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Distribution Centre Location and Organisation for Competitive Advantage

MODUL Service AB in China

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Abstract

To have a cost–efficient distribution channel is of great importance for any commercial corporation to run business effectively, whether it is conducted globally or in certain regions. In the process of distribution, both physical transportation and warehousing operations are critical, which need to mesh with other logistical operations.

This thesis deals with the operative distribution issue at MODUL Service AB, a subsidiary company of IKEA Group. Following the rapid expansion in the Far East, MODUL Service AB has encountered a number of distributing problems with the symptoms of high transport cost and poor controllability of the shipment.

In order to be able to sustain the competitive advantage, the operational management of MODUL Service AB has decided to improve their distribution performance in the Far East from a logistics perspective. The improvement could be achieved through streamlining the distribution channel in China. Therefore, the thesis will discuss the issues regarding distribution performance and its possible improvement in China.

Besides, the design of a research model with the guiding principles is applicable to practitioners in order for them to develop or improve existing or forthcoming facility configuration networks in reality.

Key Words: outsourcing, distribution channel, site selection, facility location, carrier selection, logistics service provider, supply chain management

Acknowledgement

Ending with a deep exhalation, I finished a long exciting "journey" as a part of my life. The thesis work took place from July of 2003 until December of 2003 in Almhult, Sweden.

I have lots of emotional feelings in my heart and lots of genuine words to say. In a word, it is unforgettable.

First of all, I would like to express my sincere appreciation to my supervisor, Professor. Arne Jensen, head of Logistics & Transport Management Programme, at the Graduate Business School, University of Gothenburg, for his excellent conduction and continuous encouragement.

Furthermore, I want to thank the people from MODUL Service AB and IKEA of Sweden AB, for the wonderful research topic and enormous support. They let me go into their organisation, and generously shared their knowledge, experience and ideas with me. Special thanks go to Tomas Axelsson, who is my mentor at MODUL Service AB.

To my parents, thank you for the invaluable encouragement and patience, and belief in me. The thesis would not have been possible to complete without your active support at the most critical time.

Tie Zheng

18th of December, 2003

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Part One

This thesis is divided into two parts. The first part consists of introduction, methodology, and review of the literature. The essence of part one is the design of the research model that will deal with the facility establishment issue.

1 Introduction

The introductory chapter briefly states the motive of the study, interprets the background of the company, defines involved questions, pinpoints the significance of the study, gives an overview of the configuration of the thesis, and delimits irrelevant issues.

More specifically, the chapter accounts for six sections. In the research background section, the factors that motivated me to select this topic are specified. Then the company profile is stated both from a global perspective and specifically focusing on the Far East. In the third section, research purpose as well as research questions are formulated, which guide the forthcoming study. The next section is to clarify the significance of the study. The fifth section demonstrates the frame of the thesis, and also describes the interrelations among the chapters. In the final section, certain limitations are identified in order to concentrate effectively on the essential questions.

1.1 Research Background

MODUL Service AB[1] is a multinational corporation. It has a branch unit situated in the southern part of China in the Far East, where it may bring numerous competitive advantages to the company. In detail, the local unit in the Far East may facilitate MODUL Service AB to implement global sourcing strategy as well as marketing strategy. Local production in China also leads to reduced production cost with approved quality. The global distribution cost is in parallel reduced since the distribution in the Far East is performed via the branch unit in South China. Furthermore, MODUL Service AB believes that in the future both purchase and sales in the Far East will rise.

Nevertheless, MODUL Service AB has observed some problems in the distributing process in the Far East. Total distribution cost is rather high in domestic China, and the controllability of the shipment is poor. Besides, MODUL Service AB has constantly felt threats from local competitors. These middle and small–scale manufacturers mostly exist in certain areas close to the sales market. Therefore, they could perform simple but efficient distributions.

The serious situation pushes MODUL Service AB to study the possible improvements in order to be able to maximise its competitiveness. From a logistics perspective, to streamline the current distribution channel in China will

[1] http://iwww.modul.ikea.com/, visited on 2003-08-18

probably result in cost reduction, service improvement, and a number of invisible advantages. Therefore, the study has been dedicated to improving the distribution performance of MODUL Service AB in China.

1.2 Company Profile[2]

At present, MODUL Service AB is running business smoothly in the Far East on the base of its branch unit in China Shenzhen. A large number of suppliers as well as customers are to be supported via that unit.

1.2.1 MODUL Service AB and IKEA Group

MODUL Service AB is a multinational corporation. Its headquarter was founded in Sweden Älmhult in 1986, and expanded with branch units in Slovakia Malacky in 2000 as well as in China Shenzhen in 2002. The organisation has a total of 380 employees and of 736 million SEK annual turnover. As the first independent subsidiary company of IKEA Group, MODUL Service AB supplies manufacturers of IKEA with furniture fittings, lamps, furnishing fabric, electrical components, store equipment and repairs all over the world.

The strategic relationship between IKEA Group and MODUL Service AB is important and significant. Today, MODUL Service AB supplies 60% of fitting articles that IKEA Group demands, therefore IKEA Group may benefit from having MODUL Service AB as a reliable business partner. In contrast, manufacturers of IKEA Group represent 97% of sales turnover of MODUL Service AB. In this sense, MODUL Service AB needs to develop tight collaboration with IKEA Group. Figure 1.1 concisely illustrates the brief process of goods flow throughout MODUL Service AB and IKEA Group.

[2] http://iwww.modul.ikea.com/, visited on 2003-08-18

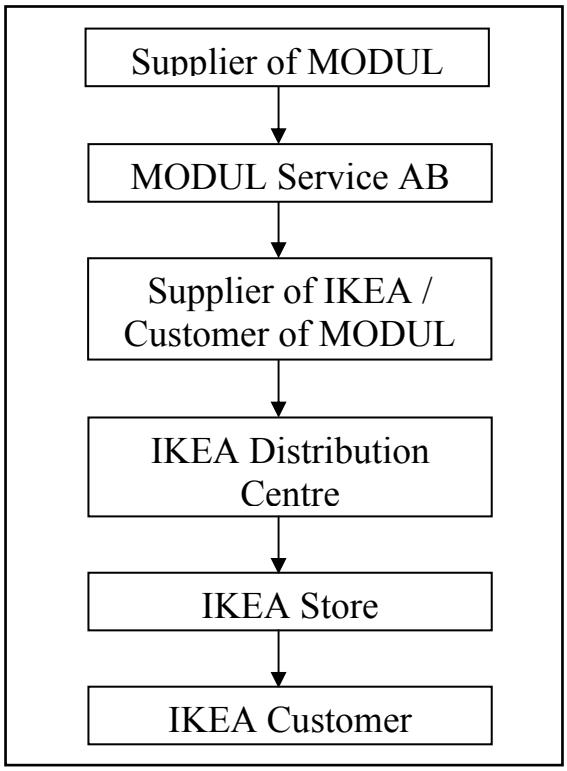


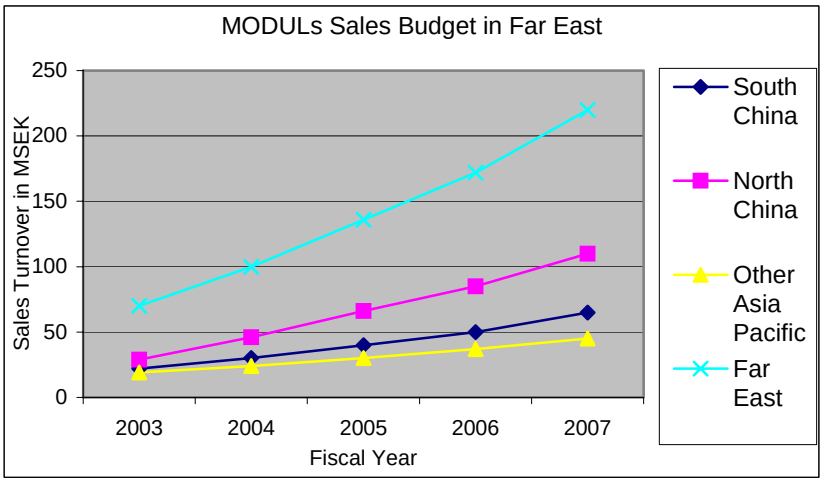
Figure 1.1: Brief Process of Goods Flow
Source: MODUL Service AB

1.2.2 MODUL Service AB in the Far East[3]

In 1998, MODUL Service AB set up a representative office with purchase and sales function in China Shenzhen. In May of 2002, a branch unit with the facility of production and warehousing was set up in Shenzhen. It aims at being able to localise the production and support the market expansion of MODUL Service AB in the Far East.

- Marketing: In line with purchase expansion of IKEA Group in Asia Pacific, MODUL Service AB believes that both purchase potential and sales potential are promising in China. Figure 1.2 indicates sales budget of MODUL Service AB in the Far East, where the most active area is the northern part of China.

