Chapter 1 Introduction

In this chapter, the background of the problem will be represented in section 1.1. Second, the research objectives and the research scope will be announced, respectively, in section 1.2 and section 1.3. Afterward, the methodology about this study and the study content will be described, respectively, in section 1.4 and section 1.5. Finally, section 1.6 will provide a brief introduction to the organization of this thesis.

1.1 Problem Statement

Taiwan is one of the countries in the world with high environmental loading due to shortage of natural resources and high population density. In the past 40years, the high degree of industrial development has improved the living standards of the people of Taiwan, but it has severely damaged the environment.

With the “Green Marketing” revolution, recycling, waste disposal, pollution, and other environmental issues have become significant agenda items for individual, business, and governments. The issues impact all facets of society, both domestically and internationally.

The concern about products being “green” from cradle to grave exactly involves logistics. Environmental awareness has become an emotional, political, and financial issue that has impacted logistics and the supply chain in many areas, including purchasing and procurement, transportation, and warehousing.

Several countries, in particular in Europe, have introduced environmental legislation charging manufactures with responsibility for the whole lifecycle of their products. By placing the onus on the producer of the waste, this makes a firm’s choice of disposal contractor critical. [1] Therefore, a discussion has started about designing

products which can be reused and about the different possibilities how items can be reused.

Companies throughout the world have recognized the importance of environmentalism and the role of the logistics in structuring a corporate response to environmental issues like recycling, waste disposal, pollution, and many others. Reverse logistics, the term often use to represent the role of logistics in environmentalism, is gaining acceptance by firms.

Since there is a growing consensus that reverse logistics should be regarded as a portion of business logistics. Logistics executives must plan their firm's reverse logistics system so that the strategies of source reduction, recycling, substitution, and disposal can be implemented as efficiently and effectively as possible. On the other hand, they also have to design the business logistics system to be operated well.

The function of goods, such as motherboard, case, power supply, hard disc, monitor, notebook, and printer, and etc, are often renewed in a marvelous speed. So as, the Information Technology (IT) hardware is weeded out frequently. While firms begin by complying with environmental regulation and have to keep gaining the rational earning as well. They not only sell the modish products but also recycle the antiquated products. Here, we will concentrate on recycling of hardware products manufactured from the IT industry, and we assume that the recycling process is integrated in the integrated logistics system.

Since, there is the trade-off between the business logistics system (BLS) and the reverse logistics system (RLS). In this thesis, an integrated logistics model (ILM) aimed for IT industry will be formulated to optimize the trade-off between the BLS and the RLS and to find out a feasible mode of the integrated logistics management. In a macro view, the ILM is used to meet an optimal solution, subjected to constraints that take into account such internal and external factors as business operating

strategies and governmental regulations, and for executives manage the integrated logistics system (ILS) well.

In this thesis, the ILM aimed for IT industry is an innovative idea to deal with the BLS and the RLS simultaneously. Because the ILM is formulated to optimize the trade-off between the BLS and the RLS, it is easy to explain various scenarios in the ILS.

1.2 Research Objectives

In this thesis, the main purpose is to develop a method to manage the ILS. Substantially, the objectives are as follows:

1. Research and analyze business logistics and reverse logistics in IT industry, then propose a suitable system to describe the channels of IT industry.
2. Develop an appropriate methodology and select a proper technical approach to research the topic about the ILS.
3. Analyze and explain the relationships, functions, activities, and cash flows among members in the ILS.
4. Formulate an ILM for IT industry to manage the ILS and achieve the maximum profit.
5. Experiment the ILM formulated in the thesis by numerical study and sensitivity analysis, then point out the power of the ILM and contributions made by it in the ILS.
6. Provide decision maker a strategy to operate and manage the ILS for IT industry.
7. Propose conclusions and recommendations for follow-up researchers to continue studying some topics like this.

1.3 Research Scope

This section will be separated into three parts. One is the presentation about hardware products in section 1.3.1; another is about the flows of demanded products in section 1.3.2; the other is the description about members of the integrated logistics system in section 1.3.3.

1.3.1 Hardware Products

In this thesis, the hardware products that will be taken into the research scope include motherboard, case, power supply, hard disc, monitor, notebook, and printer. Although return nodes (RN) accept some peripheral products, such as mouse, keyboard, etc., end-customers cannot get revenue from them.

