Chapter 6.8
Meta-Heuristic Approach to Solve Mixed Vehicle Routing Problem with Backhauls in Enterprise Information System of Service Industry

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ABSTRACT

This chapter presents the development of simulated annealing (SA) for a health care application which is modeled as Single Depot Vehicle routing problem called Mixed Vehicle Routing Problem with Backhauls (MVRPB), an extension of Vehicle Routing Problem with Backhauls (VRPB). This variant involves both delivery and pick-up customers and sequence of visiting the customers is mixed. The entire pick-up load should be taken back to depot. The latest rapid advancement of meta-heuristics has shown that it can be applied in practice if they are personified in packaged information technology (IT) solutions along with the combination of a Supply Chain Management (SCM) application integrated with an enterprise resource planning (ERP) resulted to this decision support tool. This chapter provides empirical proof in sustain of the hypothesis, that a population extension of SA with supportive transitions leads to a major increase of efficiency and solution quality for MVRPB if and only if the globally optimal solution is located close to the center of all local optimal solutions.

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INTRODUCTION

Supply chain management (SCM) processes can be classified in to two major categories: planning and execution. While planning supply chain investigates the processes related to forecasting material requirements, planning for production and distribution, and so on where as execution in supply chain focuses on the actual implementation of the supply chain plan, comprising processes such as production and stock control, warehouse management, transportation, and delivery (Ballou, 1978; Lambert et al., 1998). Both planning and execution are widely considered due to its critical impact on customer service, cost effectiveness, and, thus, competitiveness in increasingly demanding global markets. At the same time equal importance is to be given to the service sectors like food distribution, medicine distribution, blood distribution, etc.

Modern information technology (IT) and the development in software applications facilitate solving the problems related to the supply chain processes at all three decisional levels of SCM namely, strategic, tactical and operational levels. In the recent days transportation planning at the operational level received wide attention due to its complexity of the problem and normally comprises of linear programming based models. Their functionality is mainly found in most ERP systems. The operational level applications utilise mostly heuristic and meta-heuristic algorithms.

Most of the Logistics Management problems have been largely addressed as Vehicle Routing Problem (VRP) particularly in the context of manufacturing industries (Laporte and Osman 1995). Modeling and analyzing the service sectors is equally important in the optimization point of view and the benefit of serving human life as well. Blood bank management is a vital, life-saving activity with some appealing characteristics as far as logistics is concerned.

In general blood will be procured in large quantity from blood donation camps. A Central Blood Bank (CBB) governs the procurement, processing, storage and distribution of blood. Regional Blood Banks (RBB) facilitates in the functions of CBB. Thus logistics of blood bank consists of blood procurement, processing, cross matching, storage, distribution, recycling, pricing, quality control and outdating (Pierskalla, 1974; Cohen et al., 1979; Pierskalla and Roach, 1972; Perry, 1996). This chapter considers routing of CBBs, RBBs and blood donation camps, where as pickup occurs in blood donation camps (fresh blood) and also in the RBBs (unused blood), to be transferred to another RBB so as to meet the demand. The sequence of visiting RBB and blood donation camps is mixed. This problem fit in to the variant of VRP called Mixed Vehicle Routing Problem with Backhauls (MVRPB).

The remainder of the chapter is organized as follows: The motivation of problem is explained in Section 2. The structure of blood bank supply chain is described in Section 3. The literature survey for blood bank logistics is detailed in Section 4. Detailed literature of VRPB and MVRPB is provided in Section 5. MVRPB is explained in Section 6. The lower bound of MVRPB is proposed in Section 7. Simulated Annealing for MVRPB is explained in Section 8. The computational results are detailed in Section 9. Section 10 concludes the chapter.

MOTIVATION OF THE PROBLEM

In today's highly competitive and demanding environment, the pressure on both public and private organizations is to achieve a better way to deliver values to end customers. There has been a growing recognition that the two goals, cost reduction and customer service are achieved through logistics and SCM (Houlihan, 1988; New and Payne, 1995; New, 1997; and Hines *et al.*, 1998). Organizations have different strategies to manage various functions, based on their respective organizational circumstances. Though there are