別紙４－１（課程博士（英文））

Date of Submission: July 6^{th}, 2022

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Abstract (Doctor)

Title of Thesis	Robust and Optimal Design of Sustainable Closed Loop Supply Chain Considering E-commerce and Environmental Impacts

In recent years, governments have been applying pressure and refining legislation to encourage organizations and a broad sector of customers to adopt green and sustainable practices in their production and service activities. This is to handle the population growth, which requires more products to be manufactured, resulting in the limited availability of raw materials and an increase in the rateof pollution emissions. The depletion of natural resources and the degradation of the ecosystem have led many countries to adopt closed-loop supply activities in both their industrial and service sectors. With the widespread use of Internet technology, these aspects motivate the incorporation of e-commerce with the classical closed-loop supply chain.

Most real-life optimization problems are subjected to uncertainty, and the robust optimization approach is one of the efficient techniques to deal with uncertain optimization problems. Supply chain optimization problems are highly sensitive to data perturbations mostly due to the inappropriate estimation of the problem's parameters and the highly dynamic environment. In this dissertation, we propose an adaptable robust optimization model for the dual-channel closed-loop supply chain and present two counterpart models; thefirst model is an MILP model based on the adjustable box uncertainty set, while the second robust model is a mixed integer nonlinear programming (MINLP)model based on the adjustable ellipsoidal uncertainty set. We provide a novel approach for considering multiple uncertainty sets in the objective function, that provide flexibility and control risk based on the preferences of the decision-makers. This study aims at minimizing the total cost of the dual-channel closed-loop supply chain network considering uncertain purchasing, transportation, fixed, and processes costs, in addition to uncertain customer demand. Intensive computational experiments are conducted on the two robust models using GAMS software. Robust solutions are obtained, and sensitivity analysis is conducted on both models considering 10% perturbation of the uncertain parameters around their nominal values as well as a probability guarantee for not violating the constraints.

In this study, we propose a robust bi-objective optimization model of the greenclosed-loop supply chain network considering presorting, heterogeneous transportation system, and carbon emissions. The proposed model is uncertain bi-objective MILP model aims at maximizing the profit and minimizing carbon emissions considering uncertain cost, selling price, and carbon emissions.

Robust optimization approach is implemented using "Interval+ polyhedral" uncertainty set to model the robust counterpart of the bi-objective model.

The robust Pareto optimal solutions are obtained using lexicographic weighted Tchebycheff optimization approach of the bi-objective model.
Intensive computational experiments are conducted, and robust Pareto optimal front is obtained with the probability guarantee of the constraints that contains uncertain parameters are not violated (constraints satisfaction).