Chapter IX
Application of Fuzzy Analytic Network Process and Fuzzy TOPSIS to the Undesirable Location Selection Problem

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ABSTRACT

In this chapter, a combined fuzzy multiple criteria decision making (MCDM) methodology for supporting the undesirable location selection process is presented. The undesirable location selection process is formulated by using the fuzzy analytic network process (FANP), one of MCDM methods, which is used to evaluate the most suitable alternatives of undesirable facility locations. Then, the fuzzy TOPSIS (technique for order performance by similarity to ideal solution) is used to rank competing locations in terms of overall performances. Since different alternatives and various quantitative, qualitative, tangible, and intangible criteria should be considered in the selection process, fuzzy MCDM methods have been found to be a useful approach to solve this kind of location selection problems including vagueness and imprecision in the human judgments.

INTRODUCTION

The term facility involves that a particular establishment offers some kind of service to a certain group of customers. Hence, in the context of facility location, it can be argued that all facilities are necessary because of the service they provide. A facility location problem deals with the evaluation of the different kinds of points for taking into account different criteria. As technology and industrialization make our lives easier by offering new services or products, some of the facilities needed to produce these services or products may also create some byproducts that people do not find desirable. If a facility does not have any significant detrimental effects, it is usually referred to as a desirable facility; otherwise it is called an undesirable facility. For example, police stations, shopping centers, hospitals, or educational centers are facilities that people like nearby and all of these facilities are desirable to the nearby inhabitants. However, on the other hand, there are some other facilities such as nuclear reactors, garbage dump locations, chemical plants, power plants, landfills, military installations, and mega-airports that inhabitants prefer to be as far as possible and these kinds of facilities are undesirable for the surrounding population. Noxious and obnoxious facilities can be simply regarded as undesirable facilities. While noxious facilities, like nuclear reactors, involve a potential risk to public health, obnoxious facilities are less of a health risk. Despite these undesirable facilities being necessary to the community, the location of such facilities might cause a certain disagreement in the community. Such disagreement has become an opposition of people toward the installation of undesirable facilities close to them. However, most facilities cannot be considered as totally undesirable. Even if it creates some undesirable products, every facility is built to meet some need for people to maintain some standard of living. These kinds of facilities might be named as semidesirable, as those that provide valuable services to the community but at the same time cause inconveniences to the neighboring areas. For example, if a train station, an airport, or any other noisy facility is located too far from populated areas, the transportation costs to/from this semidesirable facility become heavy; on the other hand, if it is too close to populated areas, the noise and traffic density may cause important problems (Colebrook & Sicilia, 2007; Erkut & Neuman, 1989).

In recent years, environmental regulations and public opposition have increasingly forced new landfills to be allocated away from urban areas. The extra distance to these landfills has encouraged the development of regular solid waste storage locations and solid waste transfer stations. The obnoxious externalities of these storage and transfer locations (odor, noise, traffic, unsightliness) have increased public opposition. Selection of the appropriate undesirable facility location is a complex problem and requires an extensive evaluation process considering with the requirements of municipal, governmental, environmental regulations, and so forth. Inappropriate and inefficient selection causes several problems, such as social opposition, environmental problems, cost increases, and so forth. Selecting the undesirable facility locations is also one of the most complicated problems for local governments because of the availability of several potential locations for a certain type of facility in general. The determination and evaluation of positive and negative characteristics of one location relative to others is a difficult task. The increase in the popularity of using environmental design criteria in municipal planning has brought about the need to fully identify the principles to determine the best location of this kind of undesirable facilities. This environmental management issue has received considerable attention because of its applications in urban and rural infrastructure planning, industrial development planning as well as health, housing, transportation, and agricultural schemes. The planning and design of a regional