Facility location analysis

John Current

Ohio State University Columbus, OH, 43210-1399, U.S.A.

Facility location analysis has attracted the interest of researchers from the fields of economics, engineering, geography, logistics, management science/ operations research, marketing, mathematics, planning, and regional science among others. Over 2000 articles on the topic have appeared in academic journals [1,2]. However, relatively few of these have employed MCDM techniques (e.g. see [3] for a review of articles which propose multiobjective techniques for the generation of facility location alternatives).

The scarcity of MCDM approaches to facility location analysis is surprising given the multiobjective nature of most facility location decisions. For example, firms which employ just-in-time production strategies (or sell to those that do) must consider time and reliability as well as cost of delivery in designing their logistics systems. The location of production and distribution facilities clearly affects all three of these criteria. Location decisions also affect objectives related to market penetration (both existing and future) and access to labor markets and training opportunities to name just a few. In fact, location decisions may impact every functional area of business, each of which may bring its own criteria to the decision making process.

Facility location decisions frequently incur external environmental costs and benefits. For example, they may create pollution and traffic congestion, create jobs, influence property values and tax revenues. These impacts may be multiplied by one firmsŐ location decision influencing those of other firms.

These externalities are distributed spatially. That is, they affect some geographical areas more than others. As a consequence, they may be internalized to the firmŐs location decision via political decisions. For example, some facilities are prohibited at some locations (e.g., a nuclear power plant in a densely populated area, or a landfill in a political jurisdiction). Others are highly regulated at some locations (e.g., a night club must close at 2 P.M., or buildings may have height restrictions). Others are given incentives to locate in a political jurisdiction (e.g., tax rebates, or infrastructure improvements).

Firms typically view these ŇinternalizedÓ externalities as established costs or constraints. However, advantages exist for analyzing them within a MCDM framework. First, such an approach would provide the firm with information regarding the actual tradeoffs involved and thus be in a better bargaining position vis-a-vis the political jurisdiction involved. Secondly, such an analysis may give the firm a better understanding of its own opportunities. For example, a U.S. restaurant chain realized that its restaurant increased the real-estate value of adjacent land. It now internalizes this externality by purchasing more land than it needs and then sells the excess land after the restaurant is built. Profits from these sales typically exceed the cost of the restaurant. In addition, they control who their neighbors will be and prohibit competition from locating next to them. Most often, they sell the land to a motel without food service which increases sales at their restaurant.

Unfortunately, most location problems are difficult to solve optimally (i.e. NP-hard). Their combinatorial nature also means that there may exist a large number of noninferior solutions to multicriteria problems. Consequently, the generation of the entire noninferior solution set for such problems is impractical. Interactive MCDM methods can reduce the computation required to analyse these problems. The spatial nature of location problems permits solutions to be shown graphically via maps. Geographical Information Systems provide a mechanism to do this. Not only can GIS help decision makers interpret various solutions via visual displays, they are effective ways to manage the large amount of data typically involved in location decisions. For example, a video rental chain in the U.S. uses GIS to analyze demographic data to identify potential sites for outlets in new market areas.

Facility location decisions are often capital intensive and long-term in nature. Conditions which justify the cost and time required for extensive analysis. Given the data intensity, computational complexity, economic importance and inherent multiobjective nature of facility location decisions, it is my opinion that considerably more research should be devoted to the multiobjective analysis of these decisions and that this research should be directed to the development of GIS-based decision support systems that incorporate interactive MCDM techniques. I encourage you to submit papers on the multiobjective analysis of facility location problems for publication in Location Science.

References

[1] Domschke, W., and A. Drexl, ŇLocation and Layout PlanningÓ, Lecture Notes in Economics and Mathematical Systems 238, Springler-Verlag, Berlin, 1985.

[2] ŇAbstracts in Location AnalysisÓ, Published by the Ohio State University Departments of Management Science and Geography 1987-1992. In 1993 it became a regular feature of Location Science, Pergamon Press, Oxford, U.K.

[3] Current, J., H. Min and D. Schilling, ŇMultiobjective Analysis of Facility Location DecisionsÓ, European Journal of Operational Research 49, 295-307, 1990.