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Comparison of Logistics and Clothing Sectors for a Logistics Center Site Selection Using AHP

Abstract

The textile and clothing sectors can be seen as a supply chain consisting of a number of discrete activities. The supply chain from sourcing raw materials to distribution and marketing must be well organized as an integrated production network. Logistics is a very important strategy to gain competitive advantages like time, cost and customer satisfaction. In this study, the establishment of a clothing logistics center for the Turkish Clothing Industry in the Marmara Region of Turkey was evaluated by clothing and logistics sector experts. A numerical study with a questionnaire survey database aimed at the clothing industry of Turkey was conducted and the Analytic Hierarchy Process (AHP) was used to evaluate the questionnaire results.

Key words: logistics center, Analytic Hierarchy Process (AHP), clothing industry, site selection.

Introduction

Logistics is the management of the flow of goods, information and other resources between the point of origin and that of consumption in order to meet the requirements of customers. Logistics involves the integration of information, transportation, inventory, warehousing, material handling, and packaging, and occasionally security. Logistics is a channel of the supply chain which adds the value of time and place utility. It is the part of the supply chain process that plans, implements and controls the flow of goods [1].

The clothing sector is both a labor-intensive, low wage industry and a dynamic, innovative sector. The competitive advantage of firms in this market segment is related to the ability to produce designs that capture tastes and preferences in addition to cost effectiveness. Also the other major market segment is the mass production of lower-quality and/or standard products. Manufacturers for this market segment are largely found in developing countries. In the low to medium priced market, the role of the retailer has become increasingly prominent in the organization of the supply chain [2, 3].

The competitive advantages of the textiles and clothing sector in Turkey are now found in a focus on quality and de-

sign, innovation and technology, and high value-added products. Competitiveness has been retained by sub-contracting, or the relocation of production facilities, labour-intensive activities such as garment make-up to companies in countries with lower labour costs. At the same time, globalization and technological progress has led to the need to rethink the textile and clothing industry's clustering strategy.

In the first section of the article a profile of the clothing industry in Turkey and in the world is mentioned, the logistics sector in Turkey and the world explained, and an evaluation of logistics as a global strategy in the clothing industry is presented [4]. In the second part of the study, a logistics centre design was studied [5]. This paper is the third part of a study that investigates a clothing logistics centre site selection for the Turkish Clothing Industry in the Marmara Region of Turkey. A numerical study with a questionnaire survey database was conducted to compare Turkish clothing and logistics sectors for a logistics center site selection and Analytic Hierarchy Process (AHP) was used to evaluate questionnaire results.

Literature review

Tsamboulas and Kapros presented a method and models for assessing the financial viability of a new Freight village financed by private and public investments [6]. Application of the methodology and models developed was made for a Freight village in Northern Greece, demonstrating their potential for application in similar cases. Baohua and Shiwei evaluated logistics centre location and the allocation problem in an uncertain environment [7]. On the basis of the stochastic optimisation model, a robust op-

timisation model using the formation of the regret model was proposed. Huijun et. al. considered the benefits of customers and logistics planning departments and presented a bi-level programming-model to seek the optimal location for logistics distribution centres [8]. Zevgolis et. al. investigated the design of an underground Warehousing – Logistics Centre (WLC) in the wider metropolitan area of Athens [9]. The paper provided cost data regarding the construction cost, as well as the development cost. Yang et al. focused on the distribution centre location problem in the aspect of how to select distribution centres from a potential set so that the total relevant cost was minimised [10]. This research mainly investigated this problem in a fuzzy environment. Consequentially a chance constrained programming model was designed for the problem.

