ports, Infrastructure (energy, facilities))**, Economics flow** (Facility of getting a bank credit, Taxes and dues, Salary and worker productivity, Inflation rate, Presence of trade barrier**s, Institutional or ownership flows** (Legal and judicial efficiency, Bureaucracy (paper work), Safety in country, Political stability in country, Bribery and corruption, Complexity of customs procedures), **Goods flows** (Antimonopoly politics, Local competition of LC, Supply chain development, Total country import, Total country export)**, Information flows** (Telecommunication technology, The availability of new technologies)**, Other flows** (The size of domestics suppliers, Logistics competence, Cluster development, Quality of education)
Uysal F., Gülmez, M. (2014)	**Technical** (Highway infrastructure, Railway infrastructure, Airway infrastructure, Seaway infrastructure, Passenger capacity, Freight capacity)**, Economic** (Land cost), **Social** (Employment)**, Logistics potential** (Development Level), **Environment** (Weather condition, Hydrological condition, Topological cond., Geographical condition)**,**
Zalluhoğlu, A. E., Aracıoğlu, B., Bozkurt, S. (2014)	Location as Logistics, Proximity to industrial zone, Freightage potential, Size, Hinterland width, Access to educated labor force, State budget subsidies, Bureaucracy, IT infrastructure, Customs clearance infrastructure, Social facilities, Institutive infrastructure, Geographical infrastructure (Suitability to enlargement, Topography), Infrastructure Cost, Highway-freeway connection, Highway infrastructure, Highway service capacity, Airport location, Airport connections, Airport service capacity, Railroad infrastructure, Railroad service capacity, Railroad-harbor connection, Harbor depth, Harbor location, Harbor service capacity
Stević, Ž., Vesković, S., Vasiljević M., Tepić, G. (2015)	**Spatial** (Available surface, Land price)**, Geographic** (Geographical location, Macro-micro level of location)**, Traffic** (Affiliation to the form of transportation, Approach ways accessibility of transport equipment to the logistics center)
Fagaraşan, M., Cristea, C. (2015)	Economic performance, Courier services, Transport infrastructure, Level of competitiveness, Investment attractiveness, Investment level, Target market, Social dimension, Labor cost, Level of education, Safety, Environmental-friendliness
Önden, İ., Acar., A. Z., Eldemir, F. (2015a)	Proximity to highway, Proximity railway, Proximity airports, Proximity seaports, Volume of international trade, Population, Handling capabilities of the ports
Peker, I., Bakib, B., Tanyaş, Ar, I. M. (2016)	**Socio economic factors** (Environmental effect, Traffic effect, Impact of economic life, Impact of disaster logistics)**, Location** (Distance to production center, Distance to city center, Distance to airport, Distance to highway, Distance to port)**, Facility cost** (Building facility cost, Transport connection cost)**, Railway transportation, Highway transportation, Land cost** (Land Acquisition cost, padding cost), **Operation cost** (Shipping cost)**, Physical characteristic of land** (Land size, Expansion opportunity, Ground structure, Slope of land)**, Structure and ownership of land** (Ownership status of land, Availability of land for reconstruction plan) (and 7 specific Highway Transportation and Railway Transportation sub-criteria)
Özceylan, E., Erbaş, M., Tolon, M., Kabak, M., Durğut, T., (2016)	Proximity to railroad system, Proximity to highway system, Proximity to airport, Proximity to industrial zone, Population density, Acreage and possible expansion of land, Slope of land, Cost of land, Distance to forest zone, Distance to rivers, Distance to lakes, Distance to earthquake epicenter, Height difference to railway line
Cristea, M., Cristea, C. (2016)	Economic performance, Transport infrastructure, Exports , Level of competitiveness, Target market, Economic development potential, Foreign

	investments, State budget subsidies, Social dimension, Labor cost, Safety, Green areas
Uyanık, C. (2016)	**Cost** (Land, Labor, Investment, Facility, Operation, Transportation, Information), **Natural resources** (Water, Power and Electric Supply, Weather, Landform, Geographic, Topological, and Hydrological condition), Proximity to Railroad System, Proximity to Highway System, Proximity to Center of City, Proximity to Harbor, Size, Suitability to Enlargement (Land), Proximity to Industrial Zone, Macro-economic benefit/performance, Environmental impacts, Freight Transport, **Suitability to construction** (Topography, Geography, Ground Structure), **Cost of construction process** (Infrastructure-water, Electricity, Security, Road), **Accessibility to labor, Transportation and logistics attractiveness**

