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IDENTIFICATION OF THE EFFECTIVE CRITERIA FOR THE SELECTION OF A WAREHOUSE SITE IN THE HEALTHCARE LOGISTICS INDUSTRY AND THEIR PLACEMENT IN ORDER OF IMPORTANCE BY THE DEMATEL METHOD

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Abstract

The aim of this study is to select the most accurate and efficient alternative storage locations according to the 11 criteria determined for an organization in the healthcare logistics sector. Expert opinions were used during the criterion examination. On the other hand, the purpose of determining the criteria is to increase productivity while minimizing costs. DEMATEL (The Decision Making Trial and Evaluation Laboratory) method was used for the analysis of these criteria. According to the results of the analysis, access to transportation lines takes the first place, while other criteria are proximity to alternative modes of transport, proximity to suppliers, integrated environmental conditions, structure and cost of land, proximity to customers, infrastructure, accessibility to labor, inbound logistic, legal regulations, tax /encouragement.

Keywords: Healthcare logistics, Warehouse location selection, DEMATEL.

JEL Classification: I11, L29, C61.

SAĞLIK LOJİSTİĞİ SEKTÖRÜNDE DEPO YERİ SEÇİMİNDE ETKİLİ KRİTERLERİN BELİRLENMESİ VE ÖNEM SIRASINA GÖRE DEMATEL YÖNTEMİ İLE SIRALANMASI

Öz

Bu çalışmanın amacı, sağlık lojistiği sektöründe bulunan bir kuruluş için belirlenen 11 kritere göre alternatif depo yerlerinin en doğru ve en verimli şekilde seçilmesidir. Kriter incelenmesi sırasında uzman görüşlerinden yararlanılmıştır. Öte yandan kriterlerin belirlenme amacı, maliyetleri en aza indirirken verimliliği arttırmaktır. Bu kriterlerin analizi için DEMATEL (The Decision Making Trial and Evaluation Laboratory) metodu kullanılmıştır. Bu bilgiler ışığında belirlenen 11 kriterin sıralaması ulaşım hatlarına erişim ilk sırada yer alırken diğer kriterler sırasıyla alternatif taşıma modlarına yakınlık, tedarikçilere yakınlık, bütünleşik çevre şartları, arazinin yapısı ve maliyeti, müşterilere yakınlık, alt yapı, iş gücüne erişebilirlik, giriş nakliyesi, yasal düzenlemeler, vergi/teşvik olduğu tespit edilmiştir.

Anahtar Kelimeler: Sağlık lojistiği, Depo yeri seçimi, DEMATEL.

JEL Sınıflaması: I11, L29, C61.

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1. Introduction

The logistics industry grows worldwide every day, and the potential of the industry is better understood over time. In the global markets where competition has reached high levels in the 21st century, customers are looking for the right product to buy at the right time, in the right place, at the desired quality and at the lowest possible price. In parallel with these factors, logistics coordinates and controls all phases of the process from supply of products to their delivery to the customer, i.e. from production to product delivery. However, the most important and known phase of logistics is still transportation.

One of the key sub-branches of the logistics industry is “Healthcare Logistics”. Due to the fact that the end users are responsible for the lives and the health of their patients, healthcare logistics is unique as it aims to improve the effectiveness and not the efficiency. The procedures of healthcare logistics are a big part of the health care system (Kafetzidakis & Mihiotis, 2012: 23).

The delivery of a great variety of medical supplies from surgical control and patient preparation products to surgical and hygiene products, syringes to blood analysis products, and mobile health products to medical gels to healthcare institutions is naturally provided by the operations of healthcare logistics. Storage and distribution centers play a pivotal role in these operations. In the last few years, the health care industry has become one of the largest branches of the economy of developed countries. Due to aging of the societies and continuing improvement of medical treatment this trend is likely to continue. While there is an increasing pressure to provide health care services in a more cost efficient way, still the development of mathematical planning models in health care and in particular its application in the real world is remarkably underdeveloped (Doerner, K. F. & Hartl, R. F., 2008:527).