Oum and Park identified the major factors that multinational companies (MNCs) consider important when they decide the locations of their regional distribution centres, and how European and North American MNCs assess Korean cities (Seoul/Incheon; Busan/Kwangyang) as a potential location for their Northeast Asian distribution centres via-vis competing Northeast Asian cities (Tokyo/Yokohama, Osaka/Kobe, Shanghai, Beijing/Tianjin, Taipei) [11]. Ho and Emrouznejad explored the use of optimisation procedures in SAS/OR software with application to contemporary logistics distribution network design using an integrated multiple criteria decision making approach [12]. The approach proposed was combining the analytic hierarchy process (AHP) and goal programming (GP), considered both quantitative and qualitative factors. Altıparmak et al. presented a solution procedure based

Table 1. Evaluation method [20]

Evaluation 1 Criterion: Firm type	
Clothing experts	55
Logistics experts	50
Total	105
Evaluation 2 Criterion: Number of employees of clothing firms	
Between 1 - 100	15
Between 101 - 250	20
More than 250	20
Total	55

on steady-state genetic algorithms with a new encoding structure for the design of a single-source, multi-product, multi-stage supply chain network [13]. Reeves et al. reported on an empirical study that examined a suite of distribution and logistics services commonly used to manage inbound materials en route to plants [14]. The sourcing decision was examined through the lenses of transaction cost economics and the resource-based view of the firm. The results of which lend limited support to both theories in the context of such services. Results further indicate that there is little evidence supporting differences between internal versus external decision-makers.

Lee and Dong discussed logistics network design for end-of-lease computer product recovery by developing a deterministic programming model for systematically managing forward and reverse logistics flows [15]. Due to the complexity of such a network design problem, a two-stage heuristic approach was developed to decompose the integrated design of the distribution networks into

a location-allocation problem and a revised network flow problem. Sharma et al. related product characteristics to optimising supply chain delivery network design, in which the cost and service factor performance metrics were adopted as the decision criteria [16]. An analytic hierarchy process (AHP) multi-criteria decision-making methodology is then developed to take into account both qualitative and quantitative factors for the best delivery network design selection.

Ozdemir's study was based on a research project involving logistics firms in Istanbul designed to investigate the strengths and weaknesses of Istanbul in its quest to become a logistics centre serving a wider region beyond Turkey [17]. The results of the interviews and survey showed that logistics activity in the Marmara region (and Istanbul in particular) was mainly the result of economic activities taking place in a national context, rather than the result of logistics node operations at a regional or global level. Kayali examined the technical, pure technical and scale efficiencies of the profitability of textile companies in Turkey for 2007 [18]. The paper gave information about where the textile sector is in parts of the Turkish economy, as well as its conception of efficiency and Data Envelopment Efficiency. The profitability efficiency scores of the textile sector in 2007 were evaluated using Data Envelopment Analysis, the result of which showed that the efficiency score of the textile sector was low.

As mentioned above, there are many types of studies related to logistics centres, such as the financial viability of a new freight village, the logistics centre

Table 2. Fundamental scale for making judgements [21].

1	Equal
2	Between Equal and Moderate
3	Moderate
4	Between Moderate and Strong
5	Strong
6	Between Strong and Very Strong
7	Very Strong
8	Between Very Strong and Extreme
9	Extreme

location and allocation problem, an optimal location for logistics distribution centres and regional distribution centres, logistics distribution network design, logistics network design and optimising the supply chain delivery network [6 - 18]. As distinct from a classic logistics centre (freight village), there has been no study about the establishment of a logistics centre for the clothing industry. This study presents a different concept of a logistics centre, one which is developed to offer common services and activities to clothing enterprises as well as provide comprehensive transport and logistics services. In our previous studies we first evaluated globalisation strategies of the Turkish clothing industry and presented an external analysis of the Turkish clothing industry [19]. Then we analysed the clothing industry in terms of logistics and designed a logistics centre [4, 5]. This paper is the last part of the study that presents a clothing logistics center site selection for Turkish clothing industry in Marmara Region and also compares Turkish clothing and logistics sectors for a logistics center site selection as a strategic solution.

