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NEW APPLICATOIN OF LOGISTICS PROCESSING

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Abstract: *The report analyzes the possibility of using analytic hierarchy process in logistics demand forecasting. It proposes a method to estimate parameters of the individual values of the analysis.*

Key wards: *logistics management, analytical hierarchy process, storage area.*

I. Introduction

Demand forecasting plays an important role in today's integrated logistics system. It provides valuable information for several logistics activities including purchasing, inventory management, and transportation. To minimize the total logistics cost, an accurate and reliable forecasting approach should be developed and adopted. In real-world situations, both quantitative and qualitative factors affecting the demand should be taken into consideration simultaneously. Since analytical hierarchy process has emerged as the promising methodology for dealing with a wide variety of decision - making problems, this chapter presents an analytical hierarchy process - based approach to analyze the priority rankings of all relevant factors to formulate a forecasting mathematical equation.

II. Exposition

Logistics management is sophisticated because it involves numerous complicated activities including customer service, demand forecasting, distribution management, information maintenance, inventory management, materials handling, order processing, packaging, purchasing, reverse logistics, transportation, warehousing, and so on. It is undoubted that these activities are interrelated. For instance, reducing the inventory of finished products will reduce the inventory carrying costs and warehousing costs, but may lead to stock-out as a result of reduced levels of customer service. Because of this relationship, logistics management can also be regarded as the administration of various activities in an integrated system [2].

Due to the presence of a wide variety of uncertainties in the realworld situations, however, the optimal inventory level is difficult to determine. One of these uncertainties is demand uncertainty, that is, the amount of finished products or services that customers will require at some point in the future is unknown. Demand forecasting, therefore, is a dominant attribute of the inventory management. Besides inventory management, demand forecasting provides valuable information for the purchasing and transportation problems, as illustrated in Figure 1. On the basis of forecasts, the decision-makers of the logistics companies can decide on the amount of raw materials to be purchased from the suppliers (i.e., the purchasing problem) to meet the production requirement, decide on the amount of work-in-process and finished products to be stored in the warehouses, and decide on the amount of finished products to be transported to the customers.

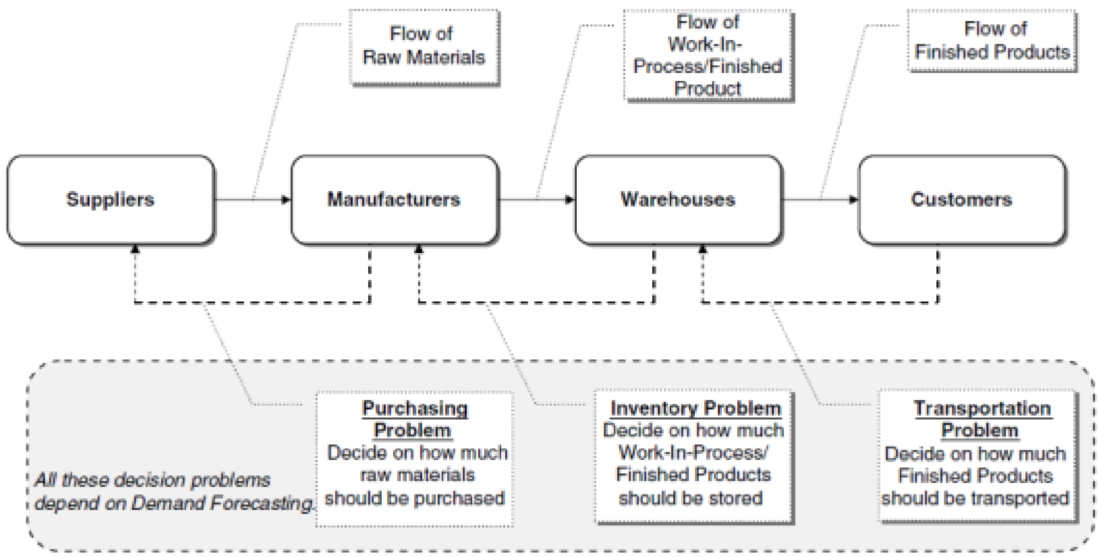

Figure 1.The role of demand forecasting in logistics supply chain management.

The analytical hierarchy process, is a theory of measurement for dealing with quantifiable and nonquantifiable criteria [5]. It can be applied to numerous areas such as performance measurement in higher education, and demand forecasting in logistics [4]. Since the analytical hierarchy process can provide a systematic framework for the decision-makers to interact and discuss about every factors relating to the decisions, it is selected as a tool to analyze the criteria affecting the demand, and most importantly, determine the demand growth in the future.

The analytical hierarchy process consists of three main operations including hierarchy construction, priority analysis, and consistency verification. First of all, the decision-makers need to break down a complex multiple criteria decision problem into its component parts of which every possible attributes are arranged into multiple hierarchical levels. For example, overall goal, criteria, attributes of each criterion are in the first, the second, and the third levels, respectively. After that, the decision-makers have to compare each cluster in the same level in a pairwise fashion basing on their own experience and knowledge. For instance, every two criteria in the second level are compared at each time whereas every two attributes of the same criteria in the third level are compared at a time. Since the comparisons are carried out through personal or say subjective judgments, some degree of inconsistency may occur. To guarantee that the judgments are consistent, the final operation called consistency verification, which is regarded as one of the most advantages of the analytical hierarchy process, is incorporated in order to measure the degree of consistency among the pairwise comparisons by computing the consistency ratio [1]. If it is found that the consistency ratio exceeds the limit, the decision-makers should review and revise the pairwise comparisons.

