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Abstract

Title	Multistage Logistic Network Optimization under Disruption Risk

(800 words)

Getting over disruptions risk has been a challenging issue for many companies under the globalization that will link to potential external source such as demand uncertainties, natural disasters, and terrorist attacks. The disruption is an unexpected event that disturbs normal flows of products and materials within a supply chain. The disruption at one members of supply chain will propagate the offers and finally affect significant impacts on the entire chain. If we look back at the natural disasters in the recent decade, we know the supply chain activities have been put at the edge of high risk that bring catastrophic impact to companies. Not only such disruptions in the supply chain are increasing in frequency, but also the severity of their impact is escalating in terms of costs and losses. Since they will eventually bring a company a partial or complete halt, it is avoidable to consider disruption as a potential threat to supply chain and logistic network. Thereat, we can anticipate the disruption by considering preventive action to ensure the supply chain. If the supply chain takes preventive action against the disruption, such action is viewed as mitigation planning.

In this research, we analyzed possible strategies that a company can apply to mitigate and minimize the impacts of supply chain disruptions and design supply chain network in which facilities are unreliable by considering the fact that the facility members may fail. Failure of the facility means that the facility is no longer available to serve its customers. When these facilities happen to fail, the concerned organization has to find alternate sources of supply to continue service to the customers , to reroute assignments that were initially intended or to incur large penalties.

To cope with the problem, we are interested in a three echelon logistic networks composed of distribution center (DC), relay station (RS) and Customer. Thereat, we consider two kinds of relay station like reliable relay station (RRS) and unreliable relay station (URS). The URS is subject to failures and the reliable relay station (RRS) becomes the hardened ones by having additional capacity or external alternative sourcing strategy. So it is more expensive to establish or operate such facility compared to URS. If the primary facility is disrupted, however, RRS will act as backup facilities to provide supply of product to customers.

Under those conditions, we formulate the logistic optimization problem so that the expected total cost associated with disruption probability is minimized under various constraints. It refers to a probabilistic mixed-integer programming problem. Then, this dissertation concerned three main problems.

The first problem considers three types of allocation model, i.e., multi-multi allocation, multi-single allocation and single-single allocation model. Taking these models, we compared some properties among three allocation models which have different configurations of the network. This is because the configuration is one of the most important and strategic issues in the logistic network design that has long lasted effect. Concern with this issue, we carried out a morphological analysis in order to measure the complexity of the multi stage logistic networks besides the expected cost. Finally, numerical experiment is carried out by applying commercial software to validate the proposed idea.

The operational level of the company will decrease below the normal condition when disruption occurs. The backup source after the disruption should be recovered not only as soon as possible, but also as much as possible. This is related to the concept of the business continuity management/plan (BCM/P) to reduce the recovery time objective. The second problem considers a robust supply chain network design by considering the effect of continuity rate to cope with the more practical circumstances. That is to say, we assume that URS is not completely halted and RRS will decrease the backup ability depending on the continuity rate of facility. Eventually, the continuity rate is percentage of ability facility to provide backup allocation to customers in abnormal situation and will affect the investment and operational costs. We evaluated the effect of the continuity rate for the foregoing three models. Finally, numerical experiment is

carried out to derive some prospects for the future studies.

In the real-world situation, we need to concern huge numbers of facility members that make the resulting problem extremely difficult to solve. Accordingly, with increasing problems size, it becomes almost impossible to solve the problem by any currently available software. In the last problem, therefore, we developed an effective hybrid method so that we can solve the problem regardless of the size. The approach is composed of meta-heuristic method like tabu search and graph algorithm. Some bench mark problems are solved to validate the effectiveness.