Methodology

The research design for this study consisted of a case study involving 55 Turkish clothing manufacturers and 50 logistics sector experts. The results were evaluated according to two criteria: firm type and number of employees (Table 1). The methods of collecting data during these studies were e-mail results and face-to-face interviews with the management teams of companies at their workplace. A numerical study with a questionnaire survey database was conducted and the Analytic Hierarchy Process (AHP) was used to evaluate the questionnaire results.

The Analytic Hierarchy Process (AHP) for decision-making is a theory of relative measurement based on paired comparisons used to derive normalised absolute

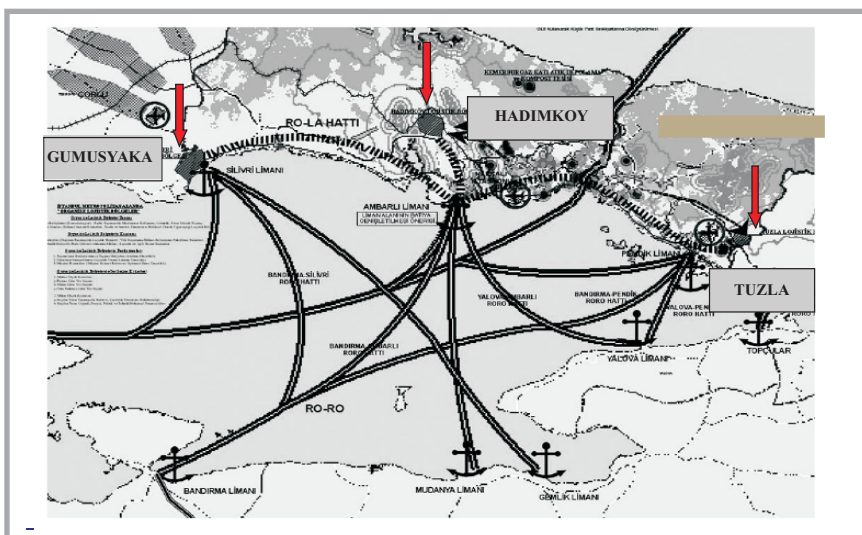


Figure 1. Candidate places for clothing logistics centre [28].

scales of numbers whose elements are then used as priorities [21, 22]. Matrices of pairwise comparisons are formed either by providing judgments to estimate dominance using absolute numbers from the 1 to 9 fundamental scale of the AHP, or by directly constructing the pairwise dominance ratios using actual measurements [23]. AHP captures priorities from paired comparison judgments of the elements of the decision with respect to each of their parent criteria [24]. As an evaluation scale, Saaty's scale of 1 - 9 will be used, as shown in *Table 2*.

Results

In this study we prepared a detailed analysis of the selection of a clothing logistics centre location. First a geographical evaluation of the Turkish clothing sector was investigated to select the region for a logistics centre. According to the data gathered from TurkStat (Turkish Statistical Institute) [25, 26], it was seen that 59% of the clothing firms were founded in the Marmara Region and 49% were also established in Istanbul. Istanbul is the biggest city in the Marmara Region and also in Turkey considering population and trade capacity. As a result it was

Table 3. Selection criteria for the clothing logistics centre site.

Site selection criteria	
Physical analysis	Transportation opportunities
Land size Expansion of physical facilities Geological status (as in the earthquake zone)	Proximity to motorway Proximity to airport
Location analysis	Labor force supply
Promotion opportunities in the region Proximity to supply points	Labor supply Labor cost
Infrastructure services	Fixed cost and capital supply
Communication infrastructure Electricity, gas and water networks Sewage and waste treatment plants	Cost of land Construction costs Cost of usage

decided to select the Marmara Region for a logistics centre establishment.

In the North Marmara Region, three sites (Tuzla, Hadimkoy and Gumusyaka) were selected to analyse the benefits they could provide if a logistics centre were developed (*Figure 1*) [27, 28]. These three sites were preferred by the Istanbul Metropolitan Planning department in order to establish a logistics centre because all three places have good transportation advantages (port, airport, highway and RO-LA, RO-RO connections).