Hospitals and healtcare facilities are like mini cities with some employing as many as 20.000 people. They’re also host to millions of dollars of medical devices and machines that require delivery and upkeep, creating a significant market for logistics in healthcare alone. In fact, according to a recent report, the global healthcare asset management market is expected to reach 29.6 million dollars by 2020 (Paola, 2019).

Healthcare organisations are complex and challenging process organisations containing actions, structures that have demanding material and personnel flows in which logistics contribute greatly to the quality of the operations. Logistics plays an increasingly important role in healthcare, and it has become one of the largest cost factors for hospitals and other healthcare organisations (Kotonen, U., Tuaminen, U., Maksimianen, A. and Kuusisto, M., 2015:766). Healthcare organisations aim to serve the population when citizens need help with a health problem, which in logistics terms is to meet customer demand. From a logistics perspective patients pass different care functions, units, organisations and health facilities (Wiger, M., 2018:3).

Warehouse location supply chain network is an important factor determining efficiency and speed storage processes contribute to increasing the material flow rate. Also, shorter delivery lead times and increased stock holding units are important for product life (Singh and Chaudhary, 2018:334).

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Logistics is a costly set of processes and there are many factor that affect its cost. Logistics companies intend to lower their costs to be one step ahead of their competitors while they want to enhance their service quality. Therefore, they make most of their investments to lower their costs. In addition, storage operation plays an important role in reducing these costs. It is very important that companies can choose the warehouse site at the optimum level to reduce costs and ensure service sustainability. In the warehouse, the layout and the storage of the products are critical issues when talking about inventory management. The warehousing should be a competitive advantage rather than a problem in health institutions; the timings, the way of displaying the materials inside the warehouse, the reception of the products and its storage in the appropriate location should be thought to be the most efficient possible (Arantes, A., 2009:10).

Warehousing is one of the most critical functions in a supply chain as it accounts for 24 percent of logistics costs and has an important role in ensuring many value- added transactions and fast fulfillment of customer orders (Amjed and Harrison, 2013).

While there are many research projects conducted on healthcare logistics worldwide, the studies carried out in this respect in our country are almost nonexistent. Therefore, this study is intended to choose the best and optimal warehouse site among alternatives in line with 11 criteria set for an organization in the healthcare logistics industry. The criterion analysis made use of the opinions of experts. Additionally, the purpose of setting criteria is to enhance productivity while minimizing costs. These criteria are analyzed using the DEMATEL (The Decision Making Trial and Evaluation Laboratory) method. Accordingly, it is intended to eliminate any shortcomings in the literature.

2. Review of Literature

The study by Gul and Eren (2017) developed a model where the AHP (Analytic Hierarchy Process) method is used for the distribution network design that provides connection between warehouses and customers for the logistics distribution problem. To calculate the weighted values of warehouses, they determined seven different criteria and put the warehouses in order among themselves by using the AHP method. Using the ILOG CPLEX software, solutions were found for the set goals.

On the other hand, the study by Ozbek and Erol (2016) aimed to find a solution to the problem of decision making related to warehouse site. The study is intended to enhance service quality and reduce costs by designating the appropriate warehouse site. To that end, an integrated model that uses AHP, COPRAS (Complex Proportional Assessment) and MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) techniques is proposed. While the weighted criteria values are determined by AHP in the selection of warehouse site, decision options are put in order using COPRAS and MOORA methods.

The study by Ashrafzadeh et al. (2012) aimed to determine the alternatives of quantitative and qualitative criteria encountered in the selection of warehouse site in Iran. The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method is used to determine the criteria. Decision makers were used to determine the qualitative criteria. The proposed approach consists of 2 steps. The first step defines the criteria for selecting warehouse site. The second step is to identify potential alternatives to the criteria chosen by experts.

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The study revealed that the Fuzzy TOPSIS method can be used successfully in selecting the warehouse site.