[3] Warehouse and Production Strategy FY03 – FY07, MODUL Service AB



	FY03	FY04	FY05	FY06	FY07
South China	22	30	40	50	65
North China	29	46	66	85	110
Other Countries in the Far East	19	24	30	37	45
Total in the Far East	70	100	136	172	220

Figure 1.2: Sales Budget of MODUL Service AB in the Far East (MSEK)
Source: MODUL Service AB

- Warehousing: Even though the warehouse space of MODUL Service AB in Shenzhen today may fulfil the demand in the Far East, the deficiency of storage space will arise from FY05[4], which eventually will restrain its development. Table 1.1 illustrates the situation of stock keeping unit (SKU) places of MODUL Service AB in the Far East.

Table 1.1: Situation of SKU Places of MODUL Service AB in the Far East

	FY03	FY04	FY05	FY06	FY07
South China	567	840	1217	1653	2336
Other Countries in the Far East	489	672	913	1224	1618
North China	747	1288	2008	2811	3954
Total in the Far East	1803	2799	4138	5687	7907
SKU places of MODUL	2900	2900	2900	2900	2900
Difference	+1097	+101	-1238	-2787	-5007

Source: MODUL Service AB

[4] IKEA Fiscal Year: from the beginning of last September to the end of this August

- Distribution: MODUL Service AB has 92 customers in the Far East. Most of them are allocated in northern part, eastern part and southern part of China. (See Figure 1.3)

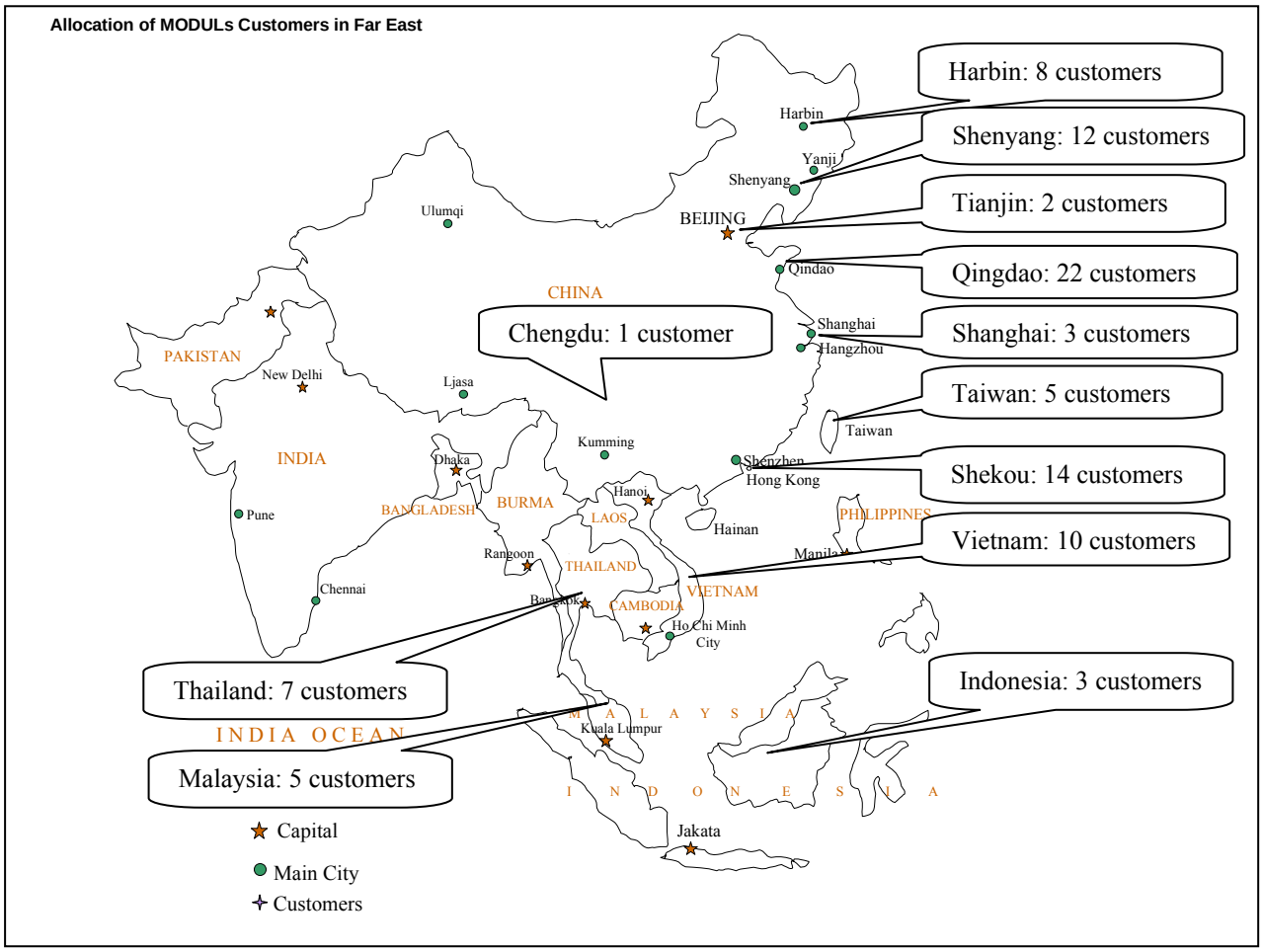


Figure 1.3: Customers of MODUL Service AB in the Far East in FY03
Source: MODUL Service AB

Specifically, MODUL Service AB has 20 customers allocated in 13 cities in North China in FY03. Their information and sales budget in FY04 are displayed in Table 1.2.

Table 1.2: Customer Information of MODUL Service AB in North China

	Customer Number	Customer Name	Location City	Sales Turnover FY03 (RMB)	Volume (KG)	Frequency FY03 (Times)	Sales Budget FY04 (RMB)
Harbin Region	55018	XiangYu Group	Yichun	3,453,592.5	137,912.6	30	2,500,000
	55389	Yi Chun ShenMu	Yichun	539,114.34	24,290	12	1,000,000
	55493	GuangMing YongSheng	Yichun	191,281.86	4,490.6	6	400,000
	55246	Zhanhe Forest Bureau	Wudalianchi	388,487.03	26,871.5	11	500,000
	55315	Harbin HuiSheng	Harbin	298,751.25	28,834	9	300,000
	55376	Harbin LiShengDa	Harbin	562,530.68	29,508	8	1,000,000
	55392	Hailin Ornament Factory	Hailin	467,788.39	44,317.5	12	550,000
	55485	Suifenhe YiXin	Suifenhe	278,705.6	26,611	2	600,000
	Sub-total	8	Helongjiang	6,180,251.65	322,835.2	90	6,850,000
Shenyang Region	55153	Jilin XinYuan	Dunhua	295	7.5	1	/
	55172	Jilin BaJiaZi	Helong	94,738.8	7,132	6	300,000
	Sub-total	2	Jilin	95,033.8	7,139.5	7	300,000
	55184	Shenyang LiTian	Shenyang	188,550	8,796	4	1,000,000
	55290	Liaoyang NingFeng	Liaoyang	763,567.5	46,874.88	33	1,000,000
	55425	Liaoyang HongYunDa	Liaoyang	1,004,223.98	130,148.2	17	1,000,000
	55399	Liaoning DeTian	Liaoyang	464,145.14	47,609.5	20	700,000
	55555	Liaoyang HuaLong	Liaoyang	116,712	11,648	2	300,000
	55314	Jinzhou RunTong	Dalian	10,305.1	142.2	3	/
	55368	Dalian DeChangNing	Dalian	524,564.35	32,067	6	800,000
	55391	Anshan WanXingLong	Anshan	318,237.81	10,622	13	1,000,000
	55489	JiXiang	Fushun	162,090.25	15,239.7	8	300,000
	Sub-total	9	Liaoning	3,552,396.13	303,147.48	106	6,100,000
	55252	Kudur Senmao Artificial	Yakeshi	262,578.2	16,664	5	300,000
	Sub-total	1	Nei Monggol	262,578.2	16,664	5	300,000
	Total	20	North China	10,090,259.78	649,786.18	208	13,550,000

Source: MODUL Service AB

The goods value of MODUL Service AB per ton to North China in FY03 could be computed through dividing the total amount of sales turnover by the total shipped tonnage.

$$\frac{10{,}090{,}259.78 \text{ RMB}}{649.786 \text{ Ton}} = 15{,}528.6 \text{ RMB/Ton}$$

The total shipped tonnage of MODUL Service AB in FY04 could be forecasted through dividing the sales budget in FY04 by the goods value per ton in FY03.

$$\frac{13{,}550{,}000 \text{ RMB}}{15528.6 \text{ RMB/Ton}} = 872.583 \text{ Ton} = 58 \text{ TEU}$$ [5]

[5] 1 TEU = 15 Tons

1.3 Purpose and Research Questions

Following the rapid expansion in the Far East, MODUL Service AB has encountered a number of distributing problems. The symptoms are increased transport costs, poor controllability, and poor flexibility. These problems have consequently caused MODUL Service AB to lose its competitive advantage.

In order to sustain the competitive advantage in the Far East, corporate management of MODUL Service AB, from a logistics perspective, has decided to improve its distribution performance by establishing a supportive distribution centre in China.

Research Purpose: To analyse where and how to establish a distribution centre as an efficient node in the distribution channel of MODUL Service AB in China.

