

## Chapter 7

# Reverse Logistics Network Design Using a Hybrid Genetic Algorithm and Simulated Annealing Methodology

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### ABSTRACT

*Reverse logistics network design (RLND) effectiveness has an important impact on the effectiveness of the whole supply network coordination. Considering that, in this study, the RLND problem is investigated and a hybrid genetic algorithms and simulated annealing (HGASA) methodology is proposed. This problem is applied to a preceding study which utilized genetic algorithms (GA) for the optimization. HGASA and GA results are tested with Wilcoxon rank-sum test for hundred runs and the results prove the difference between two approaches. Additionally, the averages and the standard deviations support that, the HGASA algorithm increases the probability of obtaining better solutions.*

### INTRODUCTION

Supply network coordination is an essential requirement in modern industry (Germain et al., 2007). According to Malone and Crowston, coordination is the concept of managing dependencies between activities (Malone and Crowston, 1994). Shared resources, producer/consumer relationships, simultaneous constraints, and tasks/subtasks can be identified as dependencies between activities in the supply network (Germain et al., 2007). Coordination is particularly problematic when considering supply networks, as

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the scope of business processes exceeds the individual company's boundaries (Danesa et al., 2004). Considering the definition, Supply Chain Management (SCM) considers the holistic, process-oriented, cross company management and coordination of processes regarding material and product flows as well as complementary, initiating and accompanying information flows and the principles of SCM build on logistics and its key issues (Fritz and Hausen, 2009). Literature on SCM emphasises the importance of coordination and integration mechanisms to manage logistics processes successfully across supply networks (Xu et al., 2009).

In terms of supply chain efficiency, the network's ability to respond quickly and effectively to the customer requirements is a key factor differentiating competing companies. Technological advancements facilitate the way of meeting customer needs. Agility, quality, traceability, and service-ability depend on collaborative logistics networks that can focus on enhancing their performance by cooperative processes. Collaborative logistics networks are collections of supply chain partners designing and providing high quality and customized products (Miranda et al., 2009). To this end, electronic environment provides various important opportunities for the efficiency of supply networks. Communication over the internet, Electronic Data Interchange (EDI), internet based business-to-business, business-to-customer applications, e-logistics, e-commerce applications, e-fulfilment applications are the examples of the opportunities provided by electronic environment. Additionally, according to Daugherty et al. (2005), it is important that the resources to be focused on developing information technology capabilities and this is also reflective for the nature of the Reverse Logistics (RL). Information support-for authorizing, tracking, and handling returns-can positively impact both economic and service-related performance (Daugherty et al., 2005). It is important for companies to be able to physically handle returns-including activities such as stock selection, transportation, centralized collection, data collection, sortation, refurbishing or remanufacturing, and disposition. However, they must also develop data management capabilities, for example they should be able to integrate manufacturer and retailer data, create invoices, generate store credits, detail accounts receivable, and issue management reports. Finally, companies should also be able to strategically apply the gathered information to streamline internal processes and support supply chain-level planning (WERC Sheet, 2003; Daugherty et al., 2005).

As stated earlier, supporting processes of RL electronically is important; however, initial establishment of the RL network (RLN) is also crucial. It can be said that, one of the important parameters of the effectiveness of RL information systems is the design of RLN with the distances, possible connections and transportations between the nodes. With the proposed approach, it is aimed to initialize a suitable environment for the effective electronic SCM applications. Definition of return channels and destinations with an effective and flexible way may provide opportunities for more flexible, reliable, fast electronic SCM environments from the point of returns. Changes in the network inputs may be easily integrated into the model and also results of the changes may be quickly and reliably obtained for the electronic SCM environment with the help of proposed approach. Before explaining the proposed approach, it would be better to first explain the RL concept and related literature.

Due to the severe environmental problems, environmental initiatives, which are enforced by governments, customers or companies themselves, have become an obligation. As a part of environmentally conscious initiatives, reverse logistics has taken considerable attention both from academicians and practitioners. Rogers and Tibben-Lembke (1998) defined reverse logistics (RL) as "the process of planning, implementing and controlling the cost effective flow of row materials, in-process inventory, finished goods and related information from the point of origin for the purpose of recapturing value or proper disposal". Traditionally, the term of "logistics" is perceived only with the forward side of the

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