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Research Article

Using Multi-Criteria Decision Making Methods to Make Logistics Decisions in Sports Clubs

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ABSTRACT

Sports have evolved into a more professional and industrial sector in the last decades and the usage of analytical decision making methods in sports clubs has gained importance than ever. Decision makers in sports clubs have to make many decisions about their logistics activities. In sports clubs, decision making of transportation of a team to the games is a complex problem that needs to be solved carefully. In this study, a Multi-Criteria Decision Making method has been proposed to solve the transportation problem of sports clubs. This problem has not been addressed for sports clubs in the literature. In this study, a two-step method is proposed to solve the problem. Analytic Hierarchy Process (AHP) is used to determine the criteria weights and ELECTRE is used to order transportation alternatives from the best to the worst. To test the proposed method, a real-life case study is presented. In this real problem, the best transportation option among various alternatives such as outsourcing or buying large, medium or small sized buses for the senior team of a volleyball branch of a Turkish sports club is chosen. The criteria are determined as cost, comfort level, time and prestige. The case study revealed that the decision makers in the club should revise their logistics decisions as the best decision is to buy a large sized bus instead of outsourcing buses per game basis.

Keywords:

Multi-Criteria Decision Making (MCDM), Logistics, Sports Clubs, Analytic Hierarchy Process (AHP), ELECTRE

Çok Kriterli Karar Verme Yöntemleri Kullanarak Spor Kulüplerinde Lojistik Kararların Verilmesi

ÖZ

Son yıllarda, spor daha profesyonel ve endüstriyel bir sektör haline gelmiş ve spor kulüplerinde analitik karar verme yöntemlerinin kullanımı çok daha önemli hale gelmiştir. Spor kulüplerinde, takımın maçlara taşınmasına karar verilmesi dikkatle çözülmesi gereken karmaşık bir problemdir. Bu çalışmada, spor kulüplerinin maçlara ulaştırılması probleminin çözümü için bir çok kriterli karar verme yöntemi önerilmiştir. Bu problem, spor kulüpleri için literatürde daha önce ele alınmamıştır. Bu çalışmada, problemin çözümü için iki aşamalı bir yöntem önerilmiştir. Analitik Hiyerarşi Süreci kriterlerin ağırlıklarının belirlenmesinde kullanılmış ve ELECTRE de taşıma alternatiflerinin en iyiden en kötüye sıralanmasında kullanılmıştır. Önerilen yöntemi test etmek üzere, gerçek bir vaka çalışması sunulmuştur. Bu gerçek vaka çalışmasında, bir Türk spor kulübünün voleybol branşındaki üst yaş takımı için en iyi taşıma alternatifi büyük, orta boy veya küçük otobüslerin dış kaynak kullanımı veya satın alımı gibi bir çok alternatif arasından seçilmiştir. Kriterler maliyet, konfor düzeyi, zaman ve prestij olarak belirlenmiştir. Bu vaka çalışması, en iyi kararın otobüsleri maç başına kiralamak yerine büyük otobüs satın almak olması nedeniyle kulüpteki karar vericilerin lojistik kararlarını değiştirmelerinin gerektiğini ortaya çıkarmıştır.

Anahtar Kelimeler:

Çok Kriterli Karar Verme, Lojistik, Spor Kulüpleri, Analitik Hiyerarşi Süreci, ELECTRE

1. Introduction

With the increased effects of the globalization in the last decades, importance of the logistics for companies have been increased. Companies who want to have a competitive advantage in their industries, try to minimize their logistics costs while offering the same service quality. To reach this aim, the quality decisions on the logistics activities have become crucial. This situation leads the logistics decision making literature to grow and offer new gaps in different areas.

Decision making in sports clubs is an interesting new area. In the past, when sports clubs were running by non-professionals, decisions were made in a more amateur way. Also, directors of the clubs used to make decisions on a smaller number of topics compared to today's professional sports clubs. As sports becoming more professional and industrialized as a sector, decision types in sports clubs have become various. Therefore, one of the biggest problems in sports clubs is the decision about its logistics operations. Logistics operations are becoming more important for the sports clubs since they can create extra budget available to make improvements on the other areas in the club. This helps clubs to gain a significant competitive advantage against the other clubs. One aspect of this problem is to choose the most suitable transportation tools and their types and sizes for a sports club branch. This type of problem is considered as a multi-criteria decision making problem.

