Environment Policy Making Supporting System for East Asian Logistic Network of Liner

博士論文（要約）

Environment Policy Making Supporting System for East Asian Logistic Network of Liner

（定期船の東アジア物流ネットワークに対する環境政策立案支援システム）

孫　楽

In the recent years, for the more and more serious global climate problems, the environment problem, especially the air pollution caused by the greenhouse gas is paid great focus by countries all over the world. To respond the problem of increased temperature all over the world and to control the emission of greenhouse gas over the safe level, a convention named as "United Nation Framework Convention on Climate Change (UNFCCC)" was past in the United Nation Conference on Environment and Development in 1992.

Based on the convention, international protocols are defined with a step-by-step plan, from the "Kyoto Protocol" in 1997 to the "Bali Roadmap" in 2007 to the "Copenhagen Protocol" in 2009. However, the protocols did not execute well. The greenhouse gas emission regulation relates to additional economic investment. Some countries do not want to assume the responsibility, and other countries do not want to pay for others. These make the protocols execute in low efficiency.

After the last economic crisis, the global trading becomes recovering. Till the year 2010, the international trading amount keeps increasing. The important measures of trading and transportations are vessels. When vessels are sailing, the greenhouse gas, especially the CO2, generates. The vessels generate a great amount of CO2 during sailing, about 3.3% of the total global generation. For the international trading keeps increasing, the emission rises. The 3.3% of emission amount is a large quantity, which equals to the total quota of Germany. The facts show necessity of vessels emission regulation, however this area is just a part of low execution efficiency.

Three reasons in different aspects lead to the low execution efficiency.

1) The policy regulations are always executed based on penalties. For the logistic executors, the revenue loss is a great obstacle to follow the regulation of their own free will.

2) The policy maker always issues the policy contents in the form of contents and purpose. There are not mechanisms and parameters in detail. Compared with the potential risk in new transportation conditions and rules, the logistic executors prefer the prior situation.

3) The policy maker adopts promotion measures. However without quantitative

information, the promotion measures, especially financial support, cannot be well designed in quantity and be implemented effectively.

We think the clear mechanism and quantitative effects are important things for policy implementation. For the policy maker, the quantitative effects can help them to predict the actual effects, based on which they can also define promotion measures in detail quantitatively. For the logistic executors, the clear mechanism may help them to understand the policy contents and the potential risks, and the quantitative promotion plans may make them to accept the policy more easily than ever before.

This research intends to solve the problem above with the model defining and the simulation system construction.

A model is defined to describe the maritime logistic network with environmental policy regulations in two steps. The purpose of this research is to support policy making quantitatively, and the policy regulation works on the maritime logistic network, so a reliable basic logistic model is necessary. In the first step, a logistic model is defined. Different from the other research, the model in this research is constructed by the most basic simple roles and economic relation. The economic relation simplified the complicated supply and demand relations in the recent stage. Further more, the economic relation helps to introduce the policy contents into the logistic model easily. In the second step, the policy content is converted to economic penalties, which is related to vessel emission amount and seemed as an additional part of the transportation fare. The order makers select vessels by considering transportation fare in the recent model, so they prefer vessels with less emission amount to vessels with larger emission amount. This mechanism will force vessels to control their emission amount of their own free will.

We introduce the multi-agent system to construct the model, because the system provides necessary mechanism for our model. The order makers select vessels based on both determined principles and their own features. The multi-agent system provides this function, which is also used by the vessels. A reliable model is required to support policy making. So when the policy is implemented, some vessels are trapped in difficult situation for large emission amount. They need to make self-adjustment by certain measures to get rid of the difficult situations. These operations confirm the actual situations and also will provide reliable results and effects for policy maker. The vessel

owners also use the multi-agent mechanism to make adjustment, on both determined principles and their own features.

During define the model, we also discuss or predict some possible features and functions of the model.

A prototype simulation system is constructed after the defined model in the basic architecture of the multi-agent system. This prototype simulation system generates results to the policy makers and us to understand the policy effects and the logistic features.

