ABSTRACT

In order to stay competitive, organizations are increasingly developing long-term relationships with a few but reliable suppliers for raw materials and MRO items and with third-party logistics providers for supporting services. This thesis addresses the two issues of: (1) how to rationalize the supplier base and (2) how to schedule and route a vehicle so as to maximize the utilization and minimize the travel time that involves a third party transporter.

We define the supplier base rationalization process to consist of: (1) determination of optimal size of supplier base, (2) selection of a method to be used for evaluation of suppliers, and (3) identification of the constituents of the supplier base. The problem of scheduling and routing is also decomposed into two sub-problem: (1) finding a subset of suppliers from whom items are to be collected and loaded on to the third-party's vehicle so as to maximize the vehicle's capacity utilization and (2) finding an optimal tour for the vehicle that starts its journey from the depot (the source), visits this subset of suppliers, loads items from them, and delivers them to the buying organization (the destination).

A mathematical model is formulated for the problem of determination of optimal size of supplier base considering major unforeseen events that cause supply disruption. Exhibiting the inadequacy of the popular decision-tree approach, we propose a simple, but elegant, method to solve the problem. The simplicity of the proposed method makes it amenable to spreadsheet and manual computations.

We recognize that most of the supplier evaluation methods do to consider the problem of measurement imprecision for qualitative criteria and compensates a bad score in some criteria by a good score in another. We propose a new non-compensatory method that uses fuzzy scores to capture expert's assessment of the relative importance of the criteria, the minimum buyer's requirement, and the performance of each supplier. Suppliers are evaluated based on the shortfall in performance from the buyer's minimum requirement.

Once the optimal number of suppliers in the supplier base to be retained is known and a supplier evaluation method is identified it is necessary to identify the suppliers who should constituents of this base. We propose a method for identifying suppliers from a list of potential suppliers. Categorizing the supplier evaluation factors as *performance* and *capability* factors, it uses the fuzzy supplier evaluation method developed for supplier evaluation to rank the suppliers separately on these two categories of factors. The supplier ranks are plotted in a *capability-performance matrix* to determine an order of preference based on which suppliers to be retained are identified.

For finding the suppliers who the vehicle should visit so as to maximize the utilization of the capacity, we propose the *exchange algorithm* for the solution of the problem. The mathematical formulation of the problem resembles that of the traditional subset sum problem. The *exchange algorithm* has a lower time complexity. Further, its quality of solutions is found to be superior to many currently available algorithms, when tested on a number of test problems given in the literature. The algorithm is also applied to maximize the utilization of the truck capacity for the aforementioned case of an integrated steel plant.

The problem of finding an optimal tour for minimizing the vehicle travel time, referred as TPRP, is closely related to the Traveling Salesman Problem (TSP). We have adapted some of the existing TSP algorithm for finding solution of the TPRP. A composite algorithm has also been proposed for the solution of the problem for finding the solution of the problem. The proposed algorithm adapts two commonly used solution approaches for TSP: the nearest neighborhood rule and the Karp and Thompson's induction method for generating the initial solution. When experimented on the test problems given in the TSPLIB website the proposed algorithm is shown to produce better quality of solution compared to the solutions produced by adaptation of TSP algorithms.