SYNOPSIS

The practical importance of determining the efficiency of alternative ways for solving transportation problems is affirmed not only by the fact that a sizeable fraction of the linear programming literature has been devoted to these problems, but also by the fact that an even larger share of the many concrete industrial and military applications of linear programming deal with transportation problems. Transportation problems often occur as subproblems in a large problem (e.g., the travelling salesman problem, warehouse location problem). Moreover, industrial applications of transportation problems often contain thousands of variables and hence a streamlined algorithm is not only computationally worthwhile but a practical necessity. In addition, a number of linear programs that appear at first glance to be unrelated to the transportation problem can nevertheless be given a transportation problem formulation.
Much of the folklore concerning the computational difficulty of solving transportation problems rests on studies involving small problems which are solved by hand calculations. An exhaustive literatures exist for drawing valid inferences about algorithms by comparing their performances on different computers on different problems. The solid transportation problem, although started two decades earlier, has a very small literature devoted to it. Very few significant work on the computational development of solid transportation problem has been carried out so far. In the present study an in-depth computational and theoretical development of the solid transportation is presented. The thesis contains four major chapters.

In the beginning of the chapter 1, the two-indexed transportation problem together with its dual has been discussed. Different methods of initial feasible solution are reviewed and a general method of optimal solution is discussed. The theory of linear programming such as complementarity and dual feasibility help in establishing the optimality of the transportation problem. The recent methods of degeneracy resolution are reviewed. In
section 2, a three-index transportation problem is formulated. A comparison between the solid transportation problem and the two-index transportation problem is given. The necessary and sufficient conditions for the existence of optimal solution are established in the light of classical transportation problem. The methods of finding initial feasible solution of the classical transportation problem hold good in the solid transportation problem also. The nature of optimal solution is discussed. A computational procedure for the optimality test is given.

In chapter 2, the variants of the transportation problem are discussed. In the beginning, two-indexed transportation problem with mixed constraints is formulated. A theoretical development for the necessary and sufficient conditions for the existence of feasible solutions are given. An extended equivalent transportation problem is formulated. We have shown theoretically that the optimal table of the extended problem contains the optimal solution of original problem. A simple procedure is given to read off the optimal solution of the original problem from the optimal table of the extended problem. The section 2 of the present
chapter deals with the variants of the solid transportation problem. The various possible combinations of row constraints, column constraints and diagonal constraints are explicitly discussed. The nature of 351 solid transportation problems are discussed of which some are either (i) infeasible or (ii) are such that the problem can be solved by solving a related solid transportation problem. The related problem is obtained by adding at most three new constraints to the original problem. The solution of the original problem is found out from the optimal table of the related problem. Numerical examples are quoted for better understanding of the problem.

In chapter 3, a solution of solid transportation problem through Boolean procedures is developed. In the beginning of this chapter, mathematical background on Boolean methods are given. Boolean algebra, Boolean functions, expressions, equations, inequations, matrices and pseudo-Boolean functions are defined. The procedure for the solution of Boolean equations and inequations is given. Minimization of linear pseudo-Boolean function and nonlinear pseudo-Boolean function are discussed.
explicitly. In the second part, a Hungarian method for the solution of solid transportation problem in the light of Boolean techniques is developed.

The last chapter of the thesis is devoted to aggregation and disaggregation techniques for the solution of large dimension solid transportation problem. A large size original solid transportation problem is converted into an aggregated solid transportation problem using an arbitrary partition. The costs of aggregated solid transportation problem are formed as convex combination of the original solid transportation problem. We first solve aggregated solid transportation problem and from its solution, a feasible solution to the original solid transportation problem is recovered by simple transformation (disaggregation). This approximate solution is viewed as the end product of solving an aggregated solid transportation problem. Hence an appropriate measure of the loss in accuracy due to aggregation is the difference between the cost of this solution and the optimal objective value of the original solid transportation problem. Two types of bounds such as a priori bounds and a posteriori bounds are
discussed. A heuristic approach of grouping and regrouping the nodes is presented. In the second part, an improved disaggregation method for solid transportation problem is given.

Since nonlinear and discrete problems pose severe computational burdens, extension of the result to aggregation of such problems would be of great interest. The usefulness of the result will depend on efficient implementation of the mechanics of aggregation, disaggregation and the computation of the bounds. Perhaps, it should be said that, even with computational experience and good software, we don't envision universally appropriate procedure for aggregation. Rather, modellers will have to combine our results, other techniques and judgement to suit the problem at hand.