While preparing the criteria table at the second step, if the methodology contains sub-criteria, the sub-criteria are taken into consideration. Main criteria are assessed in the other situation. In Table 3.3 which is prepared at the end of the second step, it is seen that in 32 studies, in total, 453 criteria were considered. During the implementations, approximately, 8 main criteria are used on average and 26 main criteria were used in the publication of Zalluhoğlu, as the highest score. While Boile's study uses the highest number of sub-criteria by using 31 sub-criteria, Tomic follows it by 29 sub-criteria.

At the third step, all criteria were classified as Cost, Cargo Capacity/Economic Reflections, Environment, Location and Social Factors. Then the similar criteria which were classified under such five categories were united in order to obtain Table 3.4.

At the final step, criteria used less than 6 times was omitted and criteria used in a widespread manner were determined. Table 3.5 shows the ranking of criteria considering their usage frequency. Priority of the costs-related criteria is also proven as a result of the literature review. In 32 studies, in total, 30 criteria gathered under the title of natural resources were found. Landform condition, Geographic condition, Hydrological condition and Topological condition criteria which are included in the natural resources category contain transitivity with the location category.

Table 3.3 Number of evaluated decision criteria for each publication

Author / Authors	Number of Main Criteria	Number of Sub-Criteria	Evaluated Criteria Number
Chen, Y., Qu, L. (2006)	5	17	17
Wang, Liu (2007)	5		5
Ballis, A., Mavrotas, G. (2007)	10		10
Ghoseiri, K., Lessan J. (2008)	5		5
Tanyaş, M., Bamyacı M. (2008)	4	18	18
Yu , X., Zhang, X., My, L. (2009)	4	16	16
Kayikci, Y. (2010)	5	28	28
Boile, M., Theofanis, S., Gilbert, P. (2010)	5	31	31
Li, Liu, Chen (2011)	13		13
Elgün, M. N., Elitaş, C. (2011)	4	14	14
Eryürük, H., Kalaoğlu, F., Baskak, M. (2011)	5	18	18
Erkayman, B., Gündoğar, E., Akkaya, G (2011)	4	17	17
Can, A. M. (2012)	11		11
Arikan, F. (2012)	7		7
Görgülü, H. (2012)	9		9
Regmi, M. B., Hanaoka, S.(2013)	5	13	13
Yıldırım, F., Önder, E.(2014)	7		7
Uysal, T., Yavuz, K. (2014)	11		11
Chen, K. H., Liao, C. N., Wu, L. C. (2014)	5		5
Żak, J., Weglinski, S. (2014)	9		9
Yıldırım, F., Önder, E. (2014b)	8		8
Demiroğlu, Ş., Elener, A. (2014)	5	19	19
Tomic´ , D. Marinkovic´ , D. Markovic´ (2014)	6	29	29
Uysal F., Gülmez, M. (2014)	5	13	13
Zalluhoğlu, A. E et al. (2014)	26		26
Stević, Ž et al. (2015)	3	6	6
Fagaraşan, M., Cristea, C. (2015)	12		12
Önden, İ., Acar., A. Z., Eldemir, F. (2015a)	7		7
Peker, I., Bakib, B., Tanyaş, Ar, I. M. (2016)	9	28	28
Özceylan, E. et al. (2016)	13		13
Cristea, M., Cristea, C. (2016)	12		12
Uyanık, C. (2016)	16		16
Total	255	267	453
Mean	7,97	19,1	14,2

