

Utilizing Prometheus Design Tool for Truck Load Consolidation Decisions

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ABSTRACT

Load consolidation decisions constitute one of the most important operational decisions in logistics. In demand-driven truckload shipment businesses, third-party logistics companies (or agencies) try to assign orders to the most appropriate trucks which are available for the load assignment. Efficiency and the effectiveness of the load consolidation decisions directly affect the success of any logistics operation. This is mainly because the utilization of the transportation vehicles directly affects the cost of transportation services provided. Agent-based concepts are considered as novel system approaches which have effective mechanisms for modeling dynamic systems like the truck load consolidation decisions within third party logistics operations. In this paper, truck load consolidation decisions are designed by utilizing Prometheus Design Tool (PDT) which is based on Prometheus design methodology and developed for specifying and designing agent-oriented software systems.

Keywords: Agent Based Modeling, Logistics, Prometheus Design Methodology, Prometheus Design Tool, Truck Load Consolidation

INTRODUCTION

In this age of global competition, effective business management has become vital for the organizations, especially after the mass customization has become globally widespread. Competitiveness has also increased business complexity. Present age of rigorous international competition and rapidly improving technologies and improving information

systems has also forced companies to use new business management techniques (Baykasoglu & Kaplanoglu, 2006). In order to be competitive, a company should be able to provide low cost, high quality services/products in a short lead time (Baykasoglu, 2003). The competitiveness has also affected the logistics operations of the companies. This is because the business complexities have brought complex logistics operations.

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The customers place their orders of varying sizes usually at random times (Fidanboy et al., 2005). And the types of the goods/services provided to customers are huge in numbers. As the variety of goods increased and their delivery time has radically decreased the effective management of logistics operations has become extremely difficult.

Logistics are becoming more and more important, because, the cost of logistics has a considerable proportion in the total cost of products. Physical distribution cost estimates range from 7.93% to 30% of sales (Davis, 1991). Logistics costs are very vulnerable to the distribution cost and the distribution costs have a direct link with the operations decisions. Distribution costs can be reduced by applying sophisticated management techniques. However, the negotiation between third party logistics (3PL) companies and the carriers might reduce the cost of transportation.

In order to reduce the cost of transportation, manufacturers, logistics agencies, and shippers are all in contact with each other. With freight rates and transportation services now negotiable between shippers and carriers, the result is an increasing freight rate differential between truckload (TL) and less-than-truckload (LTL) shipments (Jackson, 1981). The negotiation between the 3PL company and the carriers is performed in order to make any possible consolidation and any possible cost reduction.

As the Council of Logistics Management (CLM) survey reveals, one of the most promising ways of improving logistics productivity is to use freight consolidation (Kearney, 1984). Freight or load consolidation is a transportation option that combines different items, produced and used at different locations and different times, into single vehicle loads in order to minimize transportation costs and maximize vehicle utilization. Originally, the concept of freight consolidation was introduced to cope with the frequent, small shipments, namely less-than-truckload (LTL) shipments (Min & Cooper, 1990). Consolidation occurs whenever different items travel in the same load (Hall, 1987). The consolidation concept has been

known for hundreds of years and the practices are widely used in rail, ground, sea, and air transportation (Tyan, Wang, & Du, 2003). There are many benefits of load consolidation; it depends on both the company objectives and type of consolidation applied during the operations. Although load consolidation is beneficial its achievement is not straightforward. Min (1996) stated that consolidation options are diverse and very complex.

In real business cases of 3PL, the operations decisions are so complicated as a result of *ambiguity* in the demand of the transportation services, the *uncertainty* of solutions generated by the dispatchers, and the *interdependencies* among the parties in collaboration (Wang, Wang, Vogel, Kumar, & Chiu, 2009). Because the domain of transportation especially road based ones inherently distributed and complex, multi-agent systems are especially suitable for it (Dastani, Dix & Seghrouchni, 2004; Ying & Dayong, 2005). Earlier studies on this subject reveal that agent-based systems seem very suitable for the transportation domain, but this subject needs to be verified by more deployed system (Davidsson, Henesey, Ramstedt, Törnquist, & Wernstedt, 2005; Fox, Barbuceanu, & Teigen, 2000).

In this paper, truck load consolidation decisions are designed by utilizing Prometheus Design Tool (PDT) which is based on Prometheus design methodology and developed for specifying and designing agent-oriented software systems. The problem that is planned to solve with the proposed design is the clustering of the shipper orders within the containers while satisfying system limitations such as the pick-up time of the orders, delivery time of the orders, capacity constraints of the containers and etc. By doing so, the aim of the proposed multi-agent based load consolidation system is to reduce the total operations cost of the 3PL companies. With the proposed multi-agent based load consolidation model, the communication technologies are designed to be adapted to make a better load consolidation decision.

The present paper is structured as follows: in the following section, a literature review on

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