In this paper, we investigated a multi-criteria decision making problem that chooses the most suitable transportation option in a sports club. To the best of the knowledge of the authors, this problem has not been investigated in the literature. Although many multi-criteria decision making methods have been applied in logistics, it is the first time that a multi-criteria decision making method is applied to sports clubs for their logistics decisions. We proposed a two-step methodology using Analytic Hierarchy Process (AHP) and Electre to choose the best transportation option for a sports club branch. As a case study we applied our proposed method to a Turkish sports club and discussed the results.

This paper is organized as follows. In the Section 2, literature review about decision making in logistics and decision making in sports clubs is summarized. The problem is defined in Section 3. Used methods are explained in Section 4. Then, a case study is conducted using the real data to test the proposed model in Section 5. Lastly, conclusions are given in Section 6.

2. Literature Review

Sports industry has relations with the other sectors such as food, tourism, advertisement, health, entertainment and logistics sectors. The relation between logistics and sports clubs is a new research area. Sports industry's relation with the logistics sector is divided into two major topics: (1) sports event logistics and (2) sports club logistics (Devecioğlu, 2005). In this study, we focused on the sports club logistics.

With the globalization, sports industry has improved dramatically. As the increased number of fans watch games in stadiums and on the TV, world-wide companies have sponsored sports clubs and other companies increased their advertisement shares.

This dramatically increased the budgets of sports clubs. For example, in 1948, BBC was the first company to get the broadcasting rights of the Olympic Games, and paid \$ 30,000,000. In 2012, NBC company signed a deal to get the broadcasting rights only in United States of America and paid \$ 4,400,000,000. In 2003, sports industry had 3% of the whole global trade (Balci, 2003). These can be seen as a proof of how sports have improved as an industry.

In these circumstances, if a sports club wants to be successful, it should be run as a professional company. Similar to the fact that companies want to minimize the cost and maximize the profit, sports clubs also want to minimize the cost and maximize the success. As the importance of the logistics in the companies was well understood in the last decades, sports clubs realized the importance of the logistics. In the literature, Multi-Criteria Decision Making methods have been widely used in logistics management such as in supplier selection, fleet management, reverse logistics and choosing logistics center location. Multi-Criteria Decision Making method for a flexible reverse logistics approach has been proposed (Waddhwa, Madaan and Chan, 2009). A two-staged Multi-Criteria Decision Making method which includes MCDM-A and ELECTRE to solve a location problem has been proposed (Zak and Weglinski, 2014). A combined model of AHP and ANN (Artificial Neural Network) for choosing the intermodal freight logistics center has been proposed (Kayikci, 2010). A combined model of DEMATEL, ANP and TOPSIS to evaluate the green suppliers has been proposed (Büyüközkan and Çifçi, 2012). A method combining ANP (Analytic Network Process) and TOPSIS developed for supplier selection has been proposed (Önüt, Kara and Işık, 2009). A method using DEMATEL and ANP to indicate the interdependencies of vehicle fleet management indicators have been proposed (Vujanovic et al., 2012).

In the literature, decision making has always been a popular area for researchers. Decision making is the process of using decision making techniques to achieve specific goals by choosing the best alternative among a set of alternatives (Tzeng, 2011). Every decision making process end with a definite decision (Saaty, 2008). Organizations spend significant amount of money and time on decision making processes. "Cost", "time" and "quality" are the most important terms for the companies that want to protect their compatibility and the market share. A decision making activity should be completely objective. However, intuitive decisions are generally subjective and can be affected by some personal judgements and some tendencies according to Russell and Taylor (2003). To deal with this objectivity issue and make easier decisions on complex problems, Multi-Criteria Decision Making methods are used instead of single criterion decision making models.