Table 3.4 Criteria from literature and their usage frequency

LOCATION

Proximity To Railroad System (21)
Proximity To Highway System (19)
Proximity To Airport (15)
Proximity To Harbor (14)
Size (14)
Suitability To Enlargement (Land) (13)
Proximity To Industrial Zone (12)
Suitability To Construction (Topography, Geography, Ground Structure) (9)
Proximity To Center Of City (8)
Location (6)
Land Infrastructure (4)
Proximity To Inland Waterways (4)
Land Zoning Status (4)
Harbor Service Capacity (3)
Proximity To Freeway Interchanges (2)
Highway Service Capacity (2)
Railroad Infrastructure (2)
Height Difference Between Land And Railroad System (2)
Proximity To Consumption Resources (2)
Proximity To Regional Transportation System (2)
Proximity To International Transportation System (2)
Prox. To Int. Manufacturing Market (2)
Proximity To Freight Hub (1)
Proximity To Supply Point (3)
Free-Zone Size (1)
Number Of Airports (1)
Size Of Domestic Suppliers (1)
Harbor Location (1)
Insitutive Infrastructure (1)
Length Of Rail Dock (1)
Rail-Road Cross Docking (1)
Number Of Road-Rail Crossings (1)
Passenger Capacity (1)
Surrounding Route (1)
Proximity To Customs (1)
Proximity To Europian Corridors (1)
Utility Infrastructure (1)
Proximity To Freight Shippment (1)
Maximum Depth (Harbor) (1)
Land Uses Of Neighnoring Sites And Conflicts (1)
Covenants Running With The Land That Restrict Its Free Use (1)
Hinterland Width (1)
Airport Service Capacity (1)
Airport Location (1)
Airport Connection (1)
Social Facilities (1)
Harbor Depth (1)
The Distance Between Freeway Exit (1)
Load Establishment (1)
Proximity To Rivers (1)
Proximity To Forest Zone (1)
Proximity To Lakes (1)

COST

Cost (Land, labour, investment, facility, operation, transportation, information (33)
Cost of Construction Process (infrastucture-water, electricity, security, road) (9)
Total Transport Time From Seaport (1)
Padding Cost (1)
Shipping Cost (1)
Handling Cost (1)
Cost Of Usage (1)
Recurring Cost (1)

ENVIRONMENT

Natural Resources (Water, power and electric supply, weather,landform,geographic, topological, andhydrological condition) (31)
Environmental Impacts (11)
Environmental Safety and Disassters (6)
Sewage And Waste Treatment Plants (4)
Air Pollution (4)

CARGO CAPACITY / ECONOMIC REFLECTIONS

Macro economic benefit/performance (12)
Freight Transport (10)
State Subsidies (8)
Transportation And Logistics Attractiveness (7)
Volume Of International Trade (6)
Target Market (Number Of Firms) (3)
Transport Infrastructure (3)
Development Level-Economic Level (2)
Custom Clearence Infrastructure (2)
Effects On Economy (1)
Fundamental Construction Investment. (1)
Investment Level (1)
Courier Services (1)
Commodity Feature (1)
Conformity With Ideal Standards (1)
Handling Capabilities Of The Ports (1)
Total Handling Capacity (1)
Dock Capacity (1)
Dock Contanier Capacity (1)
Dock Area (1)
Dock Length (1)
Investment Level (1)
Percantage Of Warehouse Area Allocated (1)
Commodity Storage Capacity (1)
Cantainer Storage Capacity (1)
Precense Of Trade Barriers ((1)
Facility Of Getting A Bank Credit (1)
Local Competition Of Lc (1)
Bussiness Environment (1)
Transport Time (1)
Socio Economic Factors (1)

SOCIAL FACTORS

Accessibility To Labour (9)
Safety And Security (7)
Communication (6)
Population (5)
Social Benefit (3)
Ownership Of Land (3)
Level Of Education (2)
Social Facilities (2)
Bureaucracy (2)
Service Level (2)
Political Stability (2)
Legal And Judical Effiency (1)
Bribery And Corruption (1)
Anti Monopoly Politics (1)
The Availability Of New Technologies (1)
Social Stability (1)
Attitude Of Neighboring Communities (1)
Pressures From Existing Uses (1)
Management Condition (1)
Socio Economic Factors (1)
It Infrastructure (2)

