Simulation Study of Consolidated Transportation

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Abstract: Recently, in order to stay at predominance in the global infinity competition, most of c ompanies have been reducing the cost in many fields of industry. First of all, the reduction of the logistics cost have been recognized greatly as the company value rises. A rate of logistics cost ou t of GDP is still high compared with the competitors. The reduction of the transportation cost fro m overall logistics cost is most urgent subject. One of the methods to make a domestic transporta tion system efficient is the consolidation. In this paper, we try to compare the consolidated transp ortation model for a cost reduction with individual case. We also analyze the efficiency of consol idated transportation using simulation program with Arena of Rockwell Automation.

Key-Words: Consolidation, Simulation, Arena, Logistics, Transportation Cost, Network

1 Introduction

Many enterprises are focusing on minimizing the necessary costs for maintaining the status of struggling in existence, and logistics costs are one of main issues. The consolidated transportation has been assumed an efficient tool, even though 7.8% of domestic manufacturers conduct the consolidation. They are investigated that 87.4% of conductors report successful results. Still many adversities exist such as excess money of investments, conflicts of participants, spillage of confidential information etc.

This paper shows theoretic approach of consolidation compared with general distribution model. Especially, consolidated distribution center models are analysed for simulation model. We used Arena of Rockwell Software for the modeling, and investigated the effects and expectations by simulating relevant variables and parameters.

2 Related Literature

Pooley developed the modified vehicle routing algorithm for minimizing total transportation costs in TL(Truck Load) as well as LTL(Less than Truck Load) based on Clark and Wright's saving algorithm[1, 6]. Jackson surveyed 53 companies for freight consolidation, and analyzed the methodology of operations, structure of collecting transshipment and characteristics of cargo handling[3]. In addition assessment of logistics network was showed for reengineering by Cooper[2].

3 Proposed Model

Shipment consolidation is defined as the method of collecting LTL cargo and transporting TL cargo in order to enhance efficiency of costs. Each Manufacturer delivers LTL amount of consignments to distribution center and consolidation is conducted by mixing them considering their destinations. Our interest lies on how we can minimize transportation costs as well as keep promise their delivery time. The model decides type of vehicles and number of vehicles. Generally unit cost of large sized vehicle is less than

small sized. Therefore we first assign oversize trucks in terms of cargo volumes and weights. The proposed model is compared with individual distribution model for costs and efficiency.

3.1 Individual distribution model

We assume that each manufacturer supply single commodity to each customer. The number of Distribution to customer is one, and the quantity of transshipment is shown to be uniform distribution. The type of vehicle is four such as 2.5 ton, 5 ton, 8 ton, 18 ton. The upper loadage to allow on board has 10% tolerance. All types of vehicles have unlimited supplies. Total transportation cost is sum of all distribution cost from each manufacturer to customer. Fig. 1 shows the overview of individual distribution model.

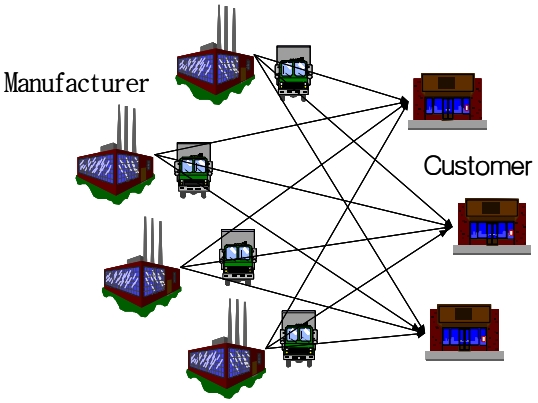

Fig. 1 Individual Distribution Model

3.2 Consolidation distribution model

Orders from customers are closed by one day before actual delivery, and manufacturer transports each shipment to distribution center once a day. Consolidations are conducted at distribution center for each customer. Considering the loadage of vehicles, we dispatch the vehicles to each route. The total transportation cost is sum of all distribution cost from each manufacturer to distribution center and sum from distribution center to customers. Fig. 2 shows the overview of consolidation distribution model.