As part of this work, Chan and Wang (2017) conducted studies on the selection of logistics centers for 16 cities of China. The purpose of the study is to optimize the logistics network and search for solutions to the urban traffic problem when selecting sites for logistics centers. The research discusses 6 major concepts that use ANN (Artificial Neural Network) and enhance the performance index. Following the study, a pairwise matrix was constructed in line with expert opinions. This matrix demonstrated that the satisfaction of customer demands through the right choice of distribution center led to a positive increase in economic and social benefits.

The purpose of the study conducted by Acar and Yurdakul (2013) is the improvement of the medical device and equipment used by the qualified healthcare team who are employed by health institutions as the primary source of the difference in quality and competitive edge. In this context, the study does not emphasize the handling of the inbound logistics process by a systematic approach regarding the purchase of devices and equipment that can be considered as a system in at health institutions, but also stresses the importance of integrated product sets. It was consequently demonstrated, through a theoretical understanding, that the inbound logistics process should be implemented by a systematic approach that is under the management responsibility of health institutions.

The study by Feibert et al. (2019) investigated the effects of logistics processes at a hospital on other health processes. The logistics processes of hospitals allow for the improved patient care and medical service processes. As part of the study, case studies were conducted on the hospitals in Denmark and the US. Decision-making criteria were set in an attempt to enhance performances. 17 criteria were set regarding the effect of logistics processes on healthcare services. The criteria set based on the study are intended to allow hospital managers to improve the healthcare services provided.

DEMATEL (Decision Making Trial and Evaluation Laboratory) method used in order to measure the sustainability performance of and the selection of suppliers on the sustainable supply chain of a company in the health sector in Istanbul. In the study, it has been tried to select the performance criteria that will increase the performance of the sustainable supply chain among the given criteria with the help of multi-criteria decision making method. As a result, delivery time, price, technology, service performance, flexibility have emerged as the primary criteria in supplier selection for the companies examined (Sarı, İ. U., & Ervural, B. Ç., & Bozat, S., 2017).

The aim of Yalnız and Candan studies is to reveal the financial and social factors, investment tool features and analysis methods that are effective in the process of evaluating the savings of individual investors in financial investment instruments. In the study, the relationship between options affecting investment sources was evaluated using the fuzzy DEMATEL method. The fuzzy DEMATEL method was used in the study and the opinions of 10 experts responsible for financial decisions were obtained. As a result of the analysis, it was seen that the most important factor for decision making by individual investors in line with the factors used in the study is the analysis techniques used in the selection of investment instruments.

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3. Methodology

DEMATEL is developed to guide the use of appropriate scientific research methods to improve the understanding of specific problematics and to contribute to the identification of the interlocked problem sets and the feasible solutions in a hierarchical structure. The graph theory based DEMATEL method allows us to divide the relevant factors used to understand the causal relationship better into cause and effect groups and to plan and solve problems in rough outline.

The key advantage of the DEMATEL method is that it encompasses indirect relationships that include a conciliatory cause-effect model. The DEMATEL method is an effective method that investigates the structure and relationships between system components or a valid number of alternatives. DEMATEL can arrange the criteria in order of priority regarding the type of relationships and the significance of their effect on each other. The criteria that are more effective on other criteria and assumed to be of high priority are called cause criteria, while those that are more affected and assumed to be of low priority are called effect criteria (Aksakal, E., & Dagdeviren, M. (2010)).

3.1. Methodology Steps

The DEMATEL method includes 7 steps. These are:

Step 1: Defining the Problem: As with any problem, the first phase of the DEMATEL method is to define the problem clearly after identification. Defining the problem is very important in terms of setting the criteria properly and making sure that there are no omissions. As it is the initial step, all results may be inaccurate in the event of an incomplete criterion resulting from an incorrect definition introduced at this point.