Table 3.5 List of widespread used decision criteria in literature

ID	Decision Criteria	Category	# of used
1	Cost (Land, labor, investment, facility, operation, transportation, information)	Cost	33
2	Natural Resources (Water, power and electric supply, weather, landform, geographic, topological, and hydrological condition)	Environment	31
3	Proximity to Railroad System	Location	21
4	Proximity to Highway System	Location	19
5	Proximity to Airport	Location	15
6	Proximity to Harbor	Location	14
7	Size	Location	14
8	Suitability to Enlargement (Land)	Location	13
9	Proximity to Industrial Zone	Location	12
10	Macro-economic Benefit/Performance	Cargo Capacity/ Economic Reflections	12
11	Environmental Impacts	Environment	11
12	Freight Transport	Cargo Capacity/ Economic Reflections	10
13	Suitability to Construction (Topography, Geography, Ground Structure)	Location	9
14	Cost of Construction Process (infrastructure-water, electricity, security, road)	Cost	9
15	State Subsidies	Cargo Capacity/Economic Reflections	8
16	Proximity to Center of City	Location	8
17	Transportation and Logistics Attractiveness	Cargo Capacity/Economic Reflections	8
18	Accessibility to Labor	Social Factors	8
19	Safety and Security	Social Factors	7

Accessibility to transportation types becomes important with the development of intermodal shipping. Especially as it reduces transportation costs and a more environment-friendly option in comparison to highway transportation, railway transportation becomes important. It is seen that road transportation is still an important option in comparison to other transportation types. Also, the size of the candidate region and its flexibility for physical expansion for future needs are determined in location selection.

4. CONCLUSION

Logistics centers emerge as a solution for freight transportation which increase both on an intra-urban and the regional scale together in urban areas. Due to high alternative costs, it is important to make the right location selection decision. Across the world, this real economic and physical problem is examined by academics. In many articles, congress papers and masters/PhD theses this issue is studied. In order to reach better solutions, accurate criteria should be determined and a proper methodology should be selected.

In this study, the literature on logistics centers' location selection problem is reviewed based on two classes: decision making techniques and decision criteria. The main aim of this study is to provide an insight for researchers and decision makers. For this aim, four master thesis, six proceedings and 26 articles were reviewed from the literature. Specifically, the studies including logistics centers' location selection problem and related applications of this research were classified.

One of the main conclusions of the analysis in this paper is: publications on the LC location problem are rapidly increasing; 2014 especially was a peak year in terms of the number of studies. Following a search conducted for the interval 1999-2016, it was seen that with half of the total studies, Turkey is the leading country for this research area. Turkey is followed by China.

Also, it can be concluded that among the MCDM techniques, AHP is the most popular one like as the other application areas of MCDM techniques. AHP is followed by TOPSIS and ELECTRE, respectively. Although, most of the studies used MCDM techniques in this research area, the vagueness of this problem still needs to be examined in a more detailed way. Hence, there is a gap for the usage of fuzzy MCDM techniques. Additionally, when decision criteria that are part of this study are analyzed, it can be concluded that the cost and natural resources main criteria groups are found to be the most popular ones.

Looking to the future of MCDM research, it is expected that new techniques for handling the vagueness have the potential for establishing a new trend of MCDM applications in LC location selection problem. As it is known, in Turkey; there is no logistics master plan at the national level yet and policy makers need to be guided with the scientific method of research. Perhaps, the high number of studies realized in Turkey can provide the inspiration for the policy makers.

REFERENCES

[1] Aksoy, O, Özyörük, B, (2015) The importance of freight villages: an implementation in TCDD. Applied Mathematical Modelling. Vol.1,1-7.

[2] Arikan, F. (2012) Freight villages and an application, Bahçeşehir University, Master Thesis, Istanbul.

[3] Ballis B., Mavrotas M. (2007) Freight village design using the multicriteria method PROMETHEE. Operation Resarch Journal, 15,250-260.

[4] Bayraktutan, Y., Özbilgin, M. (2014) Türkiye'de illerin lojistik merkez yatırım düzeylerinin bulanık mantık yöntemiyle belirlenmesi. Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, Volume: 43, 1-36.

