American Journal of Theoretical and Applied Business
2017; 3(2): 23-30
http://www.sciencepublishinggroup.com/j/ajtab
doi: 10.11648/j.ajtab.20170302.12
ISSN: 2469-7834 (Print); ISSN: 2469-7842 (Online)

Application Multicriteria Decision Making Method to Determine the Placement of Power Distribution System

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To cite this article:
Gholamreza Jandaghi, Fatemeh Alah Akbari. Application Multicriteria Decision Making Method to Determine the Placement of Power Distribution System. *American Journal of Theoretical and Applied Business*. Vol. 3, No. 2, 2017, pp. 23-30.
doi: 10.11648/j.ajtab.20170302.12

Received: December 1, 2016; **Accepted**: May 15, 2017; **Published**: June 16, 2017

Abstract: Exploring the historical path of theories and placement models indicates the deployment in terms of effective criterions and useful approaches in various industries. The distribution of electricity is important because of different reasons and all the efforts are for the sake of decreasing casualties of this network and supplying customer needs. The following research tries to come up with a model for placement the electricity distributer posts and that only happens with the recognition of effective priorities. The following research has used measurement to collect data and samplings were executed with a non-accidental and judgmental method. After asking 11 experts the research detected six criterions and 28 subsets. These criterions are as follows: Technical, Economical, Exploitation, Executive Surveillance and Biological. In the beginning there was a dual comparison between the factors and the effectiveness of these factors was determined by AHP approach. Then with the assessment of all the nominated factors and performing a matrix, some of the Fuzzy TOPSIS were used. In the end the following model was executed by EXCEL and a factor has been determined as the final solution.

Keywords: Location Selection, Power Distribution System, Analytical Hierarchy Process, Fuzzy TOPSIS

1. History and Literature

The power industry is considered one of the most vital industries of a country. In the meantime, the electricity distribution networks are the confluence of electrical industry subscribers and the bugs of distribution system in the industry is considered all electricity industry problems from the perspective of consumers. Given that 53% of power industry investments relate to the distribution sector and the lack of proper design and planning system, and setting goals without projects control follow the cause of loss to national wealth, power loss, and dissatisfaction and pessimism of subscribers. Therefore, monitoring and evaluation are strongly felt in distributed systems. Generally the main goal of the design and development of electricity distribution networks is the respond to growing electricity consumption with maximum economic efficiency in a way that it does not violate the limitations of a system. Many elements in distribution networks that follow many decision variables have caused problems for designing and developing these networks (Roshan Milani, 2002).

Despite the importance of the subject, the most important challenge is the establishment of power distribution substations in optimal places which, in addition to reducing installation costs, it results in better coverage for subscribers in the region. Thus, the optimal locating of power distribution substations is one of the most important principles in order to increase their efficiency.

One of the important information that helps to achieve this goal is prioritizing candidate sites that are including greatest need to establish the power distribution substation. To achieve the target, it is required to choose a good place.

2. Locating

Studies about the locating have a long research history and are related to many different research areas, including research in operations, industrial engineering, geography, economics, computer science, mathematics, marketing, power engineering and urban planning (Cheng & Li, 2004). Also, various methods have been developed for this critical issue (Tsung-Yu, Chia-Lun, & Mei-Chyi, 2008). The basic methods that are used in locating are summarized as follows: (Kahraman, Ruan, & Doğan, 2003; Tsung-Yu et al., 2008).

a. Factors ranking (Chase & Aquilano, 1995).
b. Center of Gravity (Chase & Aquilano, 1995).
c. Method of Delphi analysis (Chase & Aquilano, 1995).
d. Analog procedure (Applebaum, 1968).
e. AHP (Badri, 1999).
f. Multiple regression analysis (Satani et al., 1998).
g. GIS (Zhang, Johnson, & Sutherland, 2011).
h. Artificial neural networks, mathematical programming techniques including dynamic programming (Canel, Khumawala, Law, & Loh, 2001).

Non-Linear Programming (Nanthavanij & Yenradee, 1999).

Integer programming (Melkote & Daskin, 2001).

Quadratic programming (Comley, 1995).

The first scientific approach with the locating was considered by mathematicians for centuries. For example, the locating of unit device, before the seventeenth century has been in the work of mathematicians. Of course, mathematicians in the past were not involved with locating problems independently. But, they attempted to resolve the problems of extreme functions (minimum or maximum functions) with this problem. Economists have suggested many theories in relation to locating economic units that in this study, we try to point out some of them.