Step 2: Setting Criteria: As explained in step 1, it will be much easier clearly to set the criteria to be used in the solution once the problem is defined. In this phase, 11 different suitable criteria for the solution of the problem as explained below are selected among the suggested total 17 different criteria by 5 different experts' that they are the manufacturer of healthcare materials in Gebze and Eskisehir industrial zones. Under this reflection, the relations of the criteria are analyzed and identified in the most accurate way. Also, 6 of these 11 criteria are used in plenty of general warehouse location selection studies for all industrial applications. Beside that few studies have been found in the literature on health logistics or warehouse location selection and then these are briefly described in our literature section, especially those related to multi-criteria decision-making methods above.

Step 3: Developing the Direct Relation Matrix: In this phase, the relations between criteria are assessed by the decision-maker(s) to measure them. The assessment of the relations between criteria by the decision-makers is carried out by pairwise comparisons using the effect scale given in the table below.

Table 1: DEMATEL Pairwise Comparison Scale

Numerical Value	Description
0	No effect
1	Minor effect
2	Moderate effect
3	Major effect
4	Very major effect

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The process of assessing the severity of effect performed by decision-makers by verbal expressions and pairwise comparisons is considered equivalent numerical values when solving the problem.

$$D = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1j} & \cdots & d_{1n} \\ d_{21} & d_{22} & \cdots & d_{2j} & \cdots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ d_{i1} & d_{i2} & \cdots & d_{ij} & \cdots & d_{in} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{nj} & \cdots & d_{nn} \end{bmatrix}$$

The size of the X matrix will be n×n, since pairwise comparisons will be made between the n number of criteria.

Step 4: Normalizing the Direct Relation Matrix: The phase following the development of the direct relation matrix requires the performance of matrix normalization as in all Multi Criteria Decision Making methods. For this operation, the sum of row and column values of the matrix are calculated individually as given in the below(x) and the highest of these total values is used.

$$x = \max\left[\max_j\left(\sum_{i=1}^{n} d_{ij}\right), \max_i\left(\sum_{j=1}^{n} d_{ij}\right)\right]$$

Then, all the elements of the matrix are divided by this value as given in the equation, and a normalized direct relation matrix is obtained.

$$ND = x^{-1}D$$

Step 5: Developing the Total Relation Matrix: The total relation matrix is calculated as shown in the equation:

$$T = ND + ND^2 + \cdots\cdots + ND^k$$

$$T = ND(I + ND + ND^2 + \cdots\cdots + ND^{k-1})$$

$$T = ND(I + ND + ND^2 + \cdots\cdots + ND^{k-1})(I - ND)(I - ND)^{-1}$$

$$T = ND(I - ND)^{-1}$$

Step 6: Identifying Relations between Criteria: For relations between criteria, the sum of row and column values of the total relation matrix is calculated as shown in equation to identify which criterion is the one that is affected more than others and which criterion is the one that affect others more.

In this phase, the sum and differences of the c and r vectors are also calculated. The sum (c+r) serves to identify the importance of criteria. The difference (c-r) is used to identify the effect of criteria. If the result is (c-r) <0 for one criterion, it is found to have an effect on other criteria.

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$$c = [c_i]_{n\times 1} = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1}$$

$$r = [r_j]_{1\times n} = \left[\sum_{i=1}^{n} t_{ij}\right]_{1\times n}$$

Step 7: Establishing the Network Pattern: First, a threshold value should be determined to establish the network pattern using the total relation matrix. After the threshold value is determined, the cell values in the total relationship matrix that are equal to or above this threshold value indicate the relations between criteria and their direction. The threshold value should be a value determined by decision-makers. If decision-makers are unable to determine a threshold value, the average of the elements of the total relationship matrix can be calculated and determined as the threshold value. Decision-makers can increase or decrease this threshold value depending on the criteria relations intended to be included in the solution or on the sensitivity of the problem.

4. Application

Step 1: It is to choose the best and optimal alternative warehouse sites according to the criteria set for an organization in the healthcare logistics industry.

