

Title	マルチモーダルロジスティクスおよび輸送システムにおけるルート選択のための多基準意思決定に関する研究
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Citation	
Issue Date	2021-09
Type	Thesis or Dissertation
Text version	ETD
URL	http://hdl.handle.net/10119/17520
Rights	
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学位の種類	博士(知識科学)		
学位記番号	博知第 289 号		
学位授与年月日	令和 3 年 9 月 24 日		
論文題目	A Study on Multi-Criteria Decision Making for Route Selection in Multimodal Logistics and Transportation Systems		
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論文の内容の要旨

Freight transportation is considered as a crucial part of the logistics and supply chain systems that ensures efficient operation and time of raw product and finished goods. As a result of the globalization of trade, the traditional mode of transportation such as truck transportation is no longer a workable solution. Traffic congestion and environmental problems associated with truck transportation are the main concerns. Accordingly, the European Transport Policy seeks to reduce pollution from road transportation and search for better modes of transportation which are more energy-efficient. Multimodal transportation is currently considered as one of the most important elements of modern transportation systems. Crucially, there are several issues needed to be identified when discussing about the multimodal freight transportation systems. However, the analyzes can be complex due to the fact that there are many factors associated with the multimodal transportation and many interactions between different modes.

The route selection strategy has become the primary focus of the design of the network of the multimodal transportation. The cost and time of transportation and also the associated risks should be considered when choosing the transportation route. However, it is considered as complex multiple objective problems that are characterized by several conflicting criteria, inaccurate and ambiguous parameters and the vagueness of the human thinking.

To overcome these problems, this research develops a five-step decision support framework by utilizing the Multi-Criteria Decision Making (MCDM) tool. The first step helps define the scope of this research by collecting the data of all the routes under consideration. In the second step, the cost and time of transportation of each route are identified according to the actual test data. The third step focuses on the evaluation of the multimodal transportation risks by utilizing the integrated quantitative risk analysis, Fuzzy Analytic Hierarchy Process (FAHP) and Data Envelopment Analysis (DEA) methodology. In the fourth step, the weights of each factor are determined relied on the opinions of the 5 decision makers, who either work in the field of transportation or work as an academic researcher, with a neutral understanding of the risks associated with transportation and with a direct involvement within the

transportation process and logistics management for more than 20 years. The significance weight of criteria which attained from Fuzzy Analytic Hierarchy Process (FAHP) can be integrated into a multi-objective optimization. Lastly, the Zero-one Goal Programming (ZOGP) is utilized to define the optimal multimodal transportation route. This research uses this approach to study the existing routes of coal transportation in Thailand. To validate the model as well as results of this research, a sensitivity analysis is used on each of the Multi-Criteria Decision Making (MCDM) methods under consideration, ensuring accuracy and practicality of the decision support tool.

This research contributes to the improvement of the decision support approach which can be more flexible and can be applied to select the optimal route that can optimize cost, time, and risks of the multimodal transportation effectively. This method can offer guidance to efficiently determine the best route which would improve the logistic system performance. The findings show that the approach can inform the decision makers about the optimal route according to the attributes mentioned above.

Keywords: Multimodal transportation, Route selection, Multi-Criteria Decision Making (MCDM), Risk analysis, Optimization problem.

論文審査の結果の要旨

Multimodal transportation is currently considered as one of the most important elements of modern transportation systems. The route selection problem is especially important and challenging in multimodal transportation because not only cost and time, but also potential risks associated should be considered when optimizing the multimodal transportation route. The principal aim of this research is to develop a new framework for solving the route selection problem in multimodal transportation systems. The main contributions are summarized as follows.

This dissertation develops a new five-step decision support framework for route selection in multimodal transportation based on multi-criteria decision making (MCDM) and optimization tools. Within the developed framework, an integrated model for quantitative risk analysis in multimodal transportation utilizing fuzzy analytic hierarchy process (FAHP) and data envelopment analysis (DEA) is first proposed and then a multi-objective optimization method based on zero-one goal programming (ZOGP) is developed to determine the optimal multimodal transportation route. Sensitivity analysis is also conducted to validate the developed model and method. Finally, the applicability of the new decision support framework is illustrated through a real-word case study of coal transportation in Thailand.

This dissertation has made good contributions both theoretically and practically in the area of multimodal transportation logistics. The research work presented in this dissertation has resulted in 2 journal papers and 2 refereed conference papers.

In summary, Ms. KAEWFAK Kwanjira has completed all the requirements in the doctoral program of the School of Knowledge Science, JAIST and finished the examination on August 3, 2021, all committee members approved awarding her a doctoral degree in Knowledge Science.