Lanhart in 2002 has presented his theory that he has considered great importance to transportation. From Lanhart's point of view, the ideal spot to deploy the industry is the point in which the total transportation costs will be possible in minimal including raw materials, finished products and fuel sources. In his spatial analysis, he has used the locating triangle to locate. Alfred Weber (2191) has insisted on minimizing costs, which include transportation, labor and industrial aggregation in determining the location of an economic plan. Tred Plander in 2153 has focused on the relationship between the cost of transport and the distance as well as the difference of shipping rates in the locating issue.

Agust Loucg, in the year 2149 has considered the impact of demand on choosing the right location, and this was something that did not pay attention to it in the previous theories. According to Agust Loucg, the establishment at minimum cost does not necessarily mean in maximum profit. Instead, production units sell more and earn more, and they will be able to earn more profit. He said in his theory that each manufacturer is looking to expand its sphere of influence in the market (Mehrabi Koshki, 2003). From another point of view, we can divide locating theories of the second period into two categories: one category includes conditions that create facilities from two-dimensional continues space or any x and y. These issues are mainly studied as k-median location problem.

3. Decision Making

Decision-making is a process that involves choosing a way or method among two or more available methods. The decision means the conscious choice that allows the person to examine the specific behavior and attitude of the set, according to a given set of conditions, and then an option will be accepted and implemented. (Yurdakul & Ic, 2004)

Rarely, a person or organization decides on the basis of a benchmark. Most decisions are multi-criteria, and they were considered by managers since the Second World War and optimization problems, according to an objective function. While today, taking into account the criteria, more attention has been paid to optimization problems (Momeni, 2008). MCDM Models are divided into two categories of multi-objective decision making MADM and multi-attribute decision making MODM, so that, MODM models are used to design. However, MADM models are used in order to select the preferred option (Asgharpoor, 2010).

One of the most prominent multi-criteria decision-making approaches are analytic hierarchy process approach, which focuses on obtaining the relative weights of factors and the overall value of each option based on the weights. (Torfi, Farahani, & Rezapour, 2010) In comparison with other methods of multi-criteria decision, the AHP method is widely used in multi-criteria decision-making and in many other issues from the decision so successfully (Torfi et al., 2010.)

TOPSIS, other multi-criteria decision-based approach is the best option that has the shortest distance of the positive ideal solution (option) and the longest distance of the solution (option) of negative ideal. The positive ideal solution is solutions that maximizes profit criteria and minimize cost criteria and maximize negative ideal solution of cost criterion and minimizes the profit criterion. (Kelemenis & Askounis, 2010)

4. Research Methodology

In this study, to collect the required data, questionnaires and interviews were used. The number of interviews Group was 11 experts in the field of electricity and to prioritize places, in this study, and to avoid ambiguity caused by uncertainty in the decision, the triangular fuzzy numbers were used. With the use of GAHP method, the weighting was done and finally, by using a fuzzy TOPSIS ranking was done. The above study steps are as follows:

a. Identify the required criteria and weighting them by the Analytic Hierarchy Process
b. Enter the calculated weight with a Fuzzy Topsis method to prioritize locations for power distribution substation
c. Categories of candidate locations for construction of power distribution substation with the output of the Fuzzy Topsis method

5. Identify Needed Criteria

In the first stage, with library studies and literature available on the subject, criteria and sub-criteria affecting the ranking of candidate sites for the construction of power distribution substations were identified. The first stage questionnaire consists of three decent ranges; it is relatively good and is not suitable. Then by filling the first stage questionnaire that its example is available in Appendix 2 and interviewing with 11 experts of electricity in Qom, criteria and sub-criteria were chosen, which include (see Figure 1):

1. Criteria related to technical dimension (Akbari Foroud, Seifi, Golsaz Shirazi, & Asiaei, 2011; Mehrabi, Koshki, 2003)
2. Criteria related to the economic dimension (Akbari Foroud et al., 2011; Mehrabi Koshki, 2003)
3. Criteria related to the utilization factor (Roshan Milani, 2002)
4. Criteria related to the Monitoring – Executive dimension (Mehrabi Koshki, 2003; Roshan Milani, 2002)
5. Criteria related to the environmental dimension (Roshan Milani, 2002)
6. Criteria related to the computing