For problems with a single criterion, decision making can be done easier than the ones with multiple criteria. Multi-Criteria Decision Making is much more complicated since the criteria are generally conflicting with each other (Tzeng, 2011). The aim of the Multi-Criteria decision making is to choose the best option among various alternatives using various criteria. In the literature, Multi-Criteria Decision Making is used to solve some problems of sports clubs. Multi-criteria Decision Making methods are mostly used for the performance measurement and evaluation of the players or the teams (Karaatlı, Ömürbek and Köse, 2014; Budak et al., 2017; Mavi, Mavi and Kiani, 2012; Dadelo et al., 2014) or the identification of relations between financial performance and sportive success of sports clubs (Çati, Es and Özevin, 2017; Pinnuck

and Potter, 2006; Ergul, 2010; Sakinc, Acikalin and Soyguden, 2017; Budak et al., 2017; Ergul, 2017).

Karaatli, Ömürbek and Köse (2014) studied the performance of the top six goal scorers in Turkish Super League in 2012-2013 season with TOPSIS and VIKOR methods. The results of the list of the goal scorers were different than the actual list of the goal scorers which is ordered by only the number of the goals. The second scorer player was on the third place in their list and the third player on the scorer list was on the second place in their list. Budak et al. (2017) proposed a Multi-Criteria model to choose the formation of a volleyball team based on the evaluation of the players for each position and find the optimal formation. Budak et al. (2017) used AHP to weigh the positions and skills in volleyball teams. As a result, they simplified the player selection according to the evaluation of the players for positions. Mavi and Mavi (2014) used AHP and TOPSIS to rank the German football clubs in Bundesliga according to player wages, coach wages, points, spectator attendances to the matches, stadium utilizations and total revenues of the team. Dadelo et al. (2014) used TOPSIS to evaluate the performances of basketball players based on the positions and find the optimal formation for the basketball teams.

Multi-Criteria Decision Making Methods have been used to understand the relation between the sportive successes of sports clubs and financial successes of corresponding companies. Çatı, Eş and Özevin (2017) worked on the relation between the financial performance on the stock market of the clubs and the sportive success by using Entropi and TOPSIS methods. Clubs were ordered by not only on their sportive success but also financial success. Success criteria are determined as cost of the transfers, value of the players, and income of the club, average attendance on the games, league points and UEFA (Union of European Football Associations) points. Results indicated that high values transfers affect the sportive success negatively. Also, average attendance affects the financial success and sportive success negatively and positively respectively. Pinnuck and Potter (2006) also studied the relation between sportive success and the financial success of Australian football clubs. They found a significant relationship between the marketing revenue and the sportive success. Ergul (2010) used TOPSIS to investigate the relationship between sportive success and financial success of sports clubs in Turkey and the results showed that there is no direct relationship. Sakinc et al. (2017) have also studied the relation between sportive success and financial success of the sports club in Europe by using TOPSIS method. The results supported the results of Ergul (2010) since they could not find a direct link between sportive success and financial success. Ergul (2017) investigated the relationship between the stock market changes in short periods of Turkish top teams and their wins and showed that there is a significant relationship.

Using Multi-Criteria Decision Making methods for the logistics activities of the sports clubs is a new topic in the literature. To the best of the knowledge of the authors, there has not been any study on Multi-Criteria Decision Making in logistics for sports clubs. In our study, AHP is used to determine the criteria weights and ELECTRE is used to find the best transportation alternative of sports clubs.

3. Problem Definition

Handling the transportation decisions of teams to travel game locations is an important problem for sports clubs. Although teams have an outside game on predetermined weekends in the fixture, the sports federation decides the exact date, time and venue in the weekdays just before the game weekend. This leads an uncertainty in decision making. Most clubs that compete in the higher divisions handle this problem by arranging sponsorship agreements with transportation companies. However, there are many sports clubs competing in the lower divisions and they are most likely not able to arrange a suitable sponsorship deals. Therefore, this problem is more serious for these lower division sports clubs.