We firstly use many cases to verify the features and functions of the simulation system. A reliable simulation system is necessary for the policy maker and us to evaluate the policy contents and to support policy-making. In the first part, we verified the functions and features of the basic logistic model without the policy regulation. The simulation results show that the system works well to provide orders randomly and select vessels according to economic principles. Then in the second part, we verified the functions and features of the model with the policy regulation. In this part, four important contents are verified. Firstly some cases show the effectiveness of the policy regulation as we defined. These cases ensure that the policy regulation works, at least. With these results we can make the following verifications. We verify the two vessel adjustment measures and also compare the differences. With the policy regulation, the adjustment measures really can reduce the emission amount for vessels. Then we verify and analyze the features and functions of the policy properties. The properties influence the policy effects as we defined and expected to a certain extent.

By using the verified system, we make more simulations by using actual data in the following contents. The system generates interesting results. Some of them show features as we verified in the contents above. And some of them show new features, which we cannot go further for limitation in the recent step, but point out new areas and directions for our future work.

Based on the simulation results, we make discussions on policy making and support. Firstly we introduce a new parameter called “Policy Efficiency” to briefly distinguish the policy with similar effects. Then we discuss the different classifications of vessels. The vessels can be classified by the simulation system by their performance. The vessel

classifications can help us to implement exact policy promotion measures.

We also discuss some important problems, which cannot be solved in the recent stage, and make plans for the future study.

This research contributes in the following area.

Firstly we define a maritime logistic model with policy regulation. In this model, we select the economic as the entry point. This point provides easy way to build the relations and to introduce the policy regulation. Depends on the economic relations, the policy regulations are introduced into the maritime logistic model and become effectiveness successfully. At the same time, not only the contents, we also introduce the policy properties in different dimensions. The properties work on policy effectiveness and acceptances.

With the model and the simulation system, we try to analyze and discuss results and effects of policy regulation quantitatively. The quantitative analysis provides measures to clearly understand and easily promote the policy contents.

Finally we also discuss the limitation of this research in the recent stage. With the framework, the recent achievements and limitations both provide thinking and ideas for the development and future work of this research topic.

The framework of the dissertation is represented as below.

Chapter 1. Introduction

This chapter starts with studying on contradictions of the recent situations in the world, which caused by the more and more serious environmental problem and the increasing maritime transportation. The study shows the necessity and the significance of this research topic. With the research topic, an approach explains the process for studying and a framework shows the missions.

Chapter 2. Related Research

The approach and framework provide process and missions for this research. The

references of existed research also provide assistance and hints to complete this research topic. Literatures provide ideas and hints on this research topic.

Chapter 3. Model Design

The basic model of the research topic is designed around the basic framework. The model is constructed in two steps. The first step is to define a basic maritime logistic model. In the second step, the policy regulation is introduced, together with some policy properties in different dimensions and vessel adjustment measures. By detailed designing, the model may supply a comparative compact mechanism for roles interactions and policy execution. By the mechanism, effects of necessary policy features are qualitative analyzed with some effects speculation at the end of this chapter for verification in the chapter 5.

Chapter 4. System Implementation

In this chapter, the prototype simulation system is constructed based on the multi-agent model. Three contents are stated as an introduction manual of this simulation system. They are input, simulation process and output.

Chapter 5. Verification and Analysis

This chapter is written based on the simulation results of the prototype system constructed in the chapter 4. Two contents are stated. Firstly, before analysis, the prototype system is verified for the basic and necessary functions, which provide the reliability for the further study. The end of chapter 3 listed some speculation and qualitative study by model and mechanism analysis. After the verification, as the second content of this chapter, the verification and study goes following the lists in the end of the chapter 3, with a large amount of result data generated by the prototype system. For some items, the further quantitative study is done with adequate data.

Chapter 6. Conclusion and Future Works

With all the contents above, this chapter firstly gives a conclusion of the recent research work, and then more topics are discussed as prospect and the future work.