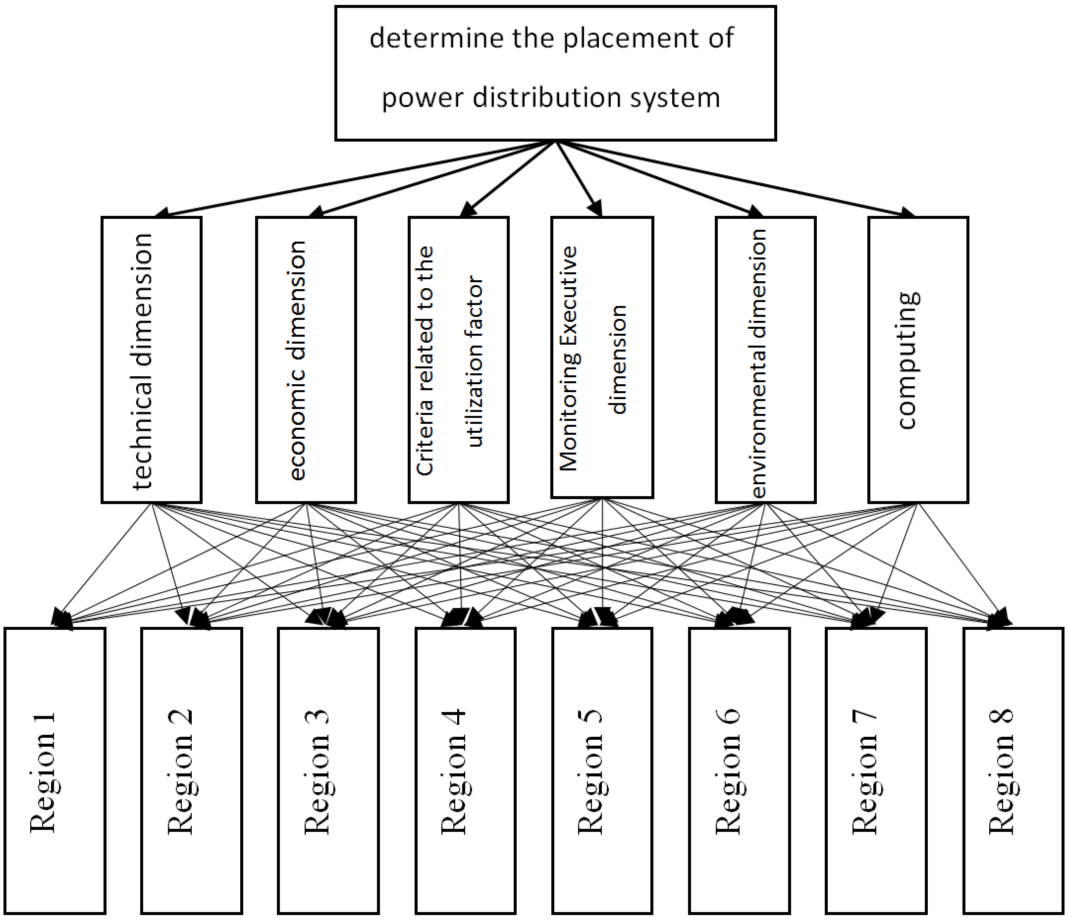

Figure 1. *Decision tree hierarchy locating.*

6. Weighting the Criteria of the Study

To weight the criteria for the study [1], the Analytic Hierarchy Process was used. AHP Process has been introduced and used for the first time by Tomas Saaty. This model is the method to decide and choose the best options, especially when there are several indicators and criteria for decision-making (Saaty, 1997). Analytical Hierarchy Process (AHP) is a logical framework that facilitates the understanding and analyzing the complex decisions by decomposing it into a hierarchical structure. (Mansor et al., 2006)

Group Analytical Hierarchy Process (GAHP)

Step 1. Calculate the weighted sum vector: multiply paired comparison matrix by the column vector "relative weight" and call the new vector, the weighted sum vector.

Step 2. Calculate Consistency vector: divide elements of the weighted sum vector by the relative priority vector. Vector is called Consistency vector.

Step 3. Obtaining λ_{max} gives the average elements of λ_{max} Consistency vector.