1.3.2 Flows of Demanded Products

After end-customers get and utilize demanded products from supply nodes (SN), there are five kinds of flow, showed as Figure 1.3-1 and described as follows, for demanded products. Nevertheless, there are three kinds of waste for end-customers; they are remanufactured products, scrap products, and useless products.

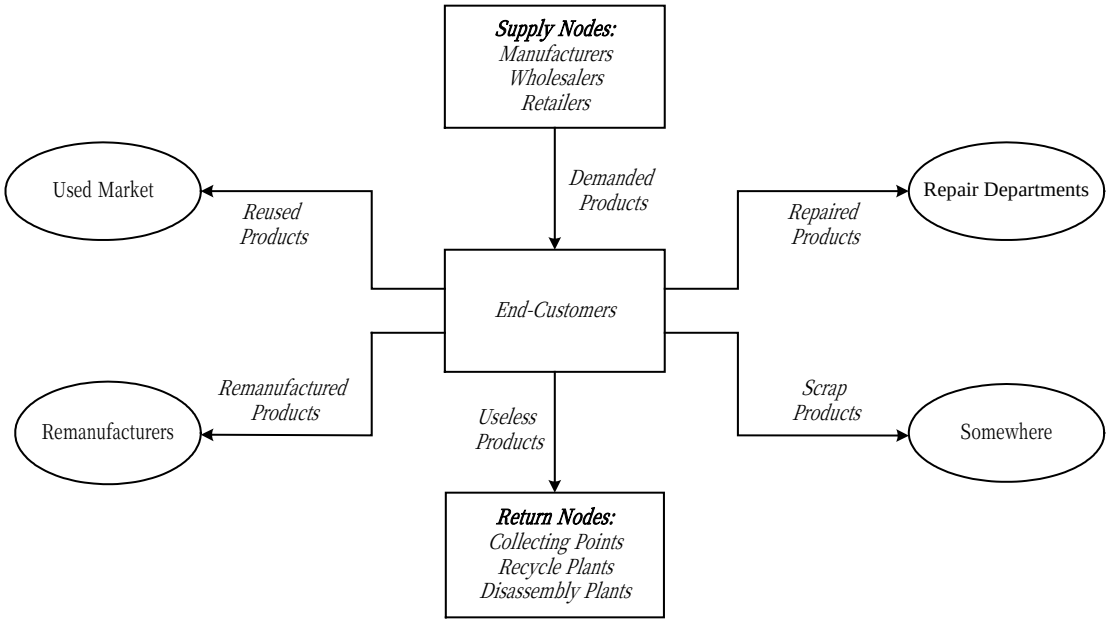

Figure 1.3-1 Flows of Demanded Products

1. Repaired products: When products are broken-down, end-customers usually send them to repair departments. If they are repairable, they will flow to end-customers again. Otherwise, they will be taken as scrap products, or useless products.
2. Reused products: When products are out of date but work well still, end-customers usually sell these to used market, which will resell these to other end-customers.
3. Remanufactured products: When products are abandoned by end-customers, but some components can work well still. Some of them may flow to remanufacturers and will be remanufactured or re-fabricated, then sold to end-customers.
4. Scrap products: When products are abandoned by end-customers but not flow into remanufacturers or RN, they are called scrap products.
5. Useless products: When products are abandoned by end-customers and flow into RN, they are called useless products.

Since there are five kinds of flow for demanded products, why choose useless products being studied in this thesis. There are several reasons represented as follows.

1. Repaired products, reused products, and remanufactured products have their own channels, which are totally different from those of useless products, so they are not considered in this study.
2. The profit of remanufactured products is minor for manufacturers. Since the remanufacturing activity is a residual activity to the behavior of manufacturing and disposal. [2]
3. Most of remanufactured products are sold to the countries of Southeast Asia but Taiwan.
4. The pollution made by useless product is the most horrible among wastes.

5. It doesn’t include repair and remanufacturing for the EOL (End of Life) products in the current system. [3]

Finally, though scrap products are mentioned in the integrated logistics system (ILS), the flows of them will not be modeled in the integrated logistics model (ILM).

1.3.3 Members of Integrated Logistics System

Members of the ILS in the investigated system scope is showed as Figure 1.3-2, which represents the ILS including raw material suppliers, manufactures, wholesalers, retailers, end-customers, collecting points, recycle plants, disassembly plants, landfills/incinerators, secondary material market and the Recycling Management Fund of the Environmental Protection Administration (RMF). More detailed descriptions are listed by the hierarchical method as follows.