A large number of aspects in the study need to be considered either strategically or operationally. Therefore, the research purpose is categorised into three research questions. Each question is respectively divided into a number of sub–topics. (See Figure 1.4)

Research Question 1: Where should the distribution centre be located?

The first problem is to determine the optimal location of distribution centre. According to supply / demand situation of MODUL Service AB in China, a locational extent will first of all be identified. Then a number of alternative locations will be studied in depth. The final determination of the optimal location will be based on the comprehensive measurement.

Research Question 2: "How should the logistics service providers be employed?

In order to implement outsourcing strategy, MODUL Service AB needs to find one or a group of suitable logistics service providers to co–operate with. The research will start with an overview of logistics service providers that have business coverage in North China. Afterwards, a number of representative logistics service providers will be investigated, and the most appropriate logistics service provider will be determined according to comprehensive evaluation.

Research Question 3: What factors will influence the physical distribution of MODUL Service AB to North China?

There are a number of factors that might influence the physical distribution of MODUL Service AB in the future. This research question will discuss the variables that arise both from external environment and from internal organisation, in order for MODUL Service AB to maximise utilities of distribution channel and / or minimise risks.

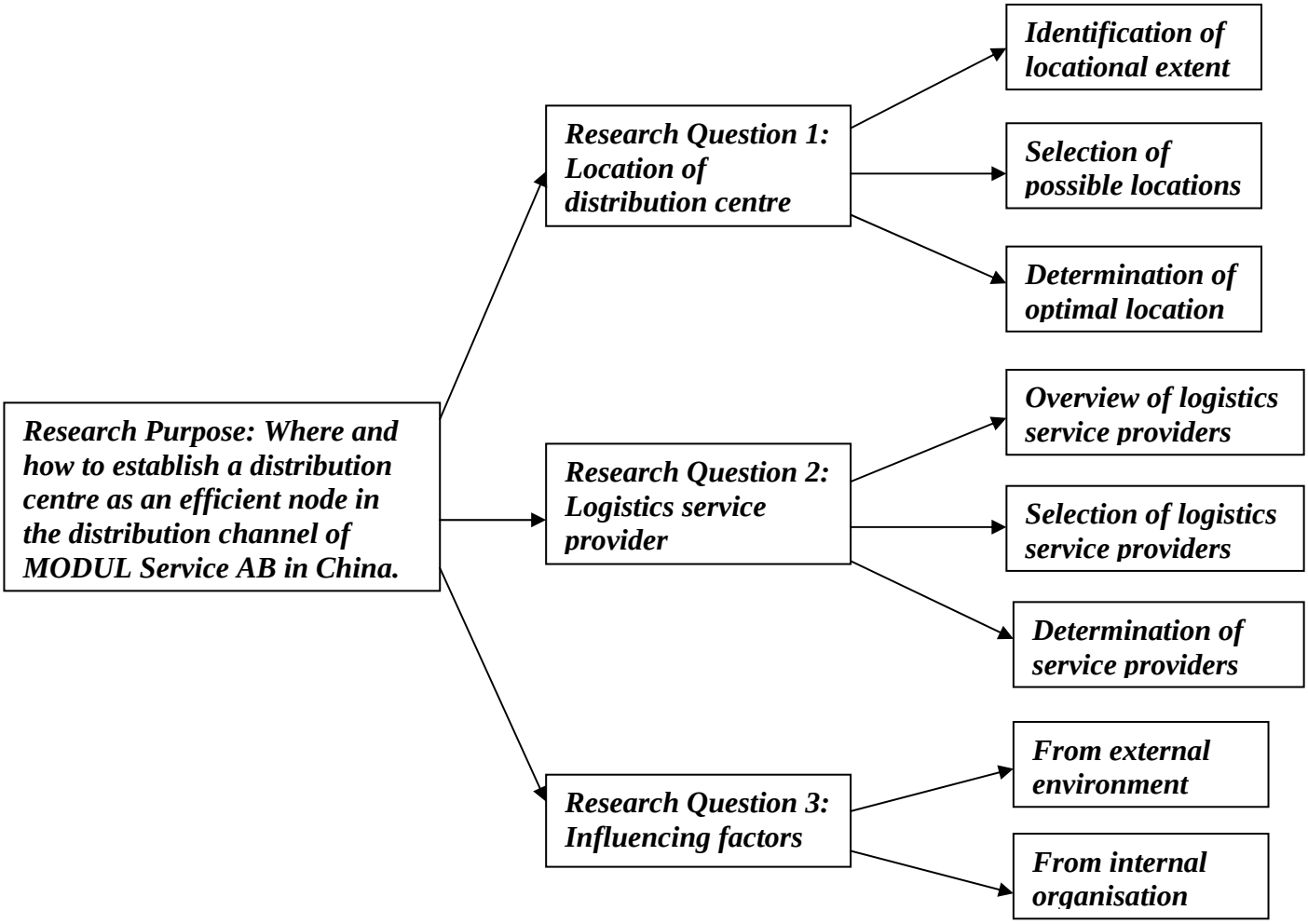


Figure 1.4: Research Purpose and Research Questions
Source: Own

1.4 Significance of the Study

The objective of this study is to improve logistics performance of MODUL Service AB in China. The significance of the study is to enable MODUL Service AB to sustain long–term competitive advantage through optimising its distribution channel. In consequence, MODUL Service AB will be able to provide the most cost–efficient service to the customers in China in association with strong controllability and great flexibility.

Another meaningful contribution of the study is in relation to the design of the research model. It could contribute to academia as a conceptual framework, and could provide some guiding principles in order for practitioners to develop or improve their existing or forthcoming facility establishment systems.

1.5 Outline of the Thesis

This thesis consists of eight chapters. The relevance of each chapter is demonstrated through Figure 1.5. The thick arrow links main research approach as a clue. The thin arrow inclusively represents their interrelation.

More specifically, methodology acts as a guideline to conduct the following chapters. Review of the literature provides theoretical knowledge to the empirical studies. Information needs is a summary of required data in order to facilitate the collection. In consequence, conclusion and suggestion will be based on the results from empirical study.

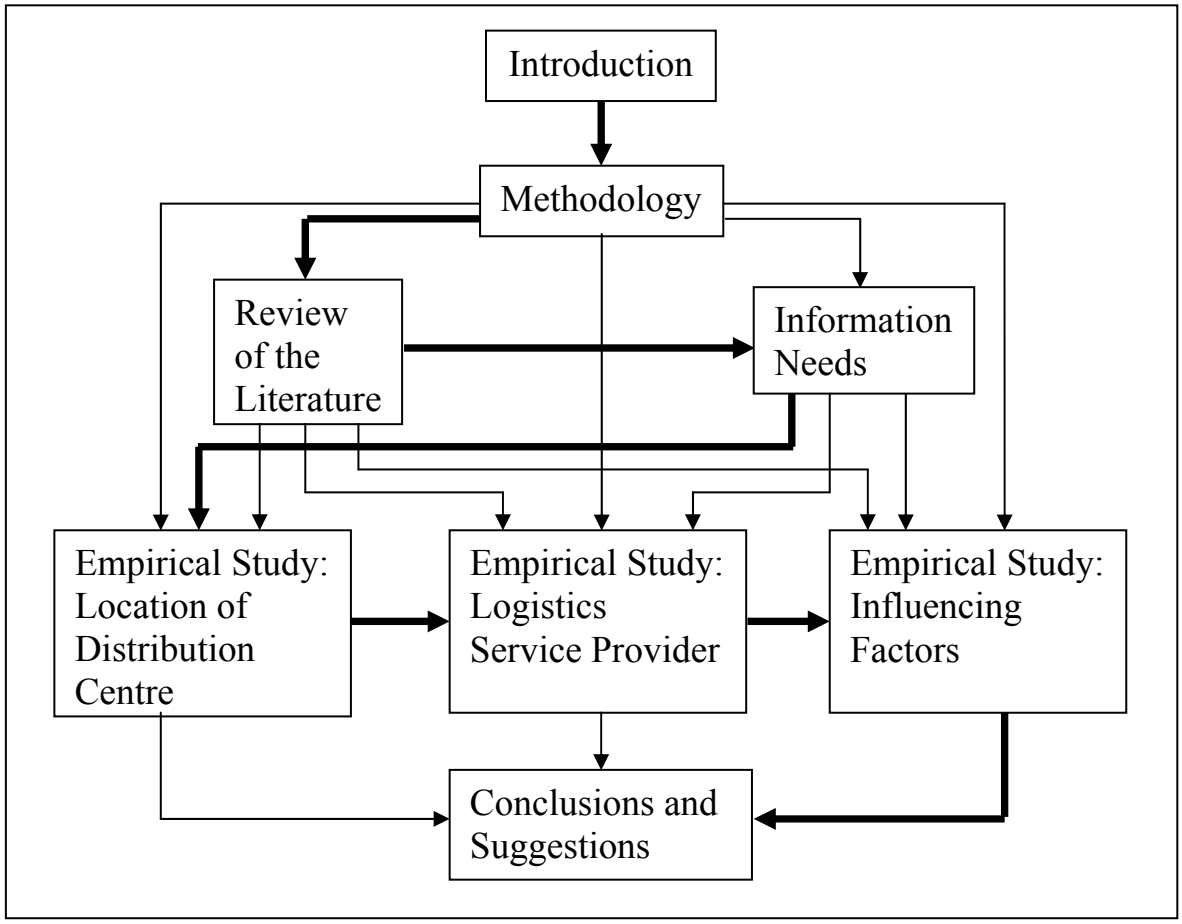


Figure 1.5: Relevance Tree of Research Approach
Source: Own

1.6 Delimitation

In the study, the research has been delimited under three dimensions: corporate strategy, number and size of distribution centre, selection of transport mode. The limitations are based on the business strategy of MODUL Service AB.