Step 4. Calculate the Consistency index=CI: Consistency index for the group AHP is defined as follows:

$$CI = \frac{\lambda_{max} - n}{n} \quad (1)$$

n is the number of options on an issue

Step 5. Calculate the ratio of consistency: consistency ratio is obtained by dividing the consistency index to random index=RI.

$$CR = \frac{C.I}{R.I} \quad (2)$$

1 Weighted sum Vector=WSV

The consistency ratio 0.1 or less expresses the consistency in comparisons; random index derived from the chart below (Azar& Rajabzadeh, 2002).

Prioritize sites for construction of fuzzy topsis power distribution substation

TOPSIS Method is broadly used in order to rank issues in real conditions. The major limitation of TOPSIS method is inability to solve vague and uncertain problems in the process of decision-making (Yu, 2002). In order to overcome this limitation, we can use fuzzy set theory with TOPSIS method that allows decision makers to determine qualitative, incomplete, non-obtainable information and detail facts with decision models. (Dağdeviren, Yavuz, & Kılınç, 2009; Kulak, Durmuşoğlu, Gumus, 2009& Kahraman, 2005) Thus, the fuzzy TOPSIS method is more appropriate and more effective than TOPSIS.

In general, algorithms for solving multi-criteria multi-index decision-making issues are provided below by fuzzy set approach.

a. The first step- Identify criteria to evaluate options, allocate appropriate linguistic variables for weighting the criteria and the allocation of points or the value of each option based on the criteria in the form of linguistic variables.
b. The second step- Constructing The Normalized Fuzzy Decision Matrix (NFDM)
c. The third step- Constructing The Weighted Normalized Fuzzy Decision Matrix (WNFDM)
d. The fourth step- Determine the positive ideal solution and fuzzy negative ideal solution
e. The fifth step- Calculate the distance of each option from the positive ideal solution and negative ideal solution
f. The sixth step- Calculate the proximity factor of each option
g. The seventh step- Ranking the options according to the calculated proximity factor
h. In the following, each of the above steps is described.

The first step- By using Group Analytical Hierarchy Process (GAHP) in the previous section, weight of each criterion has been achieved.

The second step: Create a Normalized Fuzzy Decision Matrix (NFDM)

According to a previous step, importance or weight of each criterion and ranking the options will be calculated based on each criterion as follows. (Chu, 2002)

$$x_{ij} = \frac{1}{k}(\times)\left[x_{ij}^{1}(+)x_{ij}^{2}(+)\dots(+)x_{ij}^{k}\right]; a_{ij} = \sum_{t=1}^{k} {a_{ij}^{t}}/{k}\,; b_{ij} = \sum_{t=1}^{k} {b_{ij}^{t}}/{k}\,; c_{ij} = \sum_{t=1}^{k} {a_{ij}^{t}}/{k} \tag{3}$$

$$w_{j} = \frac{1}{k}(\times)\left[w_{j}^{1}(+)w_{j}^{2}(+)\dots(+)w_{j}^{k}\right];\ e_{j} = \sum_{t=1}^{k} {e_{j}^{t}}/{k}\,; f_{j} = \sum_{t=1}^{k} {f_{j}^{t}}/{k}\,;\ g_{j} = \sum_{t=1}^{k} {g_{j}^{t}}/{k} \tag{4}$$

As mentioned above, A Fuzzy Multicriteria Group Decision-Making Problem can be briefly shown in the decision matrix below.

$$DM = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ . & . & \dots & . \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix};\ \widetilde{W} = \left[w_1, w_2, \dots, w_n\right]$$

In order to ensure compatibility between the mean of scores and the mean of weights, they must be normalized to become comparable scales. To avoid the complexity of the formula used for the classical TOPSIS normalization (Soft Euclidean), here the scale or soft line will be used to convert the scales on various criteria. As a result, normalized Fuzzy decision matrix (~ U) will be calculated (Chu, 2002). This matrix is calculated as follows.

$$c_j^{*} = Max\ _{i} c_{ij}, j \in B;$$

$$a_j^{-} = Min_i\ a_{ij}, j \in C \tag{5}$$

$$\widetilde{u_{ij}} = \left(\frac{a_{ij}}{c_j^{*}}, \frac{b_{ij}}{c_j^{*}}, \frac{c_{ij}}{c_j^{*}}\right), j \in B;$$

$$\widetilde{u_{ij}} = \left(\frac{a_j^{-}}{c_{ij}}, \frac{a_j^{-}}{b_{ij}}, \frac{a_j^{-}}{a_{ij}}\right), j \in C$$

According to the above-mentioned normalization method, the fuzzy triangular numbers range is limited to [1,0].

