ABSTRACT

Transportation and distribution play a key role in the successful functioning of any logistical operation. Problems dealing with packing of vehicle containers and routing of these vehicles in an efficient manner pose a significant challenge in the area of Operations Research in particular and Management Science in general. In layman terms, container packing problem involves decision on the packing of the regular shaped finished goods inside identical regular shaped containers in an optimal manner under certain operational constraints. The main optimization considerations for vehicle routing problem are the size of the fleet and total operating cost (proportional to the total distance traveled) for each vehicle within capacity limitations and other realistic assumptions. This thesis mainly pertains to certain classes of two-dimensional Vector Packing Problem (2DVPP) and capacitated Vehicle Routing Problem (VRP).

To obtain fast good quality solutions for 2DVPP, three algorithms called Modified Next Fit for Vector Packing (MNFVP), Modified First Fit for Vector Packing (MFFVP) and Modified Best Fit for Vector Packing (MBFVP) have been proposed. These algorithms are simple, follow an intuitive analogy, and derive their inspiration from the popular Next Fit (NF), First Fit (FF) and Best Fit (BF) techniques for one-dimensional Bin Packing Problem (ODBPP). A balance between the individual capacity parameter utilization is attempted in each bin in order to avoid disparately filled (in an unbalanced manner) bins constrained on any one parameter. The results on a set of simulated problems establish the supremacy of these methods over classical schemes with identical complexity. We have also developed some new improved lower bounds that have produced near-optimal solutions to several instances.

A hybrid heuristic scheme called SWINGS based on the combination of geometrical properties of the locations and greedy arc selection is developed and implemented to get near-optimal solutions at a faster pace for the VRP. SWINGS has performed favorably on the efficiency and speed trade-off for a number of benchmark problems. The thesis also presents some observations on an optimal solution scheme through a graph-theoretic formulation to facilitate a Depth First Branch and Bound (DFBB) tree search.

A recent approach called Grouping Genetic Algorithm (GGA) has been successfully implemented for several combinatorial optimization problem with an objective to group the member objects into one or more *partitioning* of objects, where each object is present exactly in one partition. A GGA scheme for 2DVPP called GGAVP considering three distinct cost functions has been developed and implemented. The results on a set of simulated problems have shown that GGAVP markedly outperformed other classical algorithms for certain problem classes of data sets.

The final chapter of the thesis presents a real-life industrial case-study involving decision-making relating to transportation and inventory management. Conventional mathematical programming techniques and heuristics have been proposed to solve the problem.