Table 3 shows the site selection criteria developed as a result of intensive researches of literature and individual dis-

cussions with logistics sector professionals. For the study, the next step will be to evaluate the criteria below for the best logistics centre placement for the Turkish Clothing Industry.

Figure 2 shows the Hierarchical model in the Superdecision programme for the site selection of a clothing logistics centre [29]. The goal of the study is a site selection for a clothing logistics centre; the alternative places are Hadimkoy, Tuzla and Gumusyaka.

Evaluation 1: Clothing and logistics sectors

The first question in the questionnaire was "Is the establishment of a clothing

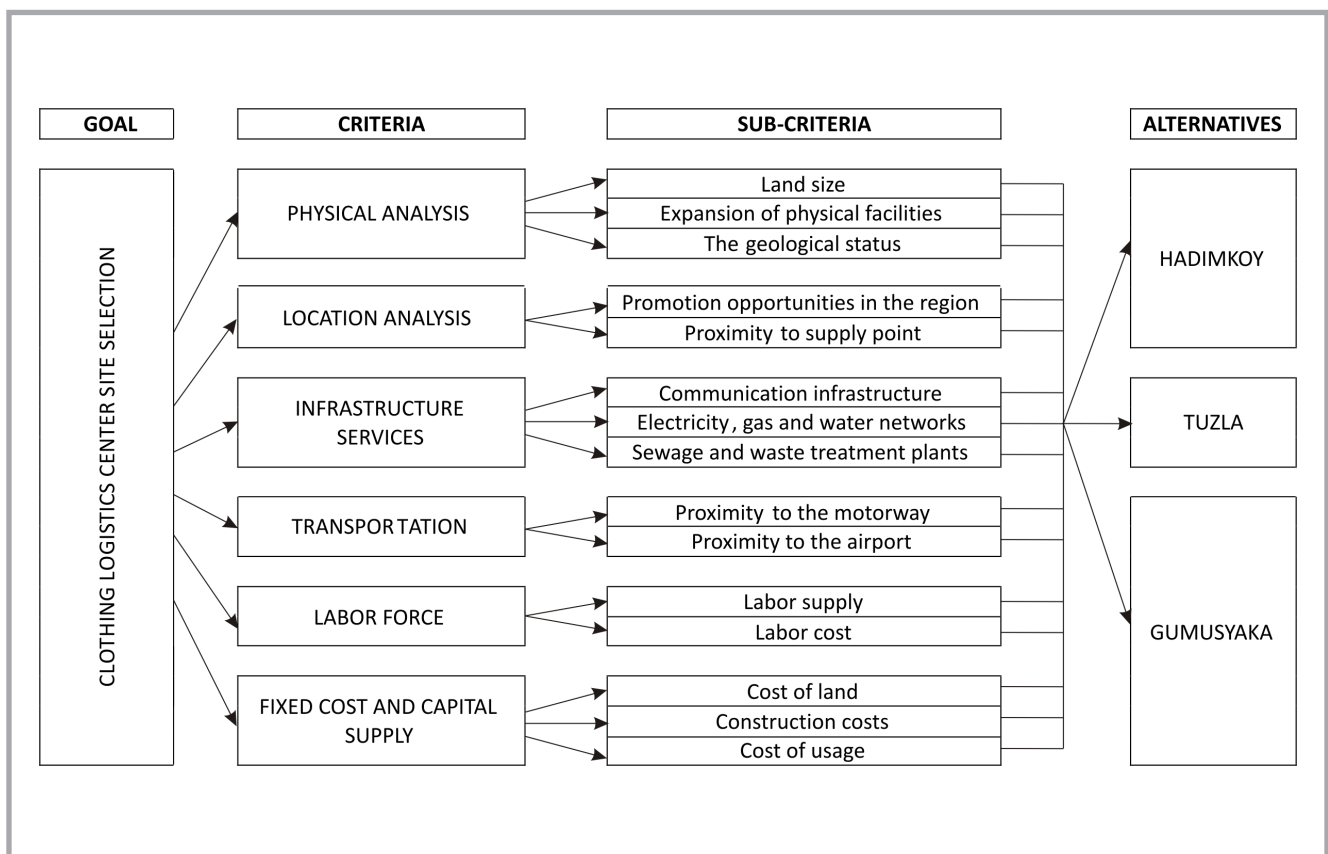


Figure 2. Hierarchical model in the Superdecision programme for the site selection of a clothing logistics centre [29].