Step 2: The healthcare logistics industry has a wide range of criteria that affects the selection during the establishment of the warehouse. The most fundamental of these criteria are as follows according to the literature review;

C1: Access to Transportation Lines

C2: Proximity to Customers

C3: Integrated Environmental Conditions

C4: Tax/Incentive

C5: Accessibility to Workforce

C6: Inbound Shipment

C7: Legislative Regulations

C8 Structure and Cost of Land

C9: Proximity to Suppliers

C10: Infrastructure

C11: Proximity to Alternative Modes of Transportation

The 11 criteria listed in this regard are set as the most fundamental and required criteria for selecting the establishment site of a warehouse to be opened in the healthcare logistics industry as explained earlier.

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These criteria can be differentiated or increased in number in parallel with requirements. Instead, the criteria codes given at the beginning of each item will be used for convenience. Before proceeding to the step-by-step solution of the problem, let's look over these criteria;

(C1) Access to Transportation Lines: The ease of access to transportation lines provided by a warehouse is very important for both employees and products to reach the warehouse.

(C2) Proximity to Customers: This criterion is important for the goods leaving the warehouse to reach the customer quickly. Additionally, this proximity results in the decreased transportation cost. This criterion becomes more important in case of urgency.

(C3) Integrated Environmental Conditions: The pros and cons of the environment containing the land to be selected for the warehouse should be taken into consideration.

(C4) Tax/Incentive: The state adopts a range of taxation and incentive practices intended for some regions. The cost of a warehouse either increases or decreases depending on these taxation and incentive practices.

(C5) Accessibility to Workforce: This criterion is important for smoother employment of the people who will work in the warehouse.

(C6) Inbound Shipment: The products arriving at the warehouse should not have any problems during the entrance.

(C7) Legislative Regulations: To avoid legal mistakes in choosing the warehouse site, the legal regulations applicable to the region where the land is located should be considered before selection.

(C8) Structure and Cost of Land: This criterion is of great importance when considering costs, such as the sales price of a land to be searched and bought or the rent of a warehouse to be searched and rented. The structure and cost of the land will be reviewed under this criterion.

(C9) Proximity to Suppliers: Another important aspect of healthcare logistics is the distance between the supplier and the warehouse. This becomes more important in case of urgencies.

(C10) Infrastructure: This criterion is preferable in cases where the selected warehouse should not have infrastructure problems, such as electricity, water and natural gas.

(C11) Proximity to Alternative Modes of Transportation: Using alternative modes of transport rather than using a certain mode of transport at all times to reduce transport costs is important in terms of cost and speed.

Step 3: The direct relation matrix is given in Table.2 after the pairwise comparison of the criteria assessed by expert opinions.

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Table.2: Direct Relation Matrix

Site Selection Factors	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	MAX
C1	0	3.4	2.4	0.8	3.6	2,8	1.4	2.6	3.2	2.2	3.6	26
C2	3	0	1.4	0.8	2.2	2.2	0.8	2	1,8	2.0	2.6	18.8
C3	3	1.6	0	1.2	2.6	2.4	1.4	2.6	2.8	3.0	2.6	23.2
C4	1.4	1	0.6	0	0.8	1.2	3.4	2	0.6	1	0.6	12.6
C5	2.8	1.8	1.8	1	0	1	1	1	1.8	1	1.6	14.8
C6	1.8	1.4	1.0	1.2	1.2	0	1.4	1.2	1.4	1.6	1.2	13.4
C7	1.4	1	1.2	2.6	1	1.6	0	1	1	1.2	1	13
C8	2.6	2	2.2	2.6	1.6	1	1.4	0	2	2.8	2.2	20.4
C9	3.8	2.4	2.2	1	2	1	1	2.4	0	1	3	19.8
C10	2.6	2	2.2	1.4	1.4	1.4	1.2	2.6	1.4	0	1.4	17.6
C11	3.6	2.8	1.8	1.2	2.6	1.4	1.2	2.4	3.4	1.8	0	22.2
MAX	26	19.4	16.8	13.8	19	16	14.2	19.8	19.4	17.6	19.8	26

Step 4: For normalization of the direct relation matrix, the sum of row and column values of the direct relation matrix should be calculated first. Then, the highest of these total values are found. These values are shown in Table.3.