Corporate strategy: there are three ways to fulfil the demand for warehousing and distribution, i.e. direct ownership, outsourcing and lease. At present, MODUL Service AB has decided to outsource the overall business to one or a group of logistics service providers. Therefore, neither the possibility of company–owned property nor the possibility of leased facilities will be studied.

Number and size of distribution centre: according to the current situation and sales forecast, MODUL Service AB believes that one distribution centre with certain space could undertake all the assignments. Therefore, one distribution centre with limited space will eventually be selected.

Selection of transport mode: according to the transport situation in China, MODUL Service AB will use trucking in road transport and shipping in sea transport.

2 Methodology

This chapter aims at illustrating the process of the research and interpreting the steps of problem solving. In many cases, the choice of how to carry out a study is essentially related to the outcome of the study. More importantly, it will not merely make the proceeding outline visible but also enable the readers to evaluate the study.

Five sections are associated in the chapter. The rationale for research approach broadly reviews the issues of post–positivistic paradigm. The rationale for a specific design is an argument of my specific design and its appropriation. The third section, methods employed and data collection, is a detailed discussion of the methods used in the study and specifies the data collection approach. The research model is the essence of the methodology that deals with research questions in a systematic way. Finally, an overview of different phases in the study is indicated diagrammatically.

2.1 The Rationale for Research Approach

There are a number of theories and issues of post–positivistic paradigm widely applied in contemporary academia. Below two groups of theories will be presented.

2.1.1 Quantitative Research and Qualitative Research

The most commonly recognised approaches are quantitative research and qualitative research. Creswell (1998)[6] states that quantitative research is "the inquiry into social or human problems based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the predictive generalisations of the theory hold true." (p.2) In contrast, qualitative research is "an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting." (p.1-2)

Creswell (1998) further explains that by its nature quantitative research, a few variables are studied in a wide extent. The qualitative method aims to create a deep view of the problem, and several variables are studied in a relatively small

[6] Creswell, J. W., (1998), *"Qualitative inquiry and research design: Choosing among five traditions"*, London Sage Publication

extent. The crucial difference is that: using a quantitative approach, the researcher must be objective and use standardised criteria in order to enable to compare the answers adequately; using a qualitative approach, the researcher may be more flexible and adjustable.

Creswell (1998) classifies five major traditions of inquiry for qualitative research as paradigms: ethnography, case study, naturalistic inquiry, biography, and grounded theory.

- Ethnography is developed from anthropology. It "studies the behaviours of a culture-sharing group." (Creswell, p.39) Or to say, it is a process of describing and interpreting cultural behaviour.

- Case study focuses on a case within a defined boundary. The case itself is at centre stage of the research not the variables. It is a preferred method when the inquirer seeks answers to how or why questions. (Creswell, p.60)

- Naturalistic inquiry so-called phenomenological study is to "seek to understand the meaning of experiences of individuals about the phenomenon". (Creswell, p.38) It is the investigation of phenomena within and in relation to their naturally occurring contexts.

- Biography generally focuses on the generation, analysis and presentation of the data of a life history of an individual.

- Grounded theory: focuses on generating a substantive theory about a phenomenon.

Quantitative research methods[7] could be summarised in three general types: true experiments, quasi–experiments, and surveys.

- True experiments are characterised by random assignment of subjects to experimental conditions and the use of experimental controls.

- Quasi–experimental studies share almost all the features of experimental designs except that they involve non-randomised assignment of subjects to experimental conditions.

- Surveys include cross-sectional and longitudinal studies using questionnaires or interviews for data collection with the intent of estimating the

[7] http://www.unr.edu/bench/chap04.pdf, visited on 2003-08-21

characteristics of a large population of interest based on a smaller sample from that population.

2.1.2 Deductive Research and Inductive Research

Gill and Johnson (1997)[8] argue that deduction and induction are two main approaches to management research. Deductive research refers to "the development of a conceptual and theoretical structure prior to its testing through empirical observation." (p.28) Inductive research is "the reverse of deduction as it involves moving from the observation of the empirical world to the construction of explanations and theories about what has been observed." (p.33)

The model in Figure 2.1 diagrammatically represents the processes of how human beings learn things. Gill and Johnson (1997) believe that deduction is on the left and induction in turn relates to the right side of Kolb's learning cycle. Deduction process "begins with abstract conceptualisation and then moves on to testing through the application of theory so as to create new experiences or observations". (p.25) Induction process is "learning by reflecting upon particular past experiences and through the formulation of abstract concepts, theories and generalisations that explain past, and predict future, experience." (p.33)

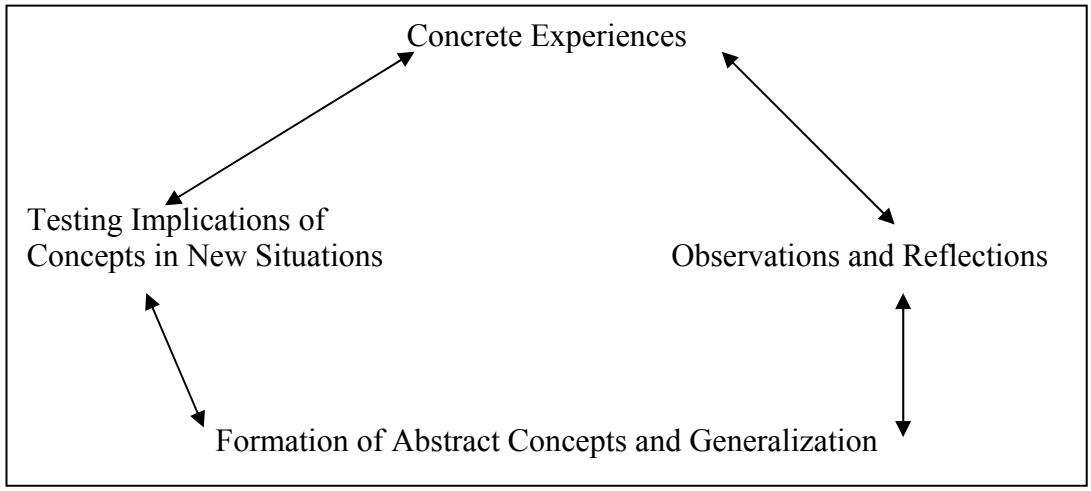


Figure 2.1: Kolb's Experiential Learning Cycle
Source: John Gill and Phil Johnson, 1997, p.24

[8] John Gill and Phil Johnson, (1997), *"Research Methods for Managers – Second Edition"*, Paul Chapman Publishing Ltd

2.2 The Rationale for a Specific Design

Normally, a study begins with the selection of topic and research design. The selection of which research approaches are appropriate shall be based upon the problem of interest, resources available and the competence of researcher.

A basic principle of the research design of my thesis is to employ and combine different methods. Creswell (1998) states that a good research "employs one or more traditions of inquiry". (p.51) Therefore, a combination of quantitative research and qualitative research is something useful and applicable to the study. Research methods, such as surveys and case study, are associated in different phases.

In parallel, the inductive research approach is fundamentally engaged in the study. After a specific research purpose associated with research questions has been formulated, the empirical study is carried out. According to the existing theories and observations, the adaptive explanations will eventually be developed.

2.3 Method Employed and Data Collection

The employment of appropriate research methods is of importance to the precision of the study. In association with specific research design, several methods are mixed in order to obtain both qualitative data and quantitative data.

Green and Tull (1978)[9] define five major sources for obtaining data: secondary sources, respondents, natural experiments, controlled experiments and simulations. Furthermore, Zikmund (1988)[10] categorises different data sources into three collection methods. One of the most common manners of collecting primary data is to design surveys. Respondents can be contacted through mail, telephone interview or Internet. Observation is another method widely applied. The main advantage is that the researcher can collect data without relying on respondents, just observe the target people. The third method is called secondary data collection, which refers to all the ordinary access to search data. Data may be gathered through such media as library, Internet, database or many types of document.

In my study, methods of secondary data collection, survey, and observation are employed in a time sequence.

[9] Green & Tull, (1978), *"Research for Marketing Decisions"*, Paul Chapman Publishing Ltd
[10] Zikmund W, (1988), *"Business Research Methods"*, Paul Chapman Publishing Ltd

- By means of secondary data collection method, both up–to–date data and past data could be obtained, and they are often less costly and / or more accurate. This knowledge and information is coming from literature, company documents, databases, the Internet, and other sources.

- Survey method is performed as typical types of interview as well as questionnaire. A number of interviews, both structured and unstructured, have been arranged with authority officials, corporate employees, logistics service providers, and logistics specialists. Meanwhile, focused questions have been sent to different respondents who cannot be met face to face.