Figure 3. Site selection criteria weights of clothing firms.

Gumusyaka was second with 32.2% and Tuzla third with 30.5%. Logistics sector experts preferred Hadimkoy as the best place for the establishment of a logistics centre because this region is a busy area in terms of transportation opportunities. Moreover the widely used Ambarli Port and Ataturk Airport are very near to Hadimkoy.

logistics centre necessary?" As seen from the **Figure 3**, most of the experts stated that the clothing logistics centre was necessary for the sector.

In this part, AHP results were investigated with respect to the clothing firms and logistics firms. **Figures 4 and 5** show the site selection criteria weights of clothing and logistics experts. When the site selection model is evaluated in terms of clothing experts and logistics experts, it is seen that the most important criterion is the fixed cost and capital supply with 30% and 22%. As a result of the evaluation, clothing experts selected labour force supply as the second criterion (23%) and transportation opportunities as the third (19%). Logistics experts se-

lected transportation opportunities in second position (20%) and the location analysis in the third (19%) (**Figure 5**).

Figure 6 shows the result of site selection for clothing firms. When the site selection model was evaluated in terms of clothing firms, Hadimkoy came first with 36.7%. Gumusyaka was second with 32.9% and Tuzla was third with 30.3%. Apparel firms disapproved of building a clothing logistics centre in Tuzla and they selected Hadimkoy because apparel firms are mostly concentrated in the European part of the country.

Figure 7 shows the site selection result for logistics firms. When the site selection model was evaluated in terms of logistics firms, Hadimkoy came first with 37.3%,

Evaluation 2: Evaluation of clothing firms according to the number of employees

In the second part, AHP results were investigated with respect to the employee number of clothing firms. **Figure 8** show the site selection criteria weights of clothing firms. Clothing firms that have employees between 1 - 100 mostly emphasised the fixed cost and capital supply with 37.13% and then labor force supply with 21.51%. Clothing firms that have employees between 101 - 250 attached nearly equal importance to the fixed cost and capital supply (25.41%) and labour force supply (23.36%). Clothing firms that have more than 251 employees selected fixed the cost and capital supply (27.70%) as the first criterion and labour force supply (22.00%) as the second.

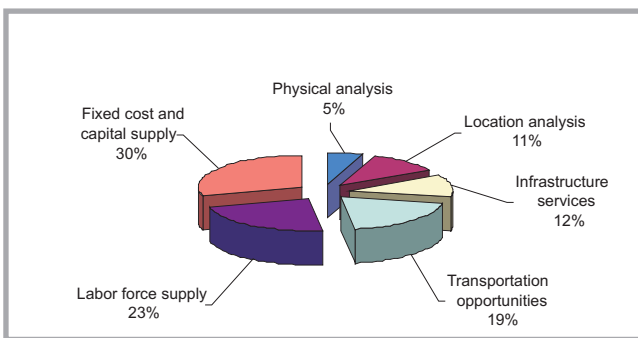


Figure 4. Site selection criteria weights of clothing experts.

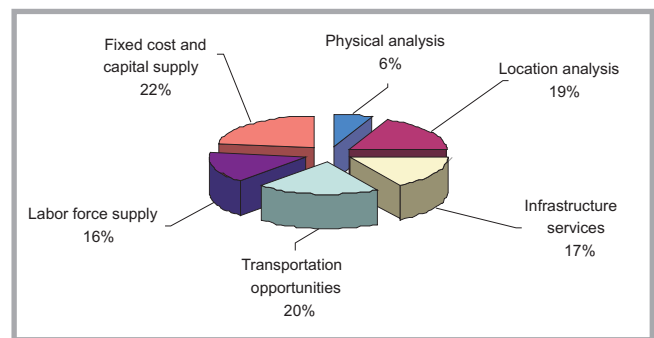


Figure 5. Site selection criteria weights of logistics experts.