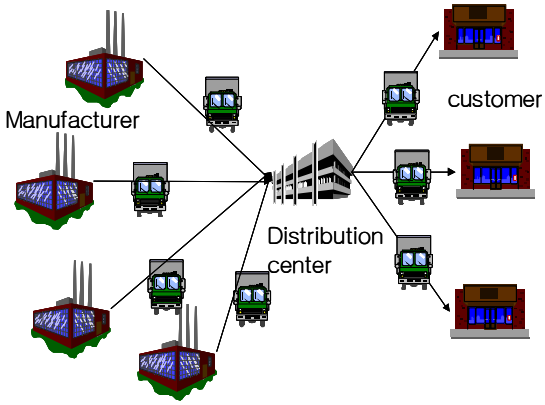

Fig. 2 Consolidation Distribution Model

4 SIMULATIONS

Our model is implemented by Arena simulation software by Rockwell Automation and we analyzed the transportation costs and reduction ratio[5]. Rules are as mentioned above, and we prioritize the large vehicle to small trucks because of loadage efficiency. The quantity of orders by customers has Uniform distribution, and we experimented (2, 20), (10, 30), (20, 50) tons. Table 1 displays transportation cost from city A to city B, and city B to city C[4].

Table 1: Transportation cost

Ton	Individual Distribution (10,000won)	Consolidated Distribution(10,000won)	
		City A ⇒ City B	City B ⇒ City C
18 t	30.4	19.9	19.9
8 t	22.8	15.2	9.00
5 t	22.0	14.5	8.00
2.5 t	21.7	14.0	6.20

The simulation was summarized as three factors. First, the distribution of commodity volumes are varied by uniform distribution.. Second, We increase the number of manufacturers and customers. Finally, the distance from manufacturers to distribution centers as well as centers to customers are simulated accordingly.

Total run of 30 results in Fig. 3 for the

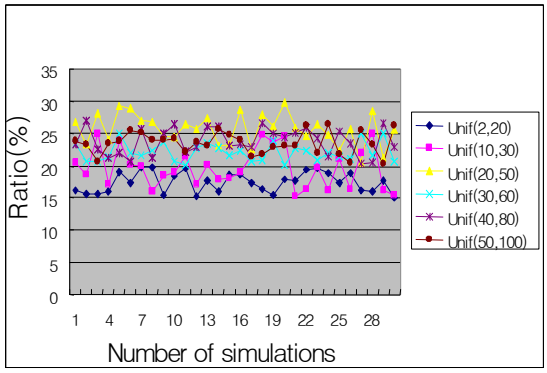

Fig. 3: Cost reductions by distribution of commodity volumes

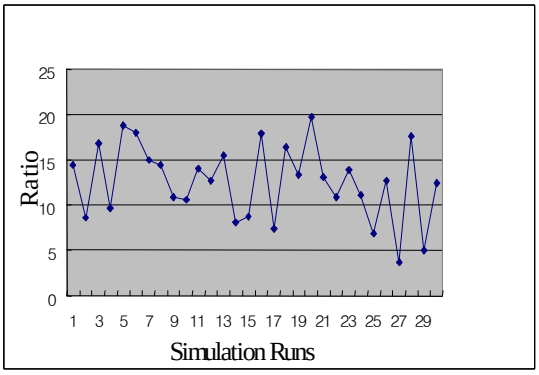

Fig. 4: Cost reductions by distance from Manufacturer to Customers

first factor, the distribution of commodity volumes. We can observe that consolidation can reduce the cost 15% up to 30% compared with individual distribution. The reduction increases as the interval of volume increases. This also results in loadage of vehicles.

Table 2 show the result of simulation by increasing the number of customers. Basic model has 3 customers, and we increased the number such as 4, 5, 6, ..., 10.

Table 2: Cost reductions by increasing the number of customers

# customers	Individual	Consolidation	Reduction(%)
4	520.0	421.7	18.9
5	611.3	484.8	20.7
6	734.0	580.6	20.9
7	821.0	655.2	20.2
8	890.8	692.2	22.3
9	974.7	748.6	23.2
10	1100.8	837.7	23.9

Fig. 4 shows the result of simulation by the distance from manufacturer to customers. We observed that the cost reduction of 3% up to 20%, the average of 12.6%. More experiments have been conducted, and we observed very similar results.

5 Conclusions

This paper showed the consolidated transportation model with simulation scheme and we analyzed the characteristics of the model in terms of cost and efficiency. In summary, three facts has been resolved. First, varying the distribution of cargo volume of customers orders reduced the transportation cost ranged from 14.7% to 25.6%. Second, when the number of the manufacturer or the customers increases, the reduction ration reinforces accordingly. Especially, if we incremented the number of manufacturer, the reduced cost rapidly generated. Finally, the distance between manufacturer and customer was another factor. Rather than short distance, we observed that the efficiency of consolidation was enormous in long distance.

The future study may cover the assumptions of truck availability, cargo factors such as weights, shapes, and so. Above will lead more realistic simulation outputs and also anticipate more constructive participation of the consolidation strategy.

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