Nevertheless, sports clubs have two main options to handle this problem. First option, owning a bus, gives the sports clubs full control on the usage of their assets. However, in a typical sports club, even in its single branch, there are more than one group, such as teams of different age groups. This option needs very complex and perfectly designed programming to avoid the possible clashes in the game schedules. Or alternatively, sports clubs need more buses to assign each team of a branch and this leads to a significant cost. Second option is to outsource transportation activities. This option can be further divided into the periods of the outsourcing such as renting a bus monthly or per game basis (match-to-match). Bus type is another point to be addressed. A bus can be small, medium or large sized. These options are listed in Table 1.

Alternative	Description
01	Outsource (Rent) a large-sized bus per game basis
02	Outsource (Rent) a medium-sized bus per game basis
03	Outsource (Rent) a small-sized bus per game basis
04	Outsource (Rent) a large-sized bus monthly
05	Outsource (Rent) a medium-sized bus monthly
06	Outsource (Rent) a small-sized bus monthly
07	Own a large-sized bus
08	Own a medium-sized bus
09	Own a small-sized bus

Table 1. Alternatives of sports club transportation decision problem

On the other hand, the alternatives are evaluated according to certain criteria. In this study, four criteria that affect the decision are determined as: (1) Cost, (2) Comfort Level, (3) Time and (4) Prestige. These criteria are identified by the interviews with the real sports clubs as explained in Section 5 in detail. Cost criterion can be defined as the financial effects of the decision. A bus can be bought or outsourced, and each type has different cost. This criterion is one of the main factors for most outsourcing decisions. Another criterion is Comfort Level, which is defined as the comfort of the staff and players during the trip to the games. Decision makers believe that this criterion psychologically affects the success of players and staff. Also, comfort level is affected by the size of the bus. Time criterion can be defined as the duration of a trip. For decision makers, reducing the time has a positive effect on players and staff because of reduced tiredness and increased stamina. Lastly, Prestige criterion is a psychological factor that gives a competitive advantage to the players. Decision makers believe that the players and staff become more motivated and determined if they believe that the club is more prestigious.

4. Methodology

In this paper, AHP is used to determine the criteria weights and ELECTRE I method is used to evaluate alternatives and choose the best one. Analytic Hierarchy Process (Saaty, 1972) is one of the most widely used Multi-Criteria Decision Making methods in the literature. AHP has been used in various areas such as sustainable and renewable energy (Singh and Nachtnebel, 2016), agriculture (Abdollahzadeh et al., 2016), health (Nguyen and Nahavandi, 2016), nuclear power (Erdoğan and Kaya, 2016).

AHP is also extensively used in logistics literature. Some of the application areas are location selection for logistics center (Atalay, Karakaş and Akça, 2017), logistics service provider selection (Falsini, Fondi and Schiraldi, 2012; Ecer, 2017; Gürcan et al., 2016), decision making of outsourcing logistics operations and decision making on reverse logistics (Bouzon et al., 2016). AHP is also used in the area of sports. For example, AHP was used in football player selection (Ozceylan, 2016), and sport sponsorship decision making (Lee and Rose, 2012).

ELECTRE I method has been introduced by Benayoun Raphael in 1966 (Benayoun, Roy and Sussman, 1966). ELECTRE I method's main aim is to find and select the best option (Milani, Shanian and El-Lahham, 2014).

5. Case Study

In the case study, the volleyball branch of Izmirspor – a local sports club in Izmir, Turkey – is used. The proposed model has been applied to choose the best transportation option of the senior team in volleyball branch in Izmirspor to the matches. First, alternatives and criteria are determined. Weights of the criteria are calculated by Analytic Hierarchy Process and an MS Excel sheet which is developed by Klaus D. Goepel (taken from <http://bpsmg.com>). The decision maker, a member of the board of the directors and responsible of management of the volleyball branch in this case, is asked to compare factors with each other with an interview, according to the Linear Scale which is shown in the Table 2. Linear Scale is used to compare the alternatives with each other according to the importance.

Importance Intensity	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate Importance	Experience and judgment strongly favor one activity over another
5	Strong Importance	Experience and judgement strongly favor one activity over another
7	Very Strong Importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme Importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate Values	When compromise is needed

Table 2. Linear Scale (T. L. Saaty 2008: 83)

Pairwise Comparison Matrix, showing the importances of the criteria over each other, is constructed as in Table 3.