New synthesis for: Super Decisions Main Window: model.clothing...

Here are the overall synthesized priorities for the alternatives. You synthesized from the network Super Decisions Main Window: model.clothing.mod

Name	Graphic	Ideals	Normals	Raw
1Hadimkoy		1.000000	0.367152	0.122384
2Tuzla		0.825211	0.302978	0.100993
3Gumusyaka		0.898455	0.329870	0.109957

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Figure 6. Result of decision regarding clothing logistics centre site selection by clothing experts.

New synthesis for: Super Decisions Main Window: model.logistic...

Here are the overall synthesized priorities for the alternatives. You synthesized from the network Super Decisions Main Window: model.logistics.mod

Name	Graphic	Ideals	Normals	Raw
1Hadimkoy		1.000000	0.373042	0.124347
2Tuzla		0.818468	0.305323	0.101774
3Gumusyaka		0.862198	0.321636	0.107212

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Figure 7. Result of decision regarding clothing logistics centre site selection of logistics experts.

Small firms of 1 - 100 employees selected Gumusyaka (34.48%) as the best place to establish a clothing logistics centre (*Figure 9.a*). Hadimkoy (33.67%) was selected as the second place and Tuzla (31.84%) was selected as the third. Clothing firms that have employees between 101 and 250 selected Hadimkoy (38.36%) as the most suitable place for a clothing

logistics centre (*Figure 9.b*) as well as clothing companies that have more than 250 employees (35.38%) (*Figure 9.c*).

Conclusion

The objective of this research was to find the best place for a logistics centre for the clothing industry. A case study meth-

odology was selected and an AHP based questionnaire was applied to 55 clothing companies and 50 logistics companies located in the Marmara Region of Turkey. Clothing firms were evaluated and classified according to the number of employees. *Figure 10* (see page 18) shows all the results obtained as a result of site selection evaluation.