The third step: Create the weighted normalized fuzzy decision matrix (WNFDM)

According to the following equation, we can calculate the weighted normalized fuzzy decision matrix.

$$\tilde{V} = \tilde{U}(\times)\widetilde{W} \tag{6}$$

The fourth step: Determine the fuzzy positive ideal solution and negative ideal solution

We know v ij are normalized positive triangular fuzzy numbers and their range is in the closed range of [1,0]. Then fuzzy positive and negative ideal solutions include:

$$A^{*} = \left(\tilde{V}_1^{*}, \tilde{V}_2^{*}, \dots, \tilde{V}_n^{*}\right), \tilde{V}_j^{*} = (1, 1, 1) \tag{7}$$

$$A^{-} = \left(\tilde{V}_1^{-}, \tilde{V}_2^{-}, \dots, \tilde{V}_n^{-}\right), \tilde{V}_j^{-} = (0, 0, 0)$$

The fifth step: Calculate the distance of each option from the positive ideal solution and negative ideal solution.

The distance of options will be calculated from A^{*} and A^{-} as follows:

$$d_i^{*} = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^{*}), i = 1, \dots, m, \tag{8}$$

$$d_i^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^-), i = 1, \dots, m,$$

d_i^* is the distance of every option from a positive ideal solution and d_i^- is the distance of every option from a negative ideal solution.

The sixth step: Calculate the proximity factor for each option

The proximity factor is calculated based on d_i^- and d_i^* respectively as follows.

$$CC_i = \frac{d_i^-}{d_i^* + d_i^-}, A_i(\, i = 1,2, \dots, m) \quad (9)$$

The seventh step: Ranking the options, given the calculated proximity coefficient

It is clear that, if options A^* will be closer to A_i or the positive ideal solution and will be further from A^- or the negative ideal solution, the proximity coefficient cc_i will tend towards one. Then, based on the proximity coefficient, the rating of options can be done. In fact, the options that have more proximity coefficient, they will have higher rankings.

7. Evaluation Results

First phase: weighting the criteria by applying GAHP

Table 1. *Final weights of criteria.*

Cj		(W)
Criteria related to technical dimension	C1	0/163
Criteria related to the economic dimension	C2	0/252
Criteria related to the utilization factor	C3	0/174
Criteria related to the Monitoring Executive dimension	C4	0/082
Criteria related to the environmental dimension	C5	0/107
Criteria related to the computing	C6	0/223

A questionnaire was designed to determine the weighting of criteria and sub-criteria by using pairwise comparisons. Then, it was completed by interviewing 11 experts of power in Qom. Finally, by using Group Analytical Hierarchy Process (GAHP), final weights of criteria were obtained that are shown in Table 1.

8. Fitting FUZZY-TOPSIS Model

Before using, the indices of model will be defined:

According to the equations that were mentioned in the second and third sections, quantities composed of k decision-making (D_1, D_2... D_k) which are responsible for assessing the m options (A_1, A_2... A_m) based on the n criteria (C_1, C_2... C_n). Where 11= k is the number of decision-makers and evaluators and 8 = m is the number of candidate sites options as well as 6 = n is the number of factors and subjective and qualitative criteria.

In this section, the collected data were employed in the extended equations and the results of each step are shown in anatomical tables.

In the second part of the questionnaire, each time, the decision maker rates, according to a benchmark, to all the eight options, by using linguistic variables, in the following 7 ranges, where, VP is very poor with triangular fuzzy values (1, 0, 0), P is poor with triangular fuzzy values (3, 1, 0), MP is moderate poor with triangular fuzzy values (5, 3, 1), F is "fair" with triangular fuzzy values (7, 5, 3), MG is equivalent to "medium Good" with triangular fuzzy values (9, 7, 5), G is equivalent to "good" with triangular fuzzy values (01, 9, 7), and finally, the VG is equivalent to "very good" with triangular fuzzy values (10, 10, 9). Therefore, the second part of the questionnaire contains 29 tables (for each criterion a table).