- Observation method, such as site visit, provides an explicit view apart from survey method. It practically leads to a more objective perception and evaluating performance.

2.4 Research Model

According to research purpose and business strategy of MODUL Service AB, a research model is designed. (See Figure 2.2) The model could be employed to complete the study in line with research questions. Besides, the guiding principles of the model are applicable to practitioners in order for them to develop or improve existing or forthcoming facility configuration networks. The relevant theories are interpreted in Chapter 3.

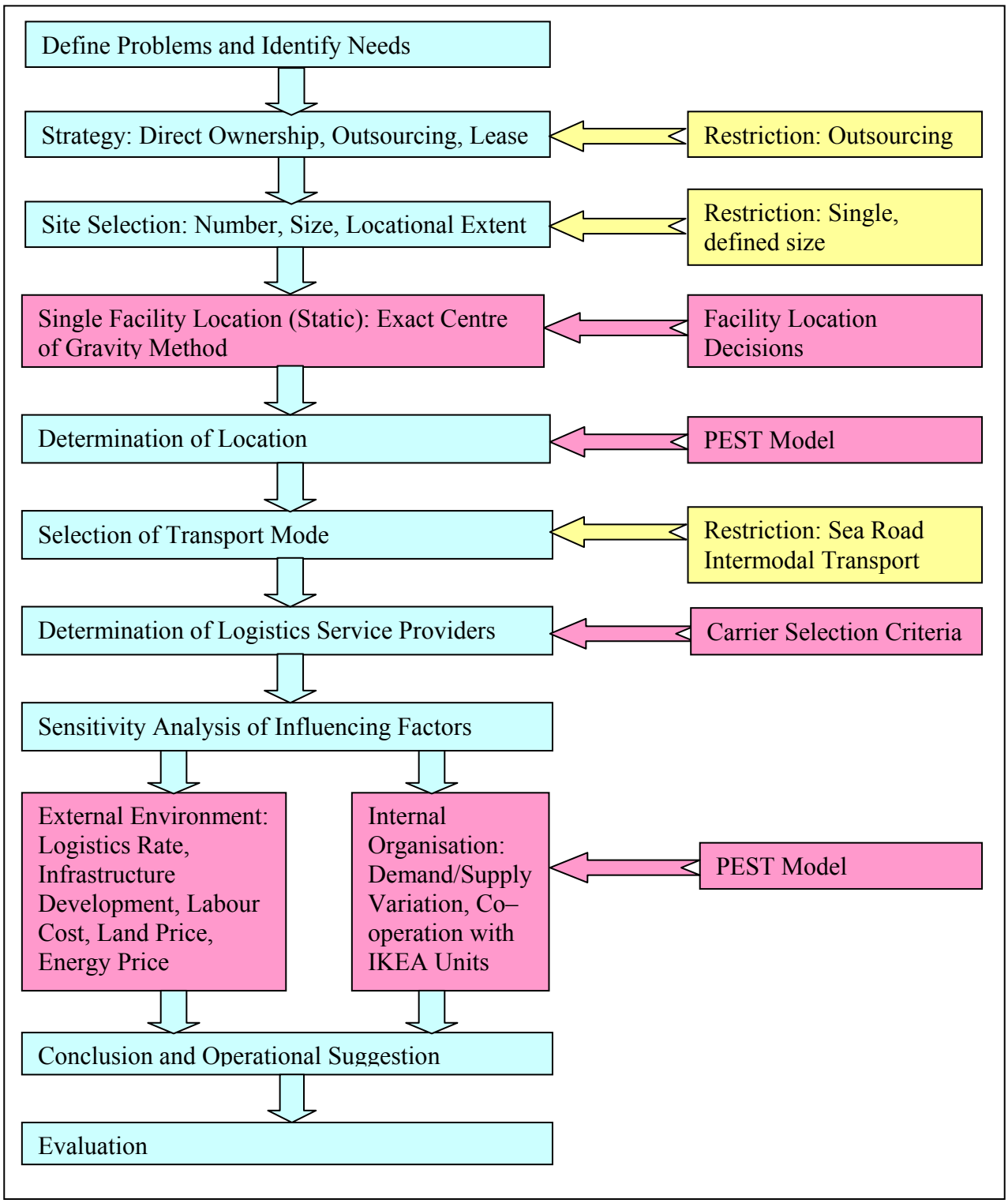


Figure 2.2: Design of the Research Model
Source: Own

2.5 Different Phases in the Study

In general, the research approach runs in circle with the aim of achieving improvement or optimum. The overall process of the study contains three phases, and it could be subdivided into six steps. (See Figure 2.3)

- The first phase is problem formulation and knowledge preparation, which is associated with two steps. First step is to understand the problem, define the purpose and split it into specific questions. Second step is to acquire the theoretical knowledge as well as practical knowledge regarding research questions.

- The second phase is information collection and analysis. Two steps are involved and combined. First step is to accumulate needed information, and investigate practical situation. Then focused analysis will be carried out.

- The third phase is conclusion and suggestion. It contains two steps: first step is to draw general conclusion; second step is to suggest specific operation.

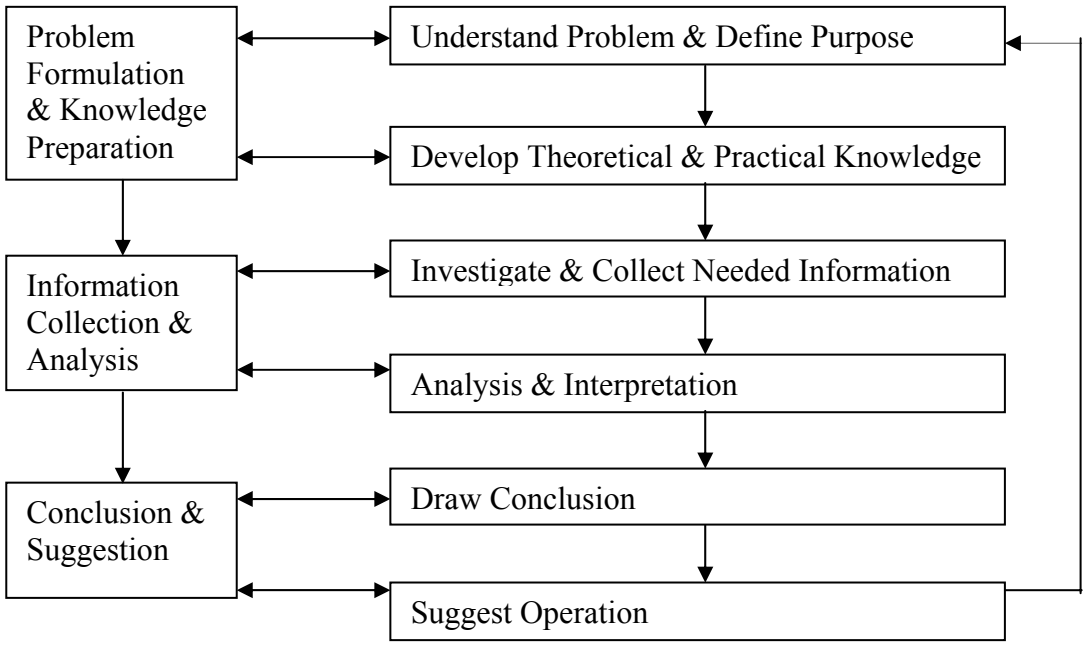


Figure 2.3: Research Phases and Steps
Source: Own

3 Review of the Literature

The intention of this chapter is to provide a general understanding of the theoretical knowledge that will be involved in the empirical study. In the introduction, the argument for the need of the theories will be stated. Then a series of theories will be interpreted and referred to the defined problems. As a consequence, a summary of how these theories mesh together for the study will be addressed.

3.1 Introduction

According to the research approach, the principle of warehouse site selection needs to be understood. The appropriate site selection method shall also be reviewed in depth. After a number of alternative locations have been selected, defined criteria are necessary to carry out comprehensive measurement.

In order to be able to select one or a group of appropriate logistics service providers, theories regarding carrier selection, inbound as well as outbound transport performances are substantial. The fundamentals of weighting criteria in terms of the daily operations are appropriate for evaluating service providers.

The physical distribution might be influenced by many factors. A systematic sensitivity analysis could assist the company to be prepared for making use of different potentials and / or avoiding risks.

3.2 Theory

The theoretical framework of the study accounts for nine theories, which are contributory to the empirical studies.

3.2.1 Warehouse Site Selection Method

The warehouse site selection process is a complex, time–consuming project. Addressed by Mulcay (1994)[11], the scope of site selection accounts for three types: international (foreign country); macro (national, state, region, or major city); and micro (within a state, region, or major city). Drivers in site selection are

[11] David E. Mulcay, (1994), *"Warehouse and distribution operations handbook"*, McGraw-Hill

essentially service availability and cost. He also states two basic steps regarding warehouse site selection.

- The first step is to determine whether the company requires one facility (centralised operation) or at least an additional facility (decentralised operation).

- The second step is to assign a dollar value and determine the estimated costs for each site selection factor. The major site selection factors are transportation, labour, taxes, land, and energy or utility.