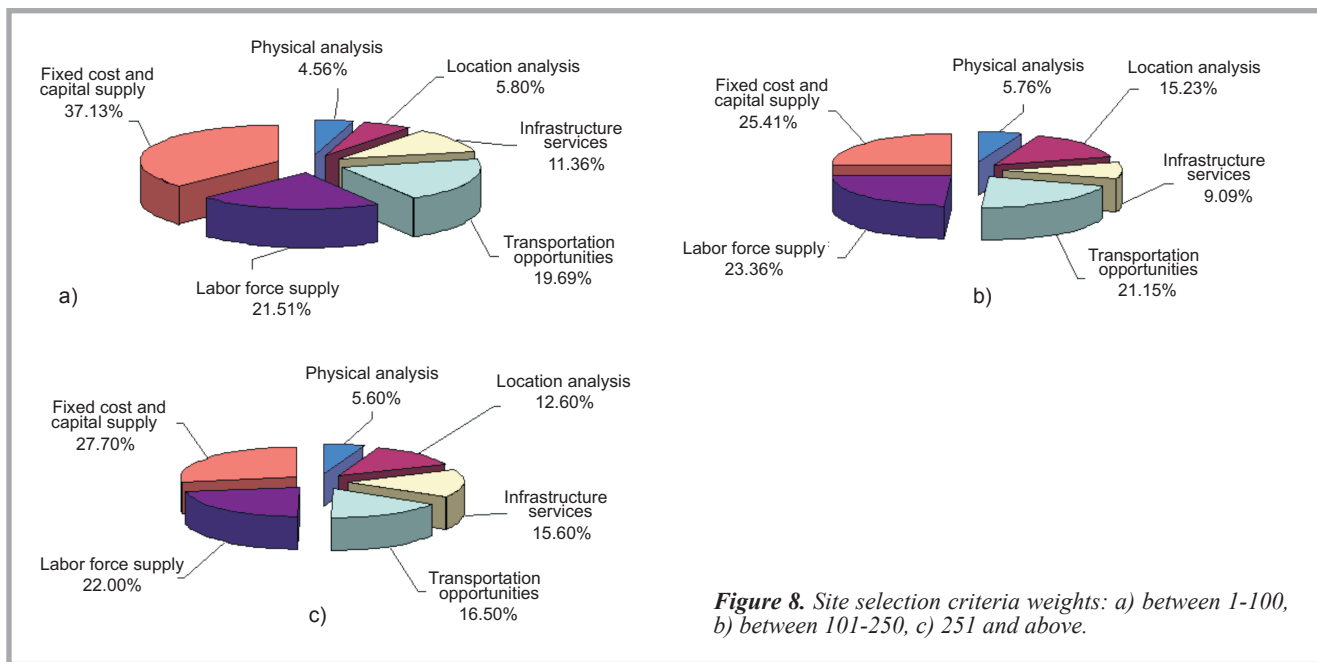


Figure 8. Site selection criteria weights: a) between 1-100, b) between 101-250, c) 251 and above.