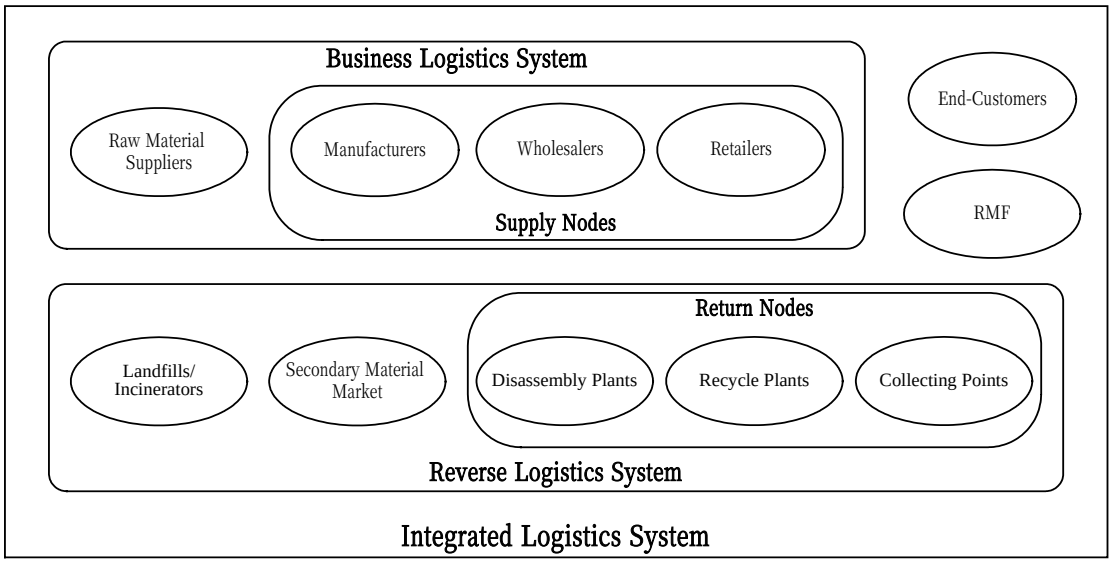

Figure 1.3-2 Members of Integrated Logistics System

The integrated logistics system includes two subsystems (business logistics system and reverse logistics system), end-customers, and RMF.

1. Business logistics system (BLS) includes raw material suppliers and supply nodes.

   (1) Supply nodes (SN) include manufacturers, wholesalers, and retailers.

2. Reverse logistics system (RLS) includes secondary material market, landfill/ incinerators, and return nodes.

   (1) Return nodes (RN) include disassembly plants, recycle plants, and collecting points.

1.4 Methodology

In order to optimize the trade-off between the BLS and the RLS, Multiple Objective Decision Making (MODM) will be the main methodology in this thesis. In the other hand, LINGO package software will be utilized to find out the optimal solution in the ILM. They will be described respectively as follows.

1. MODM

   Since the main purpose is to provide a coordinated plan rather than select a plan to eliminate conflicts between the BLS and the RLS, it is a problem about MODM. In this study, the weighting method will be utilized to solve the problem about the trade-off between the BLS and the RLS; because the weighting method is simple and clear for executives to operate the ILM. Besides, the weights of assignment could depend on decision maker's preference or the societal values.

2. LINGO

   LINGO (Linear Interactive and General Optimizer) is the correction of LINDO, a commercial optimization package, which has been broadly used for formulating and solving diverse optimization problems. Besides, LINGO is also used to solve the problems about nonlinear mathematical programming. Therefore, the LINGO is conveniently employed in this study for solving the profit-maximization problem of the integrated logistics operations.

1.5 Study Content and Flowchart

The main research works in this thesis are described in detail as follows, and the research flowchart is represented as Figure 1.5-1.

1. Research objectives identification and research scope confirmation

   Comprehend the logistics management and the problems in IT industry. Then, identify the research objectives and confirm the research scope.

2. Literature review

   Review literature about the logistics management in IT industry and the development of IT industry. The knowledge from literature will be the base to formulate the ILS and the ILM for IT industry.

3. Methodology development

   MODM and LINGO package software have to be studied in this study, and then be utilized to optimize the trade-off between BLS and RLS.