[5] Boile M., Theofanis S., Gilbert P. (2010) Feasibility of Freight Villages in the NYMTC Region. The State University of New Jersey, 11-15.

[6] Can, A. M. (2012) Selection the location of freight village in Samsun with Multi-Criteria Decision Making, Erciyes University, Master Thesis, Kayseri.

[7] Chen, K. H., Liao, C. N., Wu, L. C. (2014) A Selection Model to Logistic Centers Based on TOPSIS and MCGP Methods: The Case of Airline Industry. Journal of Applied Mathematics.

[8] Chen, Y., Qu, L. (2006) Evaluating the Selection of Logistics Centre Location Using Fuzzy MCDM Model Based on Entropy Weight. 6th World Congress on Intelligent Control and Automation, Dalian, China.

[9] Cristea, M., Cristea, C. (2016), A multicriteria decision-making approach used for the selection of a logistics center location, Annals of the University of Oradea, Volume XXV (XV), DOI: 10.15660/AUOFMTE.2016-1.3202.

[9] Demiroğlu, Ş., Elener, A. (2014) Küresel lojistik köyleri ve Türkiye'de kurulması planlanan lojistik köy bölgelerinin ÇKKV yöntemleriyle belirlenmesi. Dumlupınar University Journal of Social Sciences, Volume 42, 189-202.

[10] Elgün M., Elitaş C. (2011) Yerel ulusal ve uluslararası taşıma ve ticaret açısından lojistik köy merkezlerinin seçiminde bir model önerisi. Celal Bayar Üniversitesi Sosyal Bilimler Dergisi, Celal Bayar Üniversitesi Manisa, Vol. 9.

[11] Erkayman, B., Gündoğar, E., Akkaya, G., İpek, M. (2011) A Fuzzy Topsis Approach For Logistics Center Location Selection. Journal of Business Case Studies – May/June 2011, Volume 7, Number 3, 49-55.

[12] Eryürük, S., H., Kalaoğlu, F., Baskak, M. (2011) A Site Selection Model For Establishing A Clothing Logistics Center. Tekstil ve Konfeksiyon, Vol. 22, No. 1, 01/2012, 40-47.

[13] EUROPLATFORMS, Corporate Presentation, October 2015 http://www.europlatforms.eu/wp-content/uploads/2016/01/Corporate-Presentation-2015-Europlatforms-Final_20151229.pdf.

[14] Fagaraşan, M., Cristea, C. (2015) Logistic center location: selection using multicriteria decision making. Proceedings of the Annual Sessions of Scientific Papers "IMT Oradea", 193-198.

[15] Görgülü, H. (2012) Logistic villages and Konya application, Bahçeşehir University, Master Thesis, İstanbul.

[16] Goseiri, K., Lessan J. (2008) Location Selection for Logistic Centers using a Two- Step Fuzzy-AHP and ELECTRE Method. 9th Asia Pacific Industrial Engineering & Management Systems Conference, Bali, Indonesia.

[17] Higgins, C. D., Ferguson, M. R. (2011) An Exploration of the Freight Village Concept and its Applicability to Ontario, McMaster Institute of Transportation and Logistics.

[18] Kayikci, Y. (2010) A conceptual model for intermodal freight logistics centre location decisions. Procedia Social and Behavioral Sciences, 6297-6311.

[19] Koldemir, B., Çancı, M., Gönüler, E. (2009) Büyük Ölçekli Kent Planlamasında Lojistik Köyler. İzmir Ulaşım Sempozyumu, İzmir, 457-464.

[20] Li. Y., Liu. X., c Y. (2011) Selection of logistics center location using axiomatic fuzzy set and TOPSIS methodology in logistics management. Expert Systems with Applications, Volume 38, 7901–7908.

[21] Önden, İ., Acar., A. Z., Eldemir, F. (2015a) Evaluation of the logistics center locations using a multi-criteria spatial approach, Transport, DOI: 10.3846/ 16484142.2016.1186113.