3.2.2 Hoover's Tapered Transportation Rates

Hoover (1957)[12] observes that transportation rates are tapered with distance. To minimise inbound plus outbound transportation costs where they are the dominant locational force, a facility located between a source of raw materials and a market point will find a minimum transportation cost at one of these two points. As shown in Figure 3.1, the location between these points is economically unstable. Since Y is lower than X on the cost curves, location should be at Y. (p. 486)

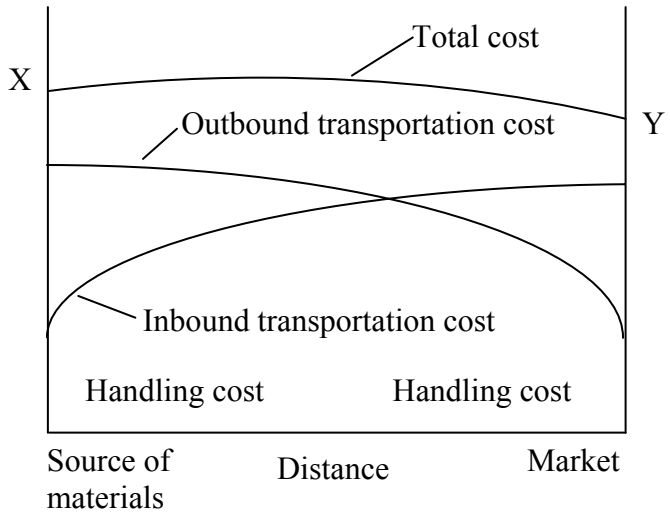


Figure 3.1: Tapered Transportation Rates Force Location to the Source of Materials or to the Market
Source: Edger M. Hoover, 1957, p.487

[12] Edger M. Hoover, (1957), *"Location Theory and the Shoe and Leather Industries"*, Cambridge, Mass.: Harvard University Press

3.2.3 Facility Location Decisions

Ballou (1998)[13] discusses a selected number of facility location methods for strategic planning. He further classifies the more practical methods into a number of categories in the logistics network, which include single–facility location, multi–facility location, dynamic facility location, retail and service location.

- Single–facility location methodology is static and represented by the exact centre of gravity method, or so–called the grid method or the centroid method. It is useful where transportation costs are the dominant cost of location. This model is also mathematically simple as a static location methodology.

- Multi–facility location methodology is more complex and realistic when two or more facilities must be located simultaneously. It is complex because these facilities cannot reasonably be treated as economically independent and the number of possible location configurations becomes enormous (p. 495). Mathematical location method is one of the best–known methods to deal with multi–facility location problem. It is statically employed with three typical approaches: exact methods (including multiple centre of gravity approach and mixed–integer linear programming), simulation methods, heuristic methods (including selective evaluation and guided linear programming).

Generally speaking, Ballou (1998) characterises several basic planning questions for multi–facility location problem. (See Figure 3.2)

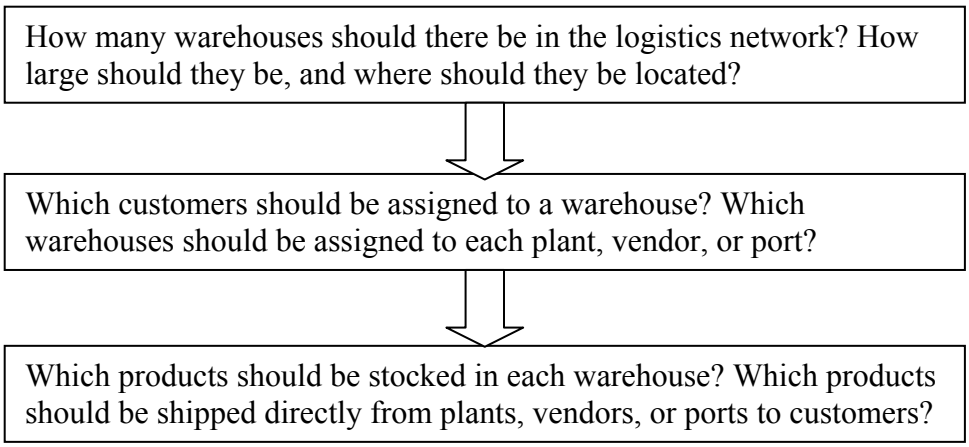


Figure 3.2: Basic Planning Questions for Multi–Facility Location Problem
Source: Ronald H. Ballou, 1998, p.495

[13] Ronald H. Ballou, (1998), *"Business Logistics Management – Planning, Organizing, and Controlling the Supply Chain – Fourth Edition"*, Prentice Hall

- Dynamic facility location methodology is essentially dynamic in nature. It is changing in order to maintain an optimal network configuration since demand and cost patterns shift over time. Finding the best solutions over time can be handled in several ways. First, the best warehouse locations can be found according to the current situation and the forecast. The network configurations between the current year and the future year can then be averaged. Second, the best current network configuration can be found and implemented. Then, in each year, a comparison could be made between the old configuration and the new one. If the locational savings between the new configuration and the old one are greater than the costs associated with moving to the new configuration, the change should be considered. Third, an optimal configuration path can be found over time that will precisely show when a change to a new configuration is needed and the configuration to which the change should be made.

- The retail and service location analysis often stands differently with facility location methodology since it is more revenue based than cost based as facility location. The methodology contains several approaches such as weighted checklist, spatial–interaction model, regression analysis, covering model, game theory, location–allocation models such as goal programming and integer programming.

3.2.4 Single-Facility Location – Exact Centre of Gravity Method

Christopher and Wills (1972) [14] comprehensively present that whether the problem of depot location is static or dynamic, 'Infinite Set' approach and 'Feasible Set' approach can be identified. The infinite set approach assumes that a warehouse is flexible to be located anywhere in certain area. The feasible set approach assumes that only a finite number of known sites are available as warehouse locations. They believe the centre of gravity method is a sort of infinite set model.

Ballou (1998) states that exact centre of gravity approach is simple and appropriate for locating one depot in a region, since the transportation rate and the point volume are the only location factors. Given a set of points that represent source points and demand points, along with the volumes needed to be moved and the associated transportation rates, an optimal facility location could be found through minimising total transportation cost. In principle, the total transportation cost is equal to the volume at a point multiplied by the transportation rate to ship to that point multiplied by the distance to that point. (p. 487)

[14] Martin Christopher, Gordon Wills, (1972), *"Marketing Logistics and Distribution Planning"*, George Allen & Unwin Ltd, UK

$$\text{Min } TC = \sum_i V_i \; R_i \; d_i \qquad (3\text{–}1)$$

TC = total transportation cost
V_i= volume at point i
R_i= transportation rate to point i
d_i= distance to point i from the facility to be located

Furthermore, Ballou (p.488) outlines seven steps involved in the solution process in order to implement the exact centre of gravity approach properly.

1. Determine the X, Y coordinate points for each source and demand point, along with point volumes and linear transportation rates.

2. Approximate the initial location from the centre of gravity formulas by omitting the distance term d_i.

$$\bar{X} = \Sigma_i (V_i \; R_i X_i) / \Sigma_i (V_i R_i) \qquad (3\text{–}2)$$

$$\bar{Y} = \Sigma_i (V_i \; R_i Y_i) / \Sigma_i (V_i R_i) \qquad (3\text{–}3)$$

3. Using $\bar{X}$, $\bar{Y}$ from step 2, calculate d_i according to Equation below. (The scaling factor K need not be used at this point)

$$d_i = K\sqrt{(X_i - \bar{X})^2 + (Y_i - \bar{Y})^2} \qquad (3\text{–}4)$$

4. Substitute d_i into Equations below, and solve for the revised X, Y coordinates.

$$\bar{X} = \{\Sigma_i (V_i \; R_i X_i) / d_i\} / \{\Sigma_i (V_i R_i) / d_i\} \qquad (3\text{–}5)$$

$$\bar{Y} = \{\Sigma_i (V_i \; R_i Y_i) / d_i\} / \{\Sigma_i (V_i \; R_i) / d_i\} \qquad (3\text{–}6)$$

5. Recalculate d_i based on the revised $\bar{X}$, $\bar{Y}$ coordinates.

6. Repeat steps 4 and 5 until either of the X, Y coordinates do not change for successive iterations, or they change so little that continuing the calculations is not fruitful.

7. Finally, calculate the total cost for the best location, if desired, by using Equation (3–1).

3.2.5 PEST Model

PEST Model[15] focuses on the environment external to the organisation. The model looks at the political / legal, economical, social and technological aspects of environment in order to reveal all of the diversities, opportunities and threats. (See Figure 3.3) Therefore, it may lead to a more extensive and in depth view under certain background. The substance of the model is not merely to uncover the environment features but also to understand the proper implications for the organisation.

