

## **Abstract**

This thesis is concerned with the modeling and analysis of supply chains in Indian manufacturing companies. The research work reported in this thesis has been carried out to address a few design and implementation-related critical issues in supply chain management. Specifically, the research has been directed towards (i) assessing the status and scope of supply chain management (SCM) practices in Indian manufacturing companies, (ii) development of a supplier selection methodology that can be applied to real-life situation, (iii) development of a supplier performance measurement and evaluation methodology, and verify the methodology so developed with a real-life case data, and (iv) development of a comprehensive performance measurement and evaluation methodology for supply chain.

Despite extensive research carried out in the area of SCM worldwide, the concepts of SCM have not yet been very well adopted in developing countries like India. An attempt has been made in this thesis, through an extensive survey conducted among Indian manufacturing companies, to assess the present status and scope of SCM practices. In this survey, the first of its kind in India, opinions from the Indian manufacturers from across the country, have been sought. A number of issues such as role of information technology (IT), area of IT applications, benefits of employing SCM, supply chain performance measures, issues hindering SCM practices, common barriers in SCM implementation, and government policies in SCM practices have been addressed in the context of Indian manufacturing companies. A detailed statistical analysis of the survey responses is presented in the thesis indicating usefulness of the survey results to the companies contemplating implementation of SCM practices in near future. The findings of the survey suggest several directions of research in SCM including outsourcing decisions or supplier selection, and determination of important performance measures for the development of a comprehensive performance measurement system. A criteria-based

status review of the Indian supply chain has been provided. The main objectives of this review in a given context are (i) to understand the current practices in the supply chains, and (ii) to measure and evaluate its performance from several relevant perspectives.

Increasingly, companies are allocating more resources to their core activities and encouraging the outsourcing of non-core ones, increasing their reliance and dependence on suppliers, and the importance of effective suppliers' selection and assessment. Supplier selection and performance evaluation is a multi-criteria decision problem, which includes both qualitative and quantitative factors. Selection of an appropriate supplier requires a methodology that simultaneously considers multiple factors, such as product factor, company factor, and service factor. In this thesis, an Analytic Hierarchic Process (AHP)-based methodology for evaluation and selection of the suppliers is proposed. The methodology is explained with the help of an illustrative example from a chemical plant wherein a large number of suppliers are evaluated and ranked based on the priority scores obtained.

In order to ensure the uninterrupted supply of items, the purchasing manager needs to evaluate suppliers' performance periodically. The evaluation process typically consists of identifying the attributes and factors relevant to the decision, and measuring the performance of a supplier by considering the relevant factors. Owing to the diverse and linguistic nature of supplier attributes, usually it needs to be categorized prior to assessment. Linguistic assessment of suppliers may be carried out based on several criteria, such as quality, delivery, service, and price. Because of the imprecise nature of linguistic attributes associated with suppliers, inconsistencies in human judgment are bound to affect the grading of supplier performance. To deal with these inconsistencies, a fuzzy-based approach is proposed to convert the suppliers' linguistic attributes into fuzzy numbers and suppliers' performance is assessed using a fuzzy system. In this thesis, an attempt has been made to evaluate the suppliers' performance by adopting an

evolutionary fuzzy system. One of the key considerations in designing the proposed system is the generation of fuzzy rules. A genetic algorithm (GA)-based methodology is developed to evolve the optimal set of fuzzy rule base, and a fuzzy inference system (FIS) of the MATLAB fuzzy logic toolbox is used to assess the suppliers' performance. The proposed methodology, illustrated with the data collected in a process plant, leads to the determination of the suppliers' performance. The methodology is first of its kind for supplier performance measurement and evaluation.

An important component in supply chain design and analysis is the establishment of an appropriate performance measurement and evaluation system. The purpose of such a system is to monitor and control the supply chain performance. In this thesis, a comprehensive supply chain performance measurement and evaluation (CSCPME) methodology has been developed. The critical performance measures reflect the five specific criteria, viz. effectiveness, efficiency, quality, productivity, and profitability. The performance measures are quantified based on the concept of utility function to convert the actual values of the variable to dimensionless values (known as Achievement Score) in a common reference scale. The performance of the five specific criteria is computed based on the equation developed for measurements. A trend analysis is used to evaluate the performance of these specific criteria over time. The developed CSCPME methodology may be applicable for the performance measurement and evaluation of almost all the entities of a supply chain. This methodology is a unique one as it computes the performance scores of the specific performance criteria of a supply chain in a common measurement unit.

*Key words: Supply Chain, Modelling, Supplier Selection, Analytic Hierarchic Process, Genetic Algorithm, Fuzzy Logic, Performance Measurement, Evaluation, Utility Function,*