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A Courthouse site selection method using hesitant fuzzy linguistic term set: a case study for Turkey

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Abstract

The selection of location is generally one of the utmost significant and considered decision for future success of a courthouse building. However, site selection is an important decision and is influenced by numerous causes both quantitative and qualitative for a courthouse, yet the topic is not studied academically in Turkey. As a first study in its field in Turkey, there were no previously established criteria set for courthouse site evaluation, accordingly, the US courthouse site selection documents are handled as the most improved and available decision set for selection criteria. These criteria are adapted by an expert group for Turkish circumstances mainly under 6 headings. The key criteria taken into account in this study are, 1-required site area/site coverage, 2-site location adjacencies, 3-traffic and transportation, 4-site acquisition cost, 5-environmental impact and sustainability, 6-physical elements such as topography and hydrology. Under these main criteria some additional sub-criteria are also included because of the structure of the problem. Since these criteria tend to be inexact or ambiguous nature of the linguistic assessment of courthouse location selection problem, hesitant fuzzy approach is applied to gauge the weightings of these criteria. Then, courthouse location weighting model is established and a case study is applied with the officials of the Turkish Ministry of Justice for a newly planned courthouse in Ankara, Turkey for site selection decision. This paper demonstrates an application of hesitant multi-criteria fuzzy logic to an actual courthouse location selection problem.

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Keywords: Courthouse Site Selection; Hesitant Fuzzy Linguistic Term Set, Fuzzy Logic; Hierarchy; Multi-Criteria; Fuzzy Measure

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1. Introduction

Courthouses are one of the most significant civic buildings of a cityscape since they fulfil important functions in city life in Turkey. These buildings not only do assist essential missions, but they also contributes the formation of communal spaces. The courthouses in Turkey tend to be respected as national landmarks and a well-designed courthouse will definitely pay off its initial cost by improving environmental quality in cities. Similar to other big construction activities, location selection decision has an intense influence on practically all aspects of the design process of a courthouse project. The location of the building affects its functionality; operational efficiency; security and additional potentials of the facility since the decision directly influences the balance between the initial cost of the building, and the overall cost of the project. It is evident that the decision is highly important while achieving value for the environment and the city. While the initial cost may be a substantial motivator in Turkish case, all aspects must be considered in order to make the right decision within this process.

In this paper, a site selection criteria weighting method to evaluate the Courthouse site selection problem is addressed for Turkey. Since there were no previously established criteria for Turkey, the US courthouse site selection documents are handled as the most improved and available decision set for selection criteria[1]. The proposed criteria is based on the criteria set for the U.S. General Services Administration (GSA) suggests for similar purposes. However the criteria set is adjusted by an expert group of courthouse buildings for the Turkish case. Accordingly these criteria are adapted for Turkish circumstances mainly under 6 headings. The main criteria taken into account according to this study are, 1-required site area/site coverage, 2-site location adjacencies, 3-traffic and transportation, 4-site acquisition cost, 5-environmental Impact and sustainability, 6-physical elements (topography and hydrology). Under these main criteria and some additional sub-criteria are also included because of the structure of the problem. Later an expert group who are the members of Courthouse Buildings Technical Commission of Ministry of Justice of Turkey is evaluated the criteria from their point of view by using Hesitant Fuzzy Linguistic Term Set (HFLTS).

As in most types of the selection problems, any of the multi criteria decision making methods (MCDM) can be employed to solve this complicate decision problem. However, since in this topic decision maker could not decide superiorities of alternatives and criteria, using classical multi criteria decision making methods may not be consistent. In existing literature, site selection problem is handled with several MCDM methods. To illustrate, Hacioglu et al[2] selected appropriate locations for two air quality monitoring stations in an urban area in Turkey by using specific decision-making techniques. In their study AHP (Analytic Hierarchy Process) and ELECTRE (Elemination and Choice Translating Reality English) methods are employed. As another case in point, Erol et al[3] investigated a fuzzy MCDM context for pinpointing a nuclear power plant in Turkey. These researchers' tool that is used for the problem is based on 'fuzzy entropy' and 't norm based fuzzy compromise programming' to consider the ambiguity of human decisions. As a third example, Liu et al[4] used 'VIKOR'(Vise Kriterijumska Optimizacija I Kompromisno Resenje) method under fuzzy environment for site selection problem. However, there is no study exist currently which used HFLTS for deciphering site selection problem in literature. Since, an expert or decision maker may hesitate between different linguistic terms, they require richer expressions to fully express their knowledge, and by this means hesitant fuzzy linguistic model can be seen as a good alternative to evaluate such conditions. Hesitant Fuzzy Linguistic Term Set (HFLTS) permit decision makers to express their knowledge more properly and it is employed to increase profusion of linguistic excerpt grounded on the fuzzy linguistic approach. In this paper, the weightings of courthouse location selection criteria is congregated through an expert group survey study grounded on Hesitant Fuzzy Linguistic Term Set (HFLTS) and as a result, courthouse location selection criteria weighting is attained. The paper is organized as follows; after the introduction, in the second part steps of HFLTS algorithm in decision making is given, in the third part courthouse site selection problem using HFLTS is explained, and in the last part results of the study are discussed.

2. Steps of Algorithm of HFLTS in decision making

Decision making has been studied by using various multi-criteria decision making methods. Nonetheless, decision maker may hesitate between criteria, or alternatives about which is better. To use a richer expression to express the experts' knowledge, HFLTS is one of the best methods that has the potential. In recent years, there has