Political/legal Monopolies legislation, Environmental protection laws, Taxation policy, Foreign trade regulations, Employment law, Government stability	Economical Business cycles, GNP trends, Interest rates, Money supply, Inflation, Unemployment, Disposal income, Energy availability and cost
Social Population demographics, Income distribution, Social mobility, Lifestyle changes, Attitudes to work and leisure, Consumerism, Levels of education	Technological Government spending on research, Government and industry focus of technological effort, New discoveries/development, Speed of technology transfer, Rates of obsolescence

Figure 3.3: Key Macroeconomic Factors
Source: http://www.apsc.gov.au/fellowships/douglass.pdf

3.2.6 Carrier Selection Criteria

Johnson and Wood (1996)[16] state that "initial decisions to locate facilities may have been based on modal choice: the traditional site for a warehouse was often the point where it was most cost–effective to have shipments go in by rail and out by truck". (p.239)

Chow and Poist (1984)[17] study how the quality of service affects the carrier selection process. They find that twenty–two different factors are involved. The ten most important factors in descending order are:

[15] http://www.apsc.gov.au/fellowships/douglass.pdf, visited on 2003-09-03
[16] James C. Johnson, Donald F. Wood, (1996), *"Contemporary Logistics – Sixth Edition"*, Prentice-Hall
[17] Garland Chow, Richard F. Poist, (1984), *"The Measurement of Quality of Service and the Transportation Purchase Decision"*, Logistics and Transportation Review

- Door to door rates or costs
- Freight loss and damage experience
- Claims–processing experience
- Transit time reliability
- Experience with carrier in negotiating rate changes
- Shipment tracing
- Door to door transit time
- Quality of pickup and delivery service
- Availability of single–line service
- Equipment availability

Johnston (1986)[18] suggests these factor weightings for measurement of service provider. Each factor could be scored from 0 to 10. Then the 1–to–10 score is multiplied by the weighting factor, with the top score being 100.

- Carrier's area of geographic coverage, 0.5
- Carrier's marketing efforts, 0.4
- Carrier's transit performance, 1.8
- Equipment availability and cleanliness, 1.1
- Customer service (shipper–carrier computer interface available, shipment status reports, etc), 1.4
- Pricing, 1.4
- Billing accuracy and timeliness, 1.2
- Loss and damage claims handling, 1.2
- Carrier financial stability, 1.0

Jensen (1987)[19] defines conceptual criteria to measure the quality of transport system totally from a number of dimensions, which are relevant for the transport assignment.

- Frequency: the number of departures per time unit. This dimension affects the safety and the cycle stock at the supplier and the receiver.

- Transport time: time from A to B. Time always affects the size of the transport stock as well as the receiver's security stock. In addition, obsolescence can occur for goods with limited durability.

- Regularity: ability to maintain promised or scheduled timetable for departure and arrival.

[18] Michael L. Johnston, (1986), *"Do Your Measure Up?"*, Handling & Management
[19] Arne Jensen, (1987), *"Transport Economics and Management – Lecture Outline"*, University of Gothenburg

- Goods comfort: protection for goods and passengers against unsuitable conditions such as impact, vibration, damp, noise, high / low temperature, etc.

- Transport security: protection of goods and passengers against accidents and theft.

- Controllability: the possibility of following the transport process with regards to deviations from schedule and communicating deviations to external parties. Transport buyers want to have the possibility to follow their goods during a transport in order to be able to early identify divergences in delivery time. Systems for this are generally called tracking systems.

- Flexibility: the ability of the transport system to adapt to changes in the pre and post transport system in such dimensions as time, load carriers, packaging and handling. Adaptability to changes in the inflow, in the size and the composition of the goods flow, etc.

- Ability of disconnection: if the transport can be performed with diminishing effort by the sender's/receiver's handling equipment both physically and in time, the transport's ability of disconnection increases.

- Ability to expand: a valuation of the transport system's ability to take over more parts in the transport chain, logistic ability.

Even though the process for selecting carriers changes over time, distinct criteria might be comprehensively organised according to specific situation. Buyers of transportation service may even create their own weights in association with the existing carrier selection factors.

3.2.7 Warehouse Functionality

In the past, the initial warehouse provided a necessary bridge between production and marketing. Today, warehouse functionality can be more properly viewed as inventory mixing in the logistical system. Bowersox, Closs and Cooper (2002)[20] state that an ideal warehouse will simultaneously provide economic and service benefits. Five basic economic benefits and four service benefits are demonstrated. (p. 381–389)

[20] Donald J. Bowersox, David J. Closs, M. Bixby Cooper, (2002), *"Supply Chain Logistics Management"*, McGraw-Hill

Five economic benefits are explained below.

- Consolidation and break–bulk: the benefits are to reduce transportation cost as well as to improve transportation efficiency by using warehouse capability to increase shipment economies of scale. (See Figure 3.4)

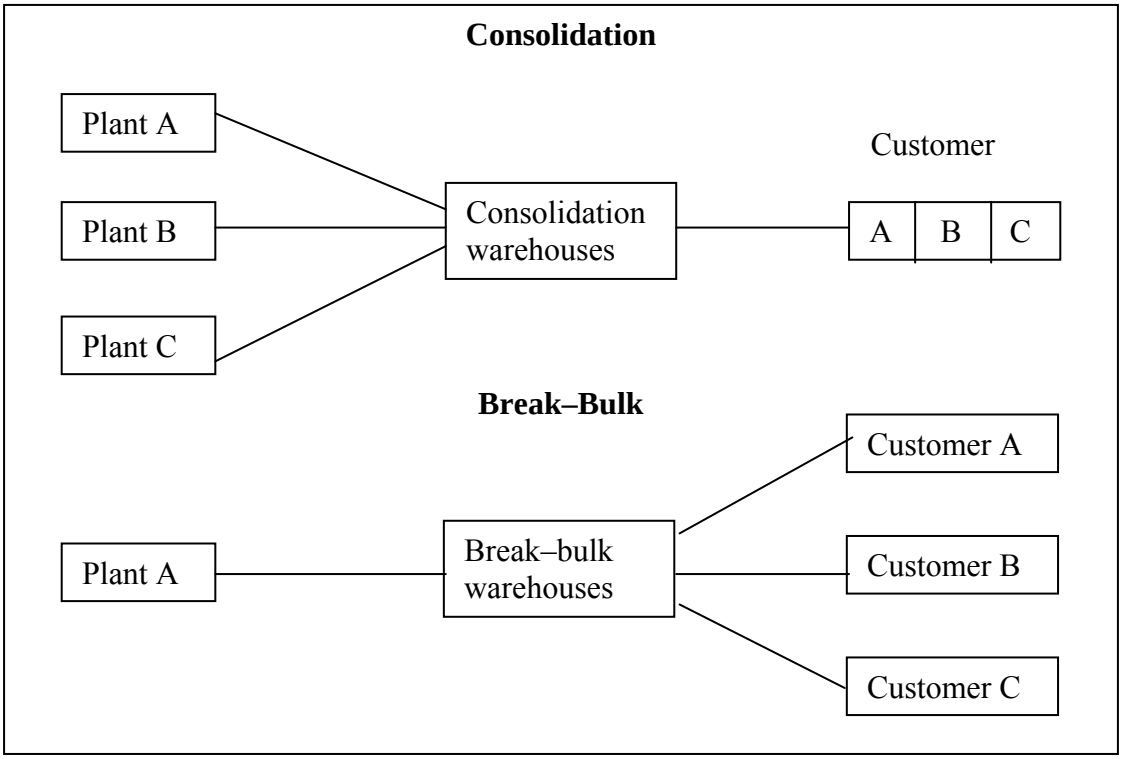


Figure 3.4: Consolidation and Break–bulk Arrangements
Source: Donald J. Bowersox, David J. Closs, M.Bixby Cooper, 2002, p. 383

- Assortment: the basic benefit is to reconfigure freight as it flows from origin to destination. Three types of assortments: cross docking, mixing, and assembly – are widely used in logistical systems. (See Figure 3.5)