Table. 3: Highest Total Values

	Row	Column
C1	26	26
C2	19.4	18.8
C3	16.8	23.2
C4	13.8	12.6
C5	19	14.8
C6	16	13.4
C7	14.2	13
C8	19.8	20.4
C9	19.4	19.8
C10	17.6	17.6
C11	19.8	22.2
Maximum	26	26

After finding maximum values, the normalized direct relation matrix is calculated by dividing the elements in the direct relation matrix by the maximum value. This matrix is shown in Table 4.

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Table.4: Normalized Direct Relation Matrix

Site Selection	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
C1	0.3435025	0.38381	0.31419	0.20426	0.386505585	0.31061	0.22	0.35168	0.37846	0.31166	0.39754
C2	0.3596997	0.20142	0.22408	0.16033	0.276070269	0.23896	0.1626	0.26776	0.26627	0.24735	0.29703
C3	0.4108737	0.2985	0.20807	0.20237	0.326940933	0.27668	0.2110	0.32777	0.33794	0.31587	0.33696
C4	0.2034724	0.15722	0.12845	0.08933	0.147684597	0.14438	0.2078	0.19069	0.14254	0.14632	0.14609
C5	0.3041468	0.22715	0.20393	0.14126	0.161350715	0.16906	0.1446	0.19702	0.22782	0.17954	0.22594
C6	0.2414055	0.18991	0.15723	0.13718	0.180477209	0.11284	0.1460	0.18163	0.18904	0.18035	0.18628
C7	0.2130163	0.16403	0.1532	0.18069	0.161639794	0.16287	0.0934	0.16509	0.16317	0.15754	0.16619
C8	0.3592324	0.28124	0.25944	0.23166	0.264359023	0.20776	0.1961	0.20996	0.28065	0.28424	0.29263
C9	0.4078323	0.30382	0.2655	0.17755	0.288669721	0.21314	0.1802	0.29843	0.22087	0.22986	0.33053
C10	0.3277185	0.25704	0.239	0.17517	0.234663574	0.20234	0.17	0.27585	0.23742	0.16681	0.24292
C11	0.4250214	0.33445	0.26834	0.19642	0.32440818	0.23996	0.1992	0.31594	0.35354	0.27042	0.24445

Step 5: The total relation matrix is calculated using the normalized direct relation matrix given in Table.4. The total relation matrix obtained by calculations is given in Table.5.

Table.5 Total Relation Matrix

Site Selection Factors	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
C1	0	0.13077	0.09231	0.03077	0.138461538	0.10769	0.05385	0.1	0.12308	0.08462	0.13846
C2	0.11538462	0	0.05385	0.03077	0.084615385	0.08462	0.03077	0.07692	0.06923	0.07692	0.1
C3	0.11538462	0.06154	0	0.04615	0.1	0.09231	0.05385	0.1	0.10769	0.11538	0.1
C4	0.05384615	0.03846	0.02308	0	0.030769231	0.04615	0.13077	0.07692	0.02308	0.03846	0.02308
C5	0.10769231	0.06923	0.06923	0.03846	0	0.03846	0.03846	0.03846	0.06923	0.03846	0.06154
C6	0.06923077	0.05385	0.03846	0.04615	0.046153846	0	0.05385	0.04615	0.05385	0.06154	0.04615
C7	0.05384615	0.03846	0.04615	0.1	0.038461538	0.06154	0	0.03846	0.03846	0.04615	0.03846
C8	0.1	0.07692	0.08462	0.1	0.061538462	0.03846	0.05385	0	0.07692	0.10769	0.08462
C9	0.14615385	0.09231	0.08462	0.03846	0.076923077	0.03846	0.03846	0.09231	0	0.03846	0.11538
C10	0.1	0.07692	0.08462	0.05385	0.053846154	0.05385	0.04615	0.1	0.05385	0	0.05385
C11	0.13846154	0.10769	0.06923	0.04615	0.1	0.05385	0.04615	0.09231	0.13077	0.06923	0