	Cost	Comfort Level	Time	Prestige
Cost	1	3	1	5
Comfort Level	1/3	1	1	3
Time	1	1	1	3
Prestige	1/5	1/3	1/3	1

Table 3. Pairwise Comparison of Criteria

Then, values are summed up for each criterion and each cell values in the column are divided by the summed up values. For example, for cost column: $1+1/3+1+1/5=2.533$. Then each cell in the column is divided as follows $1/2.533=0.39$, $0.33/2.533=0.13$, $1/2.533=0.39$, $0.2/2.533=0.08$. The standardized decision matrix is shown in Table 4.

0.39	0.56	0.30	0.42
0.13	0.19	0.30	0.25
0.39	0.19	0.30	0.25
0.08	0.06	0.10	0.08

Table 4. Standardized Decision Matrix

After that, all the values are summed up for each line to calculate the total line values. For example for the cost line: $0.39 + 0.56 + 0.3 + 0.42 = 1.67$. Then total line values are summed up and each total line value is divided by the sum of the total line values and weights are calculated for each criterion. For example to calculate the cost weight: $\frac{1.67}{(1.67+0.87+1.13+0.32)} = \frac{1.67}{4} = 0.42$. Lastly consistency ratio is checked. The consistency ratio is 4.2%, which is acceptable as it is lower than 10%. The calculated criteria weights are given in Table 5.

Criteria	Weight
Cost	0.42
Comfort Level	0.21
Time	0.28
Prestige	0.08

Table 5. Criteria weights

"Cost" values are determined using internet and real data (for 2016-2017 season) from the club, Izmirspor. In 2016-2017 season Izmirspor outsourced a large sized bus match-to-match for the senior team and outsourced a small sized bus match-to-match for younger teams, such as U-16 and U-14 team. There are average of five games that the senior team plays in a month. The cost of outsourcing a bus match-to-match includes the external costs of driver and gas costs. Outsourcing a large bus match-to-match costs 6,000 TL (Turkish Liras) per game and 30,000 TL monthly, outsourcing a medium sized bus match-to-match costs 5,000 TL per game and 25,000 TL monthly. Outsourcing a small sized bus match-to-match costs 4,000 TL per game and 20,000 TL monthly. The options of outsourcing buses monthly have variable costs such as driver cost which equals to 2,000 TL per month and 0.6 TL per km. The buses are used 8,333 km per month (on average) and it equals to 5,000 TL per month approximately. Outsourcing a large sized bus monthly costs 20,000 TL. With variable costs, it equals to 27,000 TL per month. Outsourcing a medium sized bus monthly costs 18,000 TL. With variable costs, it equals to 25,000 TL per month. Outsourcing a small sized bus monthly costs 15,000 TL. With variable costs, it equals to 22,000 TL per month. When buying options are considered, lifetime of a bus is determined as 1,000,000 km by the bus companies and it equals to the usage of 120 months. A large sized bus costs 1,500,000 TL, medium sized bus costs 1,200,000 TL and small sized bus costs 900,000 TL. The monthly fixed costs are 12,500 TL, 10,000

TL and 7,500 TL, respectively. With the same variable costs of outsourcing monthly, the costs are equal to 19,500 TL, 17,000 TL and 14,500 TL, respectively. These cost values are summarized in Table 6.

Option	Monthly Cost
Outsource (Rent) a big-sized bus match-to match	17,500
Outsource (Rent) a medium-sized bus match-to-match	15,000
Outsource (Rent) a small-sized bus match-to-match	12,500
Outsource (Rent) a big-sized bus monthly	27,000
Outsource (Rent) a medium-sized bus monthly	24,500
Outsource (Rent) a small-sized bus monthly	22,000
Own a big-sized bus	19,500
Own a medium-sized bus	17,000
Own a small-sized bus	14,500

Table 6. Monthly costs of the options to the club

Values of the "Time" criterion are determined using Google Maps to calculate the distances between the match venues and the club headquarters according to the specifications of the buses and traffic laws in Turkey, times are calculated as approximately usage times of big-sized bus, medium-sized bus and small-sized bus and the values are 20 hours per month, 25 hours per month and 30 hours per month, respectively. In practice, travel times of small-sized buses are larger than big-sized buses.

