Water supply system decision making using multicriteria analysis

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Abstract

Sound decision-making processes for investments in water supply systems need to be developed. This need arises from the problem observed in developing countries of a growing demand for water supply projects coupled with a lack of financial resources available to invest in them. A second problem is the selection of a locality that is most in need of assistance for the implementation of the water supply system. This study describes the application of multicriteria decision aid for choosing the priority city to receive a water supply system, using the ELECTRE methodology. It was found that this type of methodology accommodates the decision-making in selecting a locality, with the capacity to integrate weighted qualitative judgment criteria, incorporating the concordance and discordance indices, specifying an efficient allocation of resources available and thus maximising gains.

Keywords: investment justification, multicriteria analysis, water supply

Introduction

Nowadays some basic factors contribute to the problems of managing urban water supply systems, for example, a shortage of resources available to develop the basic infrastructure at the same time as there is an increased demand for basic sanitation systems. Various municipal districts in developing countries exemplify this situation, where there is competition for scarce funds at the same time as an increased need for water provision, with a reduced quality of life because of the lack of water supply systems.

The question then is this: when there are limited resources available for basic sanitation projects, how can a decision be made as to which is the best city for an enterprise to invest in, using the funds available.

With respect to the question of water supply, the North-East Region of Brazil is a critical area, with all towns and cities in the region clamouring for full or partial improvement in the operation and maintenance of their existing systems or even do not have any kind of water supply system.

Those responsible for the planning and allocation of resources for the basic sanitation sector have their hands tied, because they do not have an appropriate decision-making model that can help them match the strategic plans of their companies to the needs of the region (Biswas et al., 1980).

According to Gough and Ward (1996), the major characteristics of environmental decision making, for example in the provision of water supply systems, are the existence of considerable uncertainty, the potential for decisions that lead to irreversible outcomes and the likelihood of multiple decision makers and multiple criteria. Under these circumstances, multicriteria decision analysis provides a way of structuring complex decision problems so as to enhance the process of improving the likelihood of positive outcomes. This paper deals with the allocation of resources for water supply applying the ELECTRE method in order to choose the city in which the project will be implemented, in agreement with specific criteria that are usually conflicting. This method can provide solutions to increasingly complex water supply management problems. While traditional single-criteria decision making is usually aimed at maximising the benefits while minimising the costs, this method provides a better understanding of the inherent features of the decision problem, promoting the role of participants in decision making processes, facilitating compromise and collective decisions and providing an adequate platform for understanding the perception of models and analysts within a realistic scenario. Moreover, this method assists in improving the quality of decisions by making them more explicit, rational and efficient.

Multicriteria decision aid

Decisions are part of people's day-by-day behaviour. This is quite a complex, although almost unperceived activity, in which possible actions, points of view and specific forms of evaluation are involved, in other words, a multiplicity of factors (Gomes et al., 2002). Nowadays the most common form of decision making is based on intuition, called intuitive judgment, when the components of the problem analysis are not considered in an organised way.

The relevance of the multicriteria decision-aid methodology stems from the fact that in most situations when people are making a decision, they do not have only one objective; instead, they need to take into consideration a number of different points of view. Towards this, multicriteria methods may be used to guide the analysis by specifying the criteria involved in the decision to suggest a priority of choices among the alternatives.

Multicriteria decision making (MCDM) is a branch of a general class of operations research models, which deals with decision problems when a number of decision criteria are present (Zeleny, 1982). There are several methods, which can be used according to the type of problem, such as choice-based, ranking-based and sorting-based. Mixed methods can also be applied. Each method has its own characteristics.

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