Once all pairwise comparisons are carried out in every level, and are proved to be consistent, the judgments can then be synthesized to find out the priority ranking of each criterion and its attributes. The overall procedure of the analytical hierarchy process is shown in figure 2.

After the dependent and independent variables are defined, and the historical data of all variables are obtained, a forecasting mathematical equation can be formulated. It is noted that the use of regression analysis for trend projection is a time-series method rather than a casual method. Consider the quantitative data of the m - independent variables in period t ($t = 1, 2, . . . , n$) is collected. The proposed forecasting mathematical equation can be constructed in (1). Besides, the mean absolute percentage error M method, formulated in (2), is used to evaluate the accuracy and performance of the multiple regression analysis.

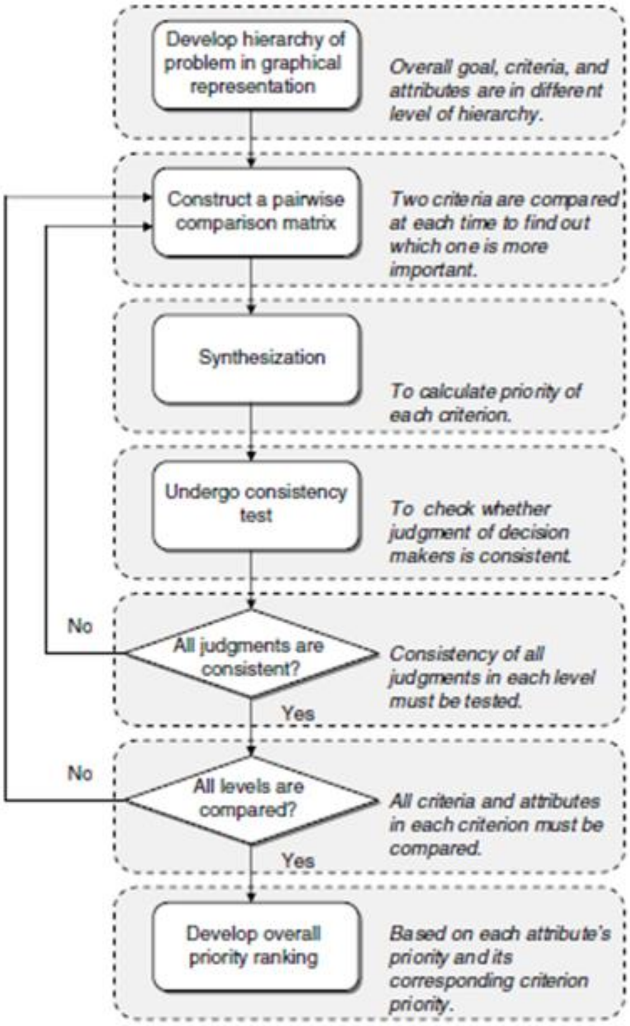

Figure 2. The algorithm of the analytical hierarchy process

$$F_t = c_0 + c_1 x_{1t} + c_2 x_{2t} + \dots + c_n x_{mt} \tag{1}$$

$$M = \frac{1}{n} \sum_{t=1}^{n} \frac{|F_t - A_t|}{A_t} \tag{2}$$

Where:

A_t - actual value of demand in period *t*;

F_t - forecasted value of demand in period *t*;

x_{it} - value of independent variable i in period *t* (*i = 1, 2, . . . , m*);

c_i - forecasted regression coefficients of independent variable *i*;

c_o - constant coefficient

The regression coefficients indicate the relative importance of the corresponding independent variable in forecasting the value of the dependent variable, and dominate the accuracy of the equation. To minimize the error of forecasted demand, the best sets of coefficients must be generated (fig 3).

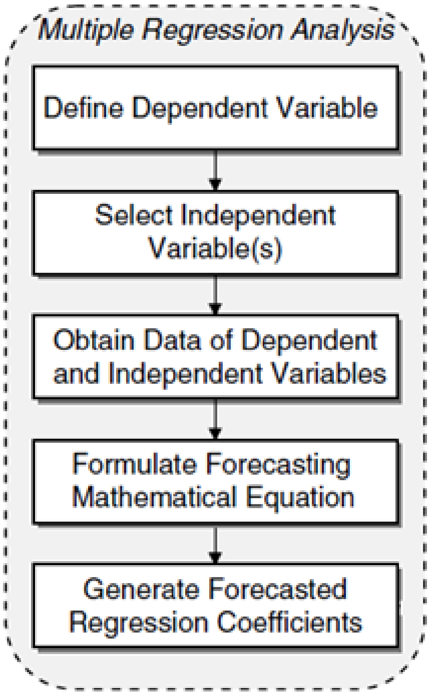

Figure 3. Multiple regression analysis

III. Conclusion

This design project illustrated again the following observations about strategic distribution system design. First, without modeling-based decision support, the configuration of a distribution system is essentially reduced to intuition or guesswork. Second through careful modeling-based sensitivity analysis a limited number of high-quality candidate configurations can be identified and submitted for final selection.

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