To determine the Comfort Level and Prestige values, the decision maker to score the options from 1 to 5 for each Comfort Level and Prestige criterion. As for the comfort level, 1 is the option that has the lowest comfort level and 5 is the option that has the highest comfort level. For the prestige criterion, 1 is the least prestigious for the club and 5 is the most prestigious for the club. To calculate the values for decision matrix, cost and time factor values are calculated using the equation of $\frac{1}{\text{value}} \times 100,000$, for example, O1's Cost criterion decision matrix value is calculated as $\frac{1}{17,500} \times 100,000 = 5.714$. These values are multiplied by 100,000 to make the calculation easier. Decision matrix is given in Table 7.

	Cost	Comfort Level	Time	Prestige
O1	5.714	3	5.00	4
O2	6.666	2	4.00	3
O3	8.000	1	3.33	2
O4	3.703	3	5.00	4.5
O5	4.081	2	4.00	3.5
O6	4.545	1	3.33	2.5
O7	5.128	3	5.00	5
O8	5.882	2	4.00	4
O9	6.896	1	3.33	3

Table 7. Decision Matrix

Then, the standardized Decision Matrix is constructed. For example, option 1's comfort level value is standardized as $\frac{3}{\sqrt[2]{3^2+2^2+1^2+3^2+2^2+1^2+3^2+2^2+1^2}} = 0.463$. Standardized Decision Matrix is presented in Table 8.

	Cost	Comfort Level	Time	Prestige
O1	0.330	0.463	0.400	0.369
O2	0.385	0.309	0.320	0.276
O3	0.461	0.154	0.267	0.184
O4	0.214	0.463	0.400	0.415
O5	0.235	0.309	0.320	0.323
O6	0.262	0.154	0.267	0.230
O7	0.296	0.463	0.400	0.461
O8	0.339	0.309	0.320	0.369
O9	0.398	0.154	0.267	0.276

Table 8. Standardized Decision Matrix

The weighted standardized decision matrix is constructed by multiplying the weights with the values of the standardized decision matrix. For example, weighted standardized value of option 1's comfort level is calculated by multiplying weight of the comfort level (w_{cl}) = 0.21) with standardized comfort level value of option 1's (0.463). Calculation can be seen as $0.21 \times 0.463 = 0.097$. All weighted standardized values can be seen in Table 9.

	Cost	Comfort Level	Time	Prestige
O1	0.138	0.097	0.112	0.029
O2	0.161	0.065	0.090	0.022
O3	0.194	0.032	0.075	0.015
O4	0.090	0.097	0.112	0.033
O5	0.099	0.065	0.090	0.026
O6	0.110	0.032	0.075	0.018
O7	0.124	0.097	0.112	0.037
O8	0.142	0.065	0.090	0.029
O9	0.167	0.032	0.075	0.022

Table 9. Weighted Standardized Decision Matrix

Concordance and Discordance sets are calculated as the next step. To calculate the concordance of option 1 with option 2, option 1's weighted standardized values are checked if it is larger than or equal to option 2's weighted standardized values. Option 1's weighted standardized values of comfort level, time and prestige are larger than or equal to option 2's weighted standardized values.

Concordance values are calculated (Table 10) by summing the weights of the factors that has concordance. For example, option 1 has concordance with option 2 at the comfort level, time and prestige factors. These factors weights are added up to calculate O1's concordance with O2: $0.21 + 0.28 + 0.08 = 0.57$.

