Chapter 15
Multi Criteria Decision Making Techniques in Urban Planning and Geology

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ABSTRACT

In this paper, Multi Criteria Decision Making (MCDM) processes will be clarified in the context of the disciplines related with the spatial information, as urban planning and its geographical perspective. For this purpose, first Spatial MCDM will be introduced, then the relation between the geographical data and GIS is established. Therefore, following sections include the detailed explanation of three widely used Spatial MCDM techniques, as Simple Additive Weighting (SAW), Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). These techniques will be clarified by giving examples related with urban planning and geological science.

INTRODUCTION

The rapid urbanization movement has been continuing in the whole world to reach the development goals. Today, there is lack of precautions in the long term, considering the consequences might appear in the future due to the rapid urbanization movement. Yet, the environmental, social and economic systems comprising the world have been deteriorating. In this regard, disciplines related with the geographical significance has been continuing to increase their significances. Urban planning and geological sciences, geological engineering as a related discipline, constitute the important part of the related disciplines, which have significance effects on the shape of the settlements, where the humankind lives. These disciplines have a vital role in controlling and directing the urbanization movements, by considering the public welfare (Chandio et al., 2012). These controlling and directing process in the rapid urbanization context require the conclusion of a great number of decision making process in its different stages.

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In the context of the disciplines related with the geographical context, for instance as urban planning, geology, geography, architecture etc., there are a great number of decision makers (*actors or stakeholders*) and alternatives exist in any decision making process. Examples related with the decision making processes in relation with the geographically related data could be the site selection of a new settlement or site selection of the hazardous waste area considering its geological suitability etc. (Rahman et al., 2012). Generally, these processes require the consideration of many evaluation criteria (*attributes*). Actually, rationally, almost all of the decisions are based on one or more criteria. The criteria could be defined as measurable attributes of the alternatives, which are evaluated to reach the final decision in the context of a decision rule. In some cases, decision making process might begin based on a single criterion; however, most of the decision making process relies upon more than one criterion (Eastman, 1999). Within the context of the evaluation process of these criteria, which are considered as inputs; value judgements of the decision makers are significant in the sense of the determination of the relative importance of each criterion. Assuming a certain criterion has different relative importance assigned by each decision maker; on the other hand, some certain criteria have the same importance (e.g. naturally protected areas). After the determination of the relative importance of each criterion, alternatives related with these criteria are developed. In the previous process, criteria were ranked, depending on the relative importance assigned by the decision makers. Hereby, alternatives are also ranked to a reach a specific, defined goal. As in the previous stage, namely the ranking of the criteria, the ranking of the alternatives depends on the subjective value judgements of the decision makers. Geographical Information System (GIS)-based SMCDM (*spatial multi criteria decision making*) enables decision makers to evaluate criteria, namely attributes having certain kinds of geographical characteristics, and conduct spatial analyses by using the related MCDM (*multi criteria decision making*) techniques and decide which geographically featured alternative is the best to reach the predefined goal. In the context of SMCDM processes, conventional techniques might cause the loss of data and this circumstance may mislead the decision makers to take appropriate decisions. Computer based GIS prevents the formation of this case and carry out the MCDM analysis by ignoring the loss of data.

In addition to these, GIS-based MCDM is an essential approach for the land suitability analyses conducted with regards to geographically related sciences. With this regard, vector data, including polygons, lines and points or raster cells are introduced as geographical units. Additionally, these geographical units compose the map layers, which are also called as the evaluation criteria in the sense of SMCDM. The core of the decision problem is consisted of the integration of the criterion maps and the relative importance of the attributes, namely criterion maps, assigned by the decision makers because relative importance of the attributes constitute the weights of those criteria. This subjective process, that is the weighting of the criteria, constitutes the distinctive characteristic of SMCDM. It could be argued that the ranking procedure related with SMCDM might differ depending on the different conditions because it constitute the subjective judgements of the decision makers and these subjective judgements generate the criteria weights, which are important in the sense of directing the final decision. The circumstances might differ in the case that the decision makers are consisted of a group of people who have different ideas that it is generally not possible to agree upon a single set of weights, but the range of weights that lead to the final decision (Chen et al., 2009).

So, problems related with MCDM are interested in the integration of the predefined criteria to generate a simple evaluation index. The usage of GIS-based MCDM is efficient in the case that there is wide range of multi-spatial, multi-temporal and multi-scale criteria. The usage of GIS enables decision makers

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