[22] Önden, İ., Eldemir, F., Çancı, M. (2015b) Logistisc center concept and location decision criteria, Sigma Journal Engineering and Natural Sciences, Volume 33 (3), 325-340.

[23] Özceylan, E., Erbaş, M., Tolon, M., Kabak, M., Durğut, T., (2016) Evaluation of freight villages: A GIS-based multi-criteria decision analysis, Computers in Industry, Volume 76, 38–52.

[24] Peker, I., Bakib, B., Tanyaş, Ar, I. M. (2016) Logistics center site selection by ANP/BOCR analysis: A case study of Turkey. Journal of Intelligent & Fuzzy Systems, Volume 30, 2383–2396, DOI:10.3233/IFS-152007.

[25] Regmi, M. B., Hanaoka, S. (2013) Location analysis of logistics centres in Laos. International Journal of Logistics Research and Applications, 16(3), 227-242.

[26] Rimienė, K., Grundey, D. (2007) Logistics center concept through evolution and definition. Engineering Economics 4 (54), 87–95.
[27] Stevic, Z., Veskovic, S., Vasilyevic M., Tepic, G (2015) The Selection of The Logistics Center Location Using AHP Method. 2nd International Logistics Congress, p.86-91., 21-23 May 2015, Belgrade, Serbia.
[28] Taniguchi, E., Noritake, M., Yamada, T. & Izumitani, T (1999) Optimal size and location planning of public logistics terminals. Transportation Research Part E, 35, 207–222.
[29] Tanyaş, M., Bamyacı M. (2008) Organize Lojistik Bölgesi Yer Seçimi Problemi için Bir Çok Ölçütlü Karar Verme Modeli: AHP-SAW. Mersin Sempozyumu, 19-22 Kasım 2009, Mersin.
[30] Tomić V., Marinković D., Marković D. (2014) The selection of logistic centers location using multi-criteria comparison: Case Study of the Balkan Peninsula. Acta Polytechnica Hungarica, Vol. 11, No. 10.
[31] Uyanık, C (2016) An integrated DEMATEL-Intuitionistic Fuzzy TOPSIS methodology for logistics centers location selection, Marmara University, Master Thesis.
[32] Uysal F., Gülmez, M. (2014) Fuzzy graph theory and matrix approach application for the selection of logistics centre location in the Mediterranean region of Turkey. Verimlilik Dergisi, Volume 1, 89-104.
[33] Uysal, T., Yavuz, K. (2014) Selection of Logistics Centre Location via ELECTRE Method: A Case Study in Turkey. International Journal of Business and Social Science, Vol. 5, Issue 9, 276-289.
[34] Wang, S., Liu, P. (2007) The Evaluation Study on Location Selection of Logistics Center Based on Fuzzy AHP and TOPSIS. International Conference on Wireless Communications, Networking and Mobile Computing, International Conference on. IEEE, 3779-3782.
[35] Weiqing, Z. (2014) Research on intelligent optimization algorithm in logistics center location. Applied Mechanics and Materials, Volume 539, 882-888.
[36] Yıldırım, Y., Önder, E. (2014a) Evaluating potential freight villages in Istanbul using multi criteria decision making techniques. Journal of Logistic Management, Vol.3, No.1, 1-10.
[37] Yıldırım, Y., Önder, E. (2014b) VIKOR Method for Ranking Logistic Villages In Turkey. Journal of Management and Economic Research, Vol.23, 293-314.
[38] Yu, X., Zhang, X., Mu, L. (2009) A Fuzzy Decision Making Model to Select the Location of the Distribution Center in Logistics. International Conference on Automation and Logistics, Shenyang, China, August 2009.
[39] Żak, J., Weglinski, S. (2014) The Selection of the Logistics Center Location Based on MCDM/A Methodology. Transportation Research Procedia, vol. 3, 555–564.
[40] Zalluhoğlu, A. E., Aracıoğlu, B., Bozkurt, S. (2014) Lojistik Köy Kurulumunun Lojistik Hizmet Sağlayıcılar Açısından Değerlendirilmesi: İzmir Örneği. Ege Strategic Research Journal, Volume 2, 81-103.