	O1	O2	O3	O4	O5	O6	O7	O8	O9
O1	-	0.57	0.57	0.91	0.99	0.99	0.91	0.57	0.57
O2	0.42	-	0.57	0.42	0.91	0.99	0.42	0.91	0.57
O3	0.42	0.42	-	0.42	0.42	0.91	0.42	0.42	0.91
O4	0.57	0.57	0.57	-	0.57	0.57	0.49	0.57	0.57
O5	0	0.57	0.57	0.42	-	0.57	0	0.49	0.57
O6	0	0	0.57	0.42	0.42	-	0	0	0.49
O7	0.57	0.57	0.57	0.99	0.99	0.99	-	0.57	0.57
O8	0.5	0.57	0.57	0.42	0.99	0.99	0.42	-	0.57
O9	0.42	0.5	0.57	0.42	0.42	0.99	0.42	0.42	-

Table 10. Concordance Table

To calculate discordance table, the largest difference of the weighted standardized values that has discordance divided by the largest difference of the weighted standardized values. For example, O1's discordance with the O2 is calculated as:

$$\frac{\max|(0.138-0.161)|}{\max|(0.138-0.161)(0.097-0.065)(0.112-0.090)(0.029-0.022)|} = \frac{0.023}{0.032} = 0.712.$$
 All discordance values are shown in Table 11.

	O1	O2	O3	O4	O5	O6	O7	O8	O9
O1	-	0.71	0.85	0.08	0.00	0.00	0.52	0.13	0.44
O2	1.00	-	1.00	0.45	0.06	0.00	0.87	0.39	0.17
O3	1.00	1.00	-	0.62	0.34	0.04	0.93	0.63	0.28
O4	1.00	1.00	1.00	-	0.28	0.31	1.00	1.00	1.00
O5	1.00	1.00	1.00	1.00	-	0.35	1.00	1.00	1.00
O6	1.00	1.00	1.00	1.00	1.00	-	1.00	1.00	1.00
O7	1.00	1.00	1.00	0.00	0.00	0.00	-	0.56	0.66
O8	1.00	1.00	1.00	0.61	0.00	0.00	1.00	-	0.76
O9	1.00	1.00	1.00	0.84	0.48	0.00	1.00	1.00	-

Table 11. Discordance Table

Next, the threshold values are determined. To calculate the concordance threshold value, all values of the concordance table are added up and divided by the multiplication of $n \times (n - 1)$:

$$\text{Concordance Threshold} = \frac{0.42+0.42+0.57+\dots+0.49+0.57+0.57}{9 \times 8} = \frac{40.21}{72} = 0.558$$

To calculate the discordance threshold value, similar calculations with concordance threshold value are made in the discordance table as:

$$\text{Discordance Threshold} = \frac{1+1+1+\dots+1+0.661+0.758}{9 \times 8} = \frac{49.47}{72} = 0.687$$

Values of the concordance table are checked if they are larger than or equal to the concordance threshold value. Similarly, values of the discordance table are checked according to the discordance threshold. Then, concordance superiority matrix is constructed with the values that are larger than concordance threshold value as in Table 12.

	O1	O2	O3	O4	O5	O6	O7	O8	O9
O1	-	1	1	1	1	1	1	1	1
O2	0	-	1	0	1	1	0	1	1
O3	0	0	-	0	0	1	0	0	1
O4	1	1	1	-	1	1	0	1	1
O5	0	1	1	0	-	1	0	0	1
O6	0	0	1	0	0	-	0	0	0
O7	1	1	1	1	1	1	-	1	1
O8	0	1	1	0	1	1	0	-	1
O9	0	0	1	0	0	1	0	0	-

Table 12. Concordance Superiority Matrix

Values in the discordance table are checked if they are larger than or equal to discordance threshold value to construct discordance superiority matrix (Table 13).

	O1	O2	O3	O4	O5	O6	O7	O8	O9
O1	-	1	1	0	0	0	0	0	0
O2	0	-	1	0	0	0	1	0	0
O3	0	0	-	0	0	0	1	0	0
O4	0	0	0	-	0	0	1	1	1
O5	0	0	0	0	-	0	1	1	1
O6	0	0	0	0	0	-	1	1	1
O7	0	0	0	1	1	1	-	0	0
O8	0	0	0	1	1	1	0	-	1
O9	0	0	0	0	1	1	0	0	-

Table 13. Discordance Superiority Matrix

Then, Total Superiority Matrix is determined by multiplying the values of Concordance Superiority Matrix and Discordance Superiority Matrix. For example, to calculate the total superiority value of O1 against O2, O1's concordance superiority value is multiplied by the O1's discordance superiority value against O2 ($1 \times 1 = 1$). Total Superiority Matrix is given in Table 14.