4. System formulation and modelling

   After comprehending logistics management in IT industry, an ILS and an ILM for IT industry will be proposed in this thesis.

5. Programming

   Program the ILM by LINGO package software.

6. Calibration and validation

   Calibrate the ILM by data sets and validate whether the ILS proposed in this study is a credible representation of the real system.

7. Model application and evaluation

   The ILM will be applied with several scenarios. Then evaluate the performance in each scenario.

8. Conclusions and recommendations

   Sum the achievements of this thesis, and then address conclusions and

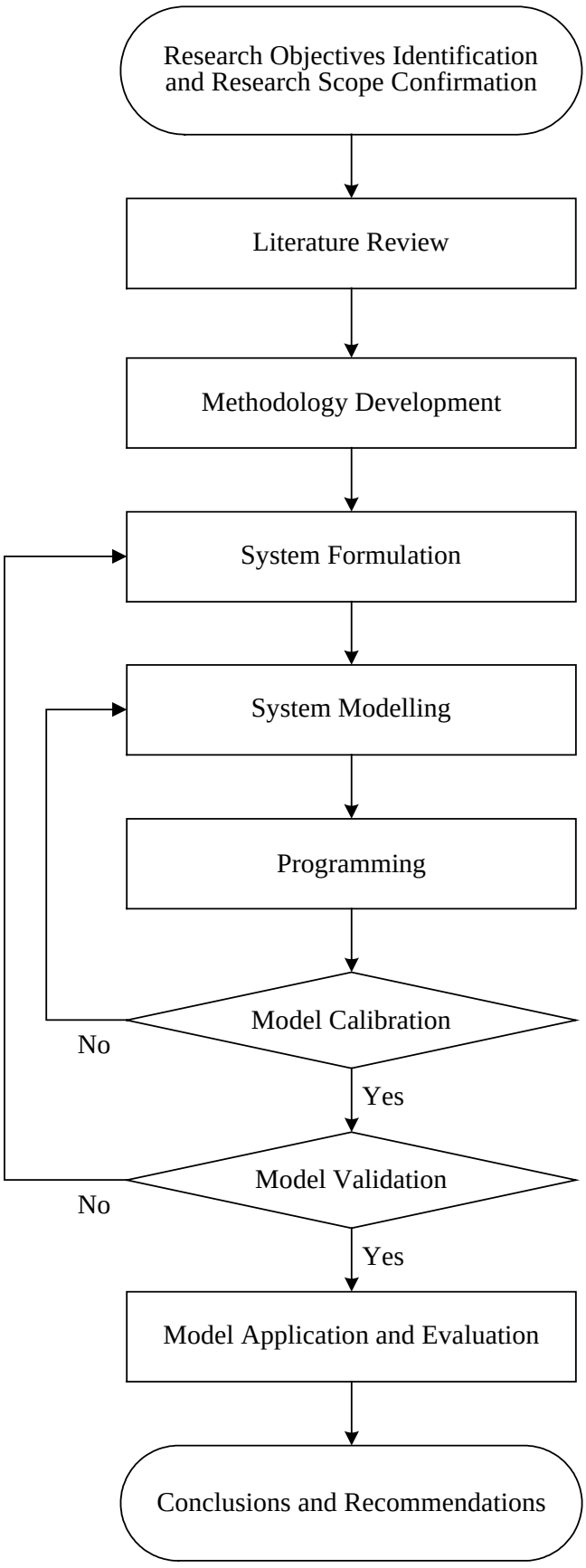

Figure 1.5-1 Research Flowchart

recommendations for follow-up researchers to study.

1.6 Organization of the Thesis

This thesis is structured as follows. In Chapter 2, previous related studies are reviewed comprehensively. In Chapter 3, an ILS is formulated and analyzed and variables used in this study are also specified. In Chapter 4, an ILM is proposed; related assumptions, system functions, derivations, objective functions, and constraints are also identified. The ILM is utilized to deal with the trade-off between the BLS and the RLS. Chapter 5 briefly introduces LINGO package software, and then utilize it to program the ILM. Besides, describe how the case and parameters will be design, validate whether the program model is correctly implemented, and calibrate it. Chapter 6 presents several numerical examples to illustrate potential applications of the proposed model. Certain sensitivity and scenarios analyses of model parameters are evaluated thoroughly. At last, conclusions and recommendations for further research are portrayed in Chapter 7.