Step 6: After developing the total relation matrix, the sum of row and column values of the matrix is calculated to identify the relations and effects between the criteria. The total row values and total column values of the total relation matrix are given in Table.6 below as well as (c + r) and (c - r) values. The sum (c + r) is used to identify the importance of the criteria. These values are considered when putting the criteria in order of importance.

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Table.6 Relation between Criteria

Site Selection Factors	C	R	C+R	C-R
C1	3.59592	3.60781	7.20373	-0.0119
C2	2.79S6	2.70161	5.5002	0.09699
C3	2.42143	3.25306	5.67449	-0.8316
C4	1.89623	1.70404	3.60027	0.19219
C5	2.75277	2.1819	4.93467	0.57087
C6	2.2786	1.90243	4.18103	0.37618
C7	1.93743	1.78091	3.71834	0.15652
C8	2.78182	2.86735	5.64918	-0.0855
C9	2.79771	2.9165	5.71421	-0.1188
C10	2.48995	2.52924	5.0192	-0.0393
C11	2.86655	3.17218	6.03874	-0.3056

Step 7: The order of importance of criteria resulting from these data sets is shown in Table 7.

Table.7 Order of Importance of Criteria

Site Selection	C+R
C1	7.2037
C11	6.0387
C9	5.7142
C3	5.6744
C8	5.6491
C2	5.50
C10	5.01
C5	4.9346
C6	4.1810
C7	3.7183
C4	3.6002

5. Conclusion

Logistics is becoming gradually more important. As a result of this increase in importance, companies make investments or changes to minimize their costs. The greatest and most important part of logistics is transportation. Healthcare logistics is one of the important sub-branches of logistics in social and consumption-related aspects. This sub-branch of logistics is an invisible hero that enables the rescue and improvement of those in danger and at risk.

The expert opinions that are of indispensable importance were used subsequently, since this study aims to choose the best and optimal alternative warehouse sites according to the 11 criteria set for an organization in the healthcare logistics industry. For the analysis of these criteria, the DEMATEL (The Decision Making Trial and Evaluation Laboratory) method was used where our main goal was to enhance productivity while minimizing costs.

Based on the results of the DEMATEL analysis, the most influenced factors criterion for companies is C1 with a score of 7.20 considering the weighted values of criteria. This next most effective criterion is followed by C11 with a score of 6.03, then in order, C9 with a score of 5.71, C3 with a score of 5.67, C8 with a score of 5.64, C2 with a score of 5.50, C10 with a score of 5.01, C5 with a score of 4.93, C6 with a score of 4.18, C7 with a score of 3.71, and C4 with a score of 3.60, respectively, based on their importance level and scores.

The findings obtained show a great similarity in the general warehouse location selection in the literature but it is also separately observed that there is little difference between them. This proves us that our study is an accurate one in the selection of the warehouse location within criteria determination and the result is reached.

In our study, it was determined that the positive added value effects of the warehouse location selection which has a very important place in health logistics will provide especially to health institutions. In the light of this information, the health sector which goes through a rapid procurement process will gain the ability to choose the suitable locations for its own strategies in order to reach the warehouse where the products to be used in the shortest and most efficient way. Therefore,it will be an important guide in the literature the studies of health institutions that will start new working life.

Besides that study can be either used for effective criteria studies to be conducted in the coming years for the selection of warehouse, facility or factory sites or verified by a different Multi Criteria Decision Making method. If it is possible to increase the number of these criteria with some modifications as well as the number of expert opinions, the accuracy rate will be higher.

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