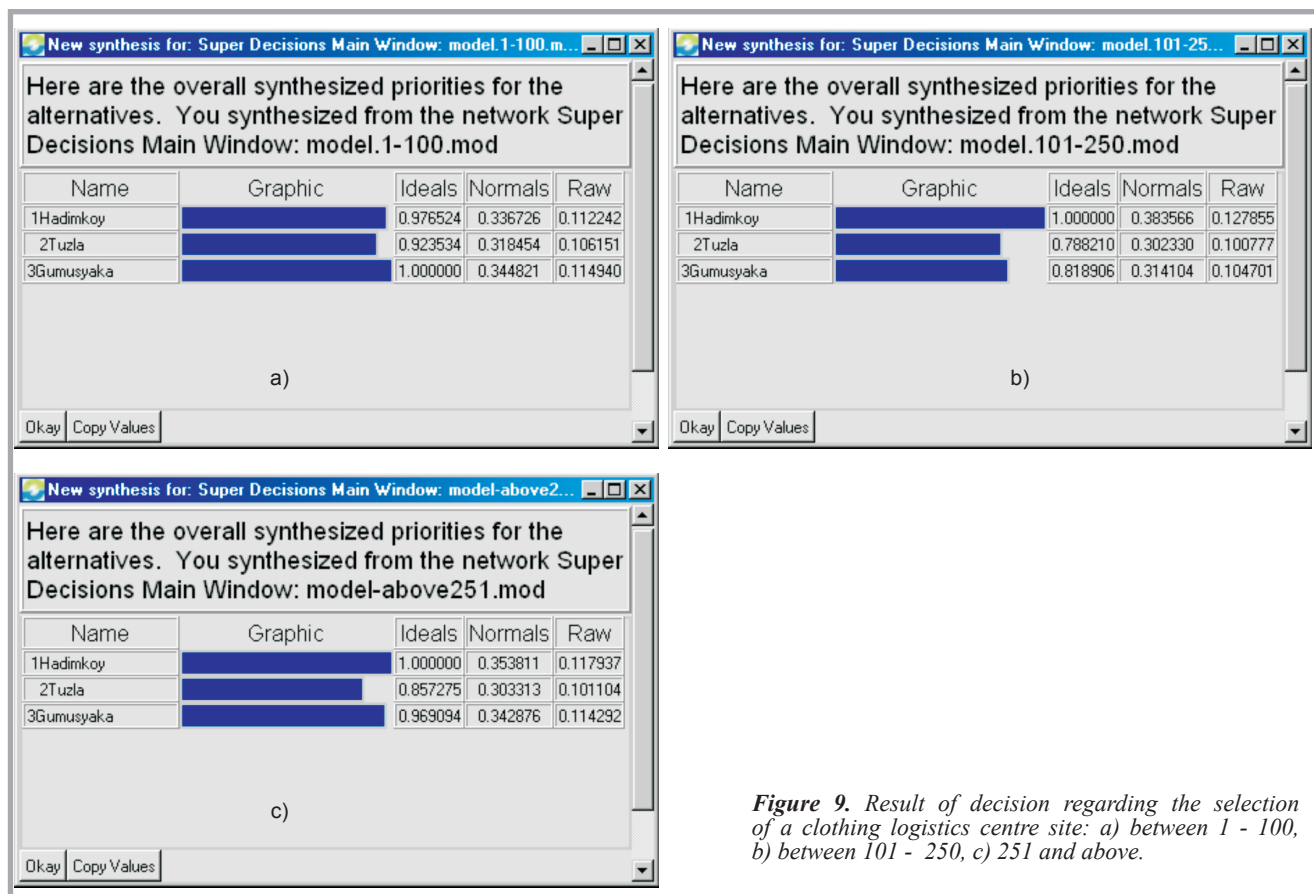


Figure 9. Result of decision regarding the selection of a clothing logistics centre site: a) between 1 - 100, b) between 101 - 250, c) 251 and above.

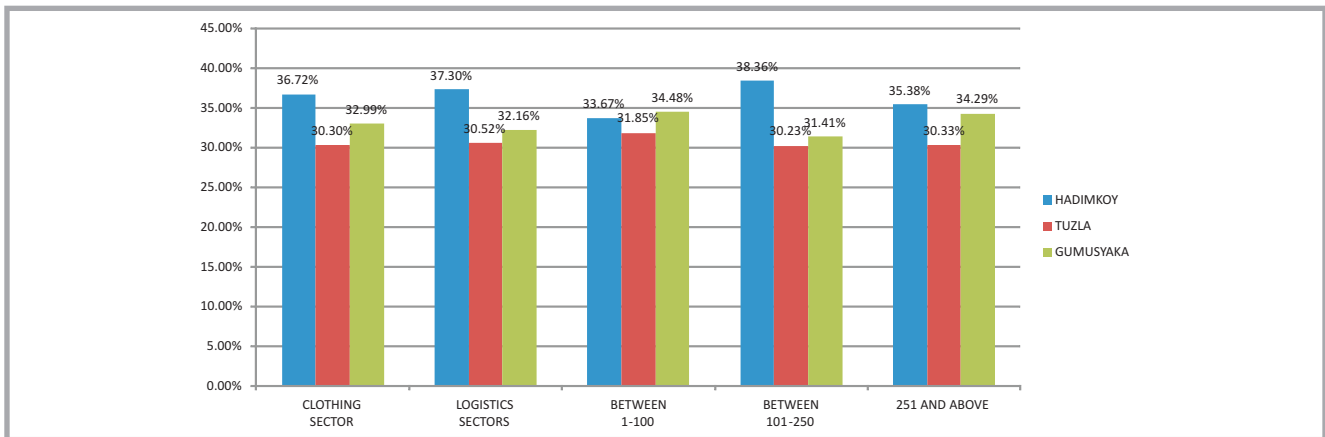


Figure 10. Site selection results.

Although all three places have good transportation opportunities, like being very close to a port, airport, highway and railway, results showed that Hadimkoy was generally preferred as the first place to establish a clothing logistics centre by all of the apparel and logistics companies concerned. Hadimkoy is a busy area in terms of transportation opportunities and labour force supply, and most of the garment manufacturers are located in this area. Also Turkey's biggest airport (Ataturk Airport) and a high-capacity port (Ambarli Port) are very close to Hadimkoy. Both clothing and logistics firms disapproved of building a clothing logistics centre in Tuzla, while they gave high scores to Hadimkoy because clothing firms are mostly concentrated in the European part of the country. Hadimkoy is a commercially intensive place, thus this is the best choice for establishing a logistics centre.

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