	O1	O2	O3	O4	O5	O6	O7	O8	O9
O1	-	1	1	0	0	0	0	0	0
O2	0	-	1	0	0	0	0	0	0
O3	0	0	-	0	0	0	0	0	0
O4	0	0	0	-	0	0	0	1	1
O5	0	0	0	0	-	0	0	0	1
O6	0	0	0	0	0	-	0	0	0
O7	0	0	0	1	1	1	-	0	0
O8	0	0	0	0	1	1	0	-	1
O9	0	0	0	0	0	1	0	0	-

Table 14. Total Superiority Matrix

According to the total superiority matrix, options are ordered according to their number of their superiorities. An option with the superiority value of 1, means that the option has superiority against the other options. Superiority numbers of options can be seen in Table 15. According to the total superiority matrix, options are ordered from most preferable to less preferable as following:

$$O7 = O8 > O4 = O1 > O9 = O2 = O5 > O3 = O6$$

Option	How many superiorities does the option have against the other options?
O1	2
O2	1
O3	0
O4	2
O5	1
O6	0
O7	3
O8	3
O9	1

Table 15. Superiority Numbers of Options

It is obvious that O7 (buying a big-sized bus) and O8 (buying a medium-sized bus) are the best options to choose. O4 (outsourcing a big-sized bus monthly) and O1 (outsourcing a big-sized bus match-to-match) are also good options to consider.

6. Conclusions

The number of decision making problems in logistics have increased in the last decades. However, logistics management in sports clubs is a quite new issue and the importance of logistics decision making in sports clubs has increased in parallel to the increasing industrialization and professionalization level of sports. On the other hand, there are only a few studies about decision making in sports clubs.

Most sports clubs are semi-professional or amateur. With the industrialization of the sports, sports clubs should be run like companies. A sports club has a fixed budget for each year and tries to be successful within that budget. Similar to companies, they try to minimize the costs and maximize their success. There is a wide range of logistics problems that decision makers can face within the sports clubs. In this paper, an important problem of transportation of sports club is addressed. This problem is

complex because the uncertainty in the fixture which is determined by the federation. There are many criteria to make the decision and many different alternatives, such as buying or renting a bus for a time period or even renting a bus match-to-match. Also, there are different bus types.

To solve this problem, a two-step methodology is proposed in this study. It is basically a decision support system for the decision makers in the sports clubs to use Multi-Criteria Decision Making methods. In the first step of the method, Analytic Hierarchy Process is used to determine the criteria weights. In the second step, Electre is used to make the decision on how teams should be transported to the games. To the best of our knowledge, Analytic Hierarchy Process and Electre methods have not been used in logistics decision making in sports clubs.

In this paper, a real-life case study has been presented to test the proposed method. Data are taken from a real sports club, Izmirspor, which is located in Izmir, Turkey. The volleyball branch of the team is selected for the case. The alternatives for transportation are renting a bus match-to-match or monthly, or buying a bus for the volleyball branch. The decision maker of the club determined the criteria as cost, comfort level, time and prestige.

In real life, sports clubs in the lower divisions usually outsource buses match-to-match basis. The sports club that has been used in our case study, Izmirspor, also outsources buses match-to-match. In the case study, it has been shown that with the real-life data, buying a large sized bus or medium sized bus are the best options for Izmirspor. Outsourcing a large sized bus monthly or match-to-match are the next best options. As a result, this case study revealed that decision makers in the case study should revise their decisions and buy a big-sized bus.

As a practical issue, decision makers generally do not favor buying buses due to the possibility of change of decision makers in a sports club after an election. They simply avoid large investments and generally outsource buses match-to-match instead of buying them. However, in contrast to the current practice, this case study has shown that buying buses is a better alternative than outsourcing. Also, buying alternative can create an extra advantage as the buses can be used by different branches or by different teams in the same branch.

For the future work, this study will be extended to include more branches and different teams of the same branch to investigate the effects of the options. Also, fuzzy multi-criteria decision making will be used to address uncertainties in the decision making process.

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