



Chapter XI

A Multi-Objective Model for Taiwan Notebook Computer Distribution Problem

Ling-Lang Tang
Yuan-Ze University, Taiwan

Yei-Chun Kuo
Vanung University, Taiwan

E. Stanley Lee
Kansas State University, USA

Abstract

A multi-objective model of global distribution for the Taiwan notebook computer industry is proposed. The proposed two-stage approach involves a mixed integer linear programming model and the fuzzy analytic hierarchy process (AHP) approach. The analytic method provides quantitative assessment of the relationships between manufacturers and customer service. To show the effectiveness of the proposed approach, a Taiwan notebook computer model is solved. The results of this multi-objective model show some dynamic characteristics among various performance criteria of the outbound logistics.

Research Background and Objective

Today's global economic environment is causing profound changes in how companies manage their operations and logistic activities. Empirical evidence suggests that vertical integration along the supply chain, modeled earlier by General Motors and Compaq, is not adequate. More and more companies are replacing vertical integration with vertical coordination and are developing long-term arrangements with outside suppliers. This phenomenon forces corporations to modify their logistics organization and invent fresh solutions; that is, alternative means of transportation, new sites for warehouses, or reallocation of inventory. In response to these infrastructure problems, companies must change their operating approaches by considering (1) increasing the procurement areas by implementing international sourcing policies, (2) pursuing wider geographical spread and greater mobility of production facilities, and (3) implementing worldwide distribution for marketing (Dornier, Ernst, Fender & Kouvelis, 1998).

Another aspect is the change in economic conditions on international trade. Taiwan, for example, had been a preferred site for offshore assembly in the semi-conductor and other assembly-required industries because of cheap labor. However, following local currency (NT) appreciation, labor was no longer cheap, and startup costs became much larger. As a result, industries moved the assembly function offshore, while Taiwan moved toward high-tech industries. In general, companies have three options for focusing their facility networks. These include focusing by market, by product, and by process. Successfully locating offshore also requires a commitment to strategic planning.

In order to carry out the above-mentioned changes and to obtain an efficient global network, the use of multi-objective optimization is ideally suited. The objectives of the logistic network are to meet the competitive priorities of the various products at various markets. Some of the priorities are cost, quality, service, and flexibility. These priorities often are incommensurate, both quantitatively and qualitatively, and carry different weights of importance. This leads to a complex problem of trade-off using the decision maker's utility or preference function. Reliable construction of a utility function, however, may be too complex, unrealistic, or impractical (Zeleny, 1982). Thus, the set of non-dominated solutions, which are not the optimum, are used frequently. To overcome this difficulty, a fuzzy set approach is used in this investigation.

In order to optimize this multi-objective global network and to help the CEO to balance between cost and customer service by selecting manufacturers, warehouse locations (Hubs), and customer assignments, we propose a combined multi-objective and fuzzy analytical hierarchy process (AHP) approach. In addition to the fuzzy aspects, the multi-objective optimization is carried out by the use of a mixed integer linear programming. The logistic problems of the computer industry and fuzzy AHP are discussed in the next two sections. The next section introduces the mathematical model, which is then used to model and to solve a typical problem; namely, a Taiwan notebook computer example in the second to last section. The final section discusses some conclusions and suggests areas for further research.

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