After reviewing the questionnaires, the summarized comments of 11 decision makers are in Tables 1 and 2.

Table 2. *Fuzzy decision making matrix.*

Matrix decision	C1			C2			C3		
A1	3/000	4/455	6/091	3/091	4/727	6/636	5/273	7/091	8/545
A2	3/909	5/909	7/727	2/273	4/091	6/091	3/727	5/727	7/636
A3	4/636	6/455	8/000	3/455	5/091	6/818	3/636	5/273	6/909
A4	2/455	4/182	6/091	2/182	3/545	5/364	3/636	5/455	7/091
A5	2/818	4/273	6/091	2/273	3/909	5/636	3/364	4/909	6/545
A6	5/182	6/727	8/000	4/091	5/909	7/545	4/545	6/182	7/545
A7	4/273	6/000	7/636	3/636	5/455	7/182	4/818	6/455	7/818
A8	4/000	5/909	7/636	3/545	5/545	7/455	4/909	6/636	8/091

Table 2. *Continued.*

Matrix decision	C4			C5			C6		
A1	4/909	6/000	6/909	5/182	7/000	8/364	4/455	6/273	8/000
A2	4/818	6/364	7/727	3/636	5/455	7/091	4/545	6/182	7/636
A3	5/818	7/455	8/545	3/818	5/455	7/091	5/455	7/091	8/273
A4	4/727	6/091	7/273	6/000	7/455	8/364	3/818	5/455	7/182
A5	4/545	6/091	7/455	1/818	2/909	4/455	5/818	7/455	8/545
A6	4/818	6/182	7/273	4/182	5/818	7/273	6/545	8/091	9/000
A7	6/091	7/818	8/909	4/000	5/909	7/545	4/182	6/000	7/727
A8	5/545	7/000	8/182	4/000	5/636	7/091	5/455	7/182	8/545

The second step: Create a normalized fuzzy decision matrix

The calculation of this step has been performed according to equation 3 in this study and the results are shown in Table 3:

Table 3. *Normalized fuzzy decision matrix.*

normalized fuzzy decision matrix	C1			C2			C3		
A1	0/301	0/449	0/617	0/326	0/504	0/712	0/532	0/720	0/875
A2	0/397	0/601	0/787	0/237	0/436	0/657	0/378	0/587	0/788
A3	0/470	0/656	0/814	0/368	0/550	0/744	0/375	0/548	0/721
A4	0/248	0/423	0/617	0/230	0/378	0/577	0/367	0/551	0/720
A5	0/292	0/441	0/627	0/242	0/427	0/622	0/351	0/515	0/689
A6	0/528	0/687	0/818	0/429	0/627	0/813	0/458	0/630	0/775
A7	0/433	0/610	0/778	0/386	0/582	0/773	0/485	0/654	0/801
A8	0/408	0/603	0/780	0/377	0/599	0/811	0/503	0/683	0/837

Table 3. *Continued.*

normalized fuzzy decision matrix	C4			C5			C6		
A1	0/492	0/607	0/708	0/521	0/706	0/846	0/451	0/638	0/821
A2	0/485	0/641	0/784	0/367	0/551	0/717	0/458	0/630	0/784
A3	0/585	0/754	0/873	0/388	0/556	0/723	0/546	0/716	0/844
A4	0/476	0/618	0/746	0/603	0/751	0/844	0/382	0/549	0/731
A5	0/471	0/636	0/782	0/187	0/299	0/458	0/594	0/766	0/885
A6	0/483	0/621	0/736	0/424	0/592	0/741	0/660	0/820	0/921
A7	0/622	0/804	0/923	0/410	0/605	0/773	0/430	0/619	0/801
A8	0/560	0/711	0/839	0/406	0/574	0/723	0/551	0/729	0/875

The third step: Create weighted normalized fuzzy decision matrix (WNFDM)

The calculation of this step has been performed according to equation 66 in this study and the results are shown in Table 4:

Table 4. *Weighted normalized decision matrix.*

Weighted normalized decision matrix	C4			C5			C6		
A1	0/049	0/073	0/101	0/082	0/127	0/179	0/092	0/125	0/152
A2	0/065	0/098	0/128	0/060	0/110	0/165	0/066	0/102	0/137
A3	0/077	0/107	0/133	0/093	0/138	0/187	0/065	0/095	0/125
A4	0/040	0/069	0/101	0/058	0/095	0/145	0/064	0/096	0/125
A5	0/048	0/072	0/102	0/061	0/108	0/156	0/061	0/090	0/120
A6	0/086	0/112	0/133	0/108	0/158	0/205	0/080	0/109	0/135
A7	0/071	0/099	0/127	0/097	0/147	0/194	0/084	0/114	0/139
A8	0/066	0/098	0/127	0/095	0/151	0/204	0/087	0/119	0/145

Table 4. *Continued.*

Weighted normalized decision matrix	C4			C5			C6		
A1	0/040	0/050	0/058	0/056	0/076	0/091	0/100	0/142	0/183
A2	0/040	0/052	0/064	0/039	0/059	0/077	0/102	0/140	0/175
A3	0/048	0/062	0/071	0/042	0/059	0/077	0/122	0/160	0/188
A4	0/039	0/051	0/061	0/065	0/080	0/090	0/085	0/123	0/163
A5	0/039	0/052	0/064	0/020	0/032	0/049	0/132	0/171	0/197
A6	0/039	0/051	0/060	0/045	0/063	0/079	0/147	0/183	0/205
A7	0/051	0/066	0/075	0/044	0/065	0/083	0/096	0/138	0/179
A8	0/046	0/058	0/069	0/043	0/061	0/077	0/123	0/163	0/195

The fourth step: Determine the fuzzy positive ideal solution and negative ideal solution

The calculation of the positive ideal solution and negative ideal solutions will be:

$$A^{*} = \{(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1)\}$$

$$A^{-} = \{(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0)\}$$

The fifth step: Calculate the distance of each alternative from positive ideal solution and negative ideal solution

Table 5. *Options distance the ideal solution both positive and negative.*

Option	A^{+}	A^{-}
A1	5/411	0/617
A5	5/336	0/687
A3	5/386	0/641
A4	5/486	0/543
A5	5/478	0/550
A6	5/360	0/666
A7	5/380	0/646
A8	5/443	0/587

The sixth step: Calculate the proximity coefficient for each option

Table 6. *Positive and negative ideal interval options and proximity of these.*

Option	d_i^*	d_i^-	CCj
A1	5/408	0/594	0/099
A2	5/358	0/651	0/108
A3	5/384	0/625	0/104
A4	5/484	0/516	0/086
A5	5/475	0/513	0/086
A6	5/441	0/565	0/094
A7	5/378	0/627	0/104
A8	5/333	0/669	0/111

The seventh step: Ranking the options, given the calculated proximity coefficient

According to the calculated proximity coefficients in the previous step, for every 8 options and compare those, the ranking of the options are as follows:

$$\{A_5\} > \{A_4\} > \{A_2\} > \{A_1\} > \{A_3\} > \{A_7\} > \{A_8\} > \{A_6\}$$

What is certain, if the option will be closer to A^* or positive ideal solution, and will be further from A^- or negative ideal solution, the proximity coefficient will tend to one. In fact, the options with more value will have higher rankings.

Thus, the maximum amount, meaning 0.1 is characteristic of the solution. That is, among the eight options, the answer will be "Five as shown in table 7. In other words, we have:

Table 7. *The optimum location.*

Location candidate selection	Region	Option
Del Azar Blv	Five	A5

9. Discussion and Conclusion

More projects that have been done in the country on locating have been done either based on the MADM methods or shipping and goal programming model, or by use of GIS. Each of these methods has its own benefits. For example, the GIS method is an appropriate method due to the complexity of the urban fabric, but it is not able to apply all kinds of descriptive information appropriately in itself particularly qualitative factors. Shipping and goal programming models do not have much application, given the circumstances of this case.

Also, in this paper, it has been tried to use a method that both apply quantitative criteria and qualitative criteria appropriately. Moreover, in order to use the advantages and avoid disadvantages, the method of Fuzzy multi-attribute decision method has been used. Initially, to calculate weights, the AHP method was used and then, in order to rank the desired location, FTOPSIS method was used in combination, to select the optimal location. In fact, in this study, by using TOPSIS FUZZY method, candidate sites were ranked for the construction of power distribution substation according to known factors. Finally, the new integrated model could choose the best place of power distribution substation with checking all the criteria.

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