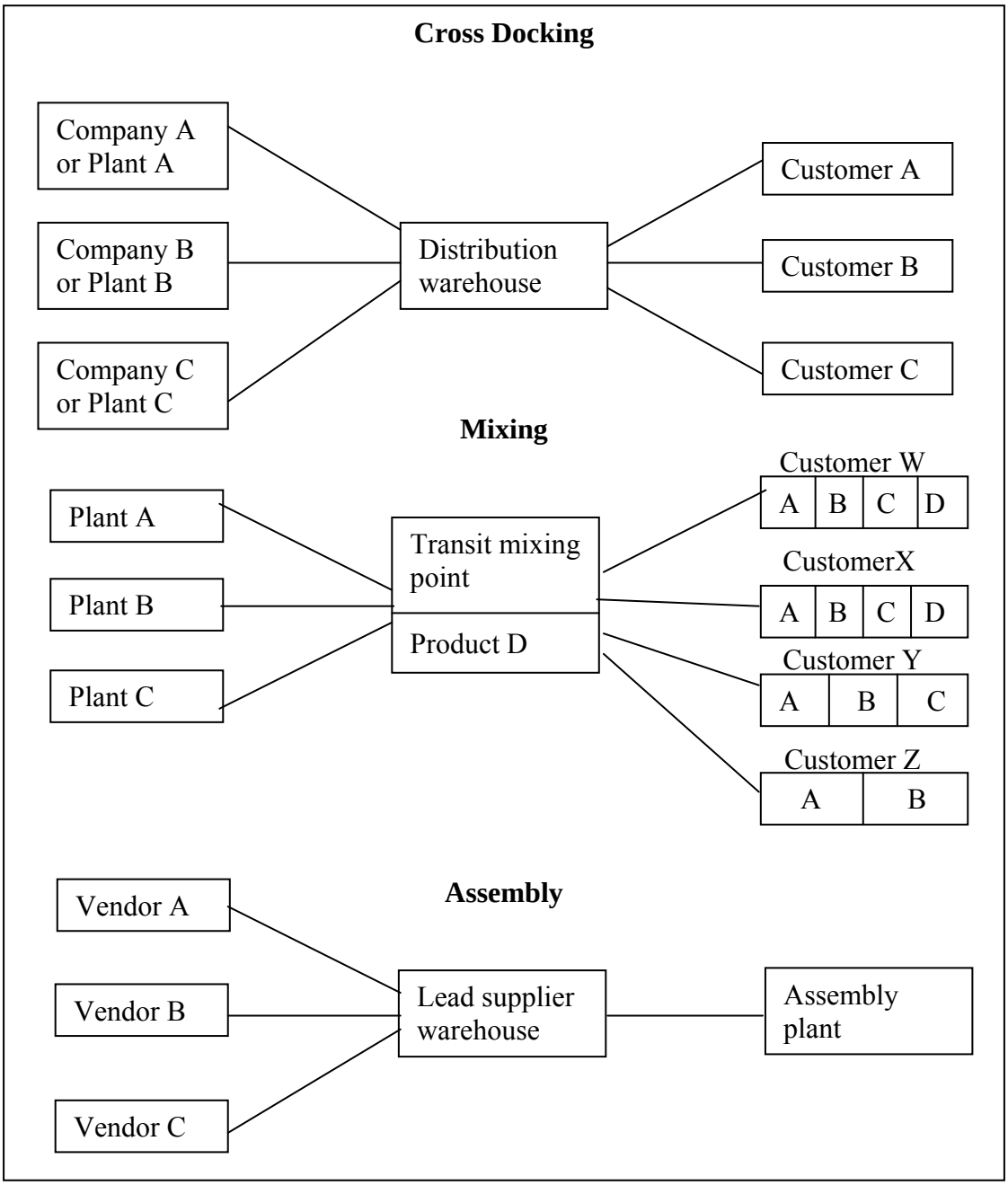


Figure 3.5: Assortment Arrangements
Source: Donald J. Bowersox, David J. Closs, M.Bixby Cooper, 2002, p. 385

- Postponement: warehouse can postpone commitment to final product configuration by completing final packaging, labelling, and light manufacturing. Postponement provides two economic benefits. First, risk is minimised because customised packaging is not performed in anticipation of customer orders or to accommodate a forecast. Second, total inventory can be reduced by using inventory of the base product to support multiple customers' labelling and package requirements. The combination of reduced risk and lower inventory can result in reduced total cost to service even if packaging

performed at the warehouse is more expensive per unit than if it were completed during manufacturing.

- Stockpiling: the direct economic benefit is to accommodate seasonal production or demand. It provides an inventory buffer that allows production efficiencies within the constraints imposed by material sources and consumers.

- Reverse logistics: most of the physical work related to product recall, reclamation, and disposal of overstock and damaged inventory is performed at warehouse. Besides, reverse logistics is concerned with controlled and regular inventory.

Warehouse service can provide benefits through enhanced revenue generation.

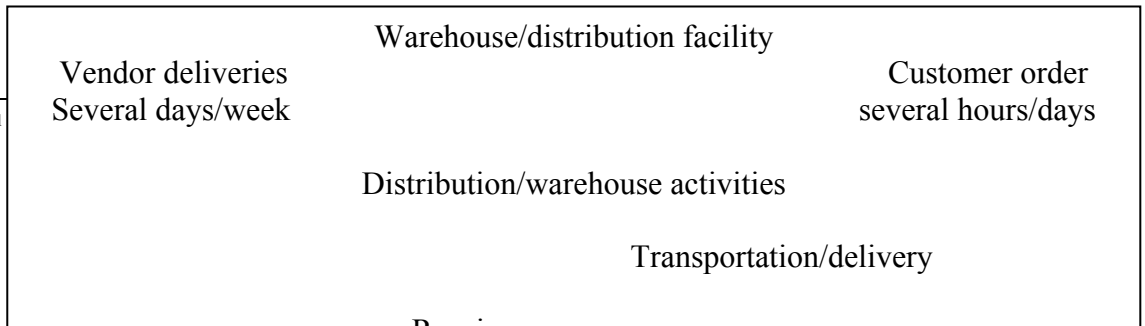
- Spot stocking: manufacturers of highly seasonal products often spot stock for the peak selling periods. In this sense, selected inventory is positioned or stocked in a warehouse in anticipation of responding to customer need during the critical sales time.

- Full line stocking: the traditional use of warehouse that is to stock product inventory in anticipation of customer orders. The full line stocking warehouse is more often restricted to a few strategic locations and operates year round.

- Product support: the warehouse stocks inventory to support manufacturing operations. Safety stocks on items purchased from outside vendors may be justified because of long lead times, potential supply discontinuity, and significant variations in usage rates.

- Market presence: a local warehouse can respond faster to customer needs than a more distant warehouse. It is anticipated that local warehouse presence will increase market share and potential profitability.

Besides, Mulcahy (1994) [21] concludes the key warehouse functions and demonstrates them through Figure 3.6. He argues that the goods and information flow within the warehouse is similar to water flowing through a funnel. "The mouth of the funnel is wide and accepts a large quantity of product and information. Over a period of time a wide mix of product in various storage unit quantities from numerous vendors or from the manufacturing facility is delivered to the warehouse and distribution facility on various types of delivery vehicles." (p. 1.1)



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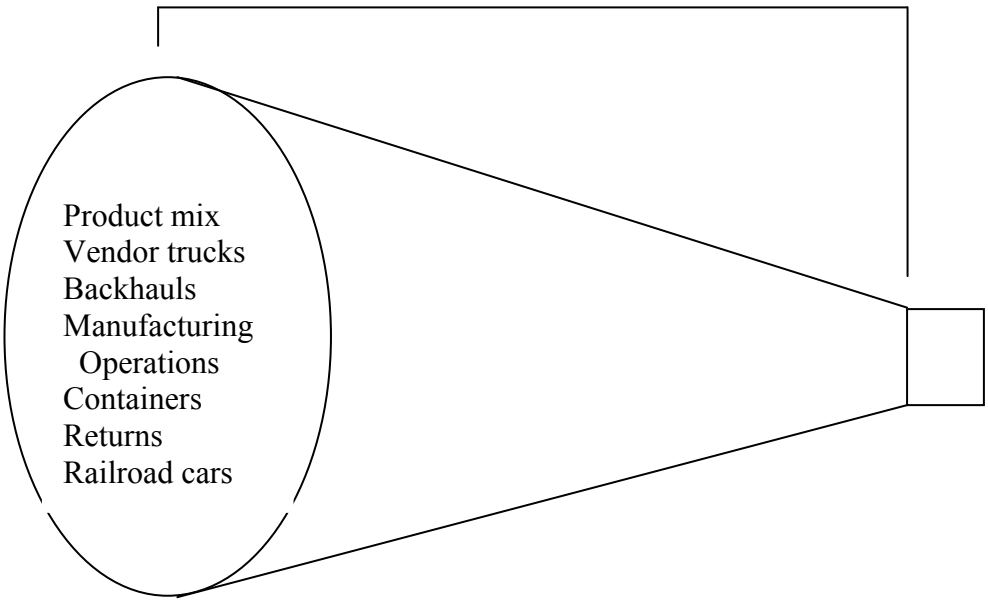

Figure 3.6: Warehouse Product and Information Flow through the Funnel
Source: David E. Mulcahy, 1994, p. 1.2

3.2.8 Warehouse Ownership Classification

Bowersox, Closs and Cooper (2002)[22] state that there typically are three sorts of warehouse ownership widely existing: private, public, and contract warehousing. (p. 393–395)

- Private warehouse: The warehouse is handled and stored by the enterprise that owns the merchandise. The building could be owned or leased. The major benefits of private warehousing are strong controllability, high flexibility, good cost–efficiency, etc.

- Public warehouse: The warehouse is operated as an independent business offering a range of for–hire services, such as storage, handling, and transportation. Public warehouses have traditionally been classified based on operational specialisation. The benefit is that almost any combination of services can be arranged on for–hire basis for either short or long term.

- Contract warehousing: This is a customised extension of public warehousing, which combines the benefits of private and for–hire warehousing. Typically, a

[22] Donald J. Bowersox, David J. Closs, M.Bixby Cooper, (2002), *"Supply Chain Logistics Management"*, McGraw-Hill

long–term contractual relationship will result in lower total cost than a public warehouse.

3.2.9 Functions of a Terminal

Lumsden (2002)[23] from the academic perspective summarises eight functions that a terminal may provide to users. (p. 313–315)

- Consolidation: the goods are collected from a relatively small surrounding. In the terminal, the goods are consolidated, loaded, unloaded and spread out.

- Transhipment: the goods may also be transhipped from one transport mode to another. This shall be done during a short period of time and often between two means of transportation with very different characteristics.

- Co–ordination: in order to adjust different types of transport modes, which arrive at the terminal at different points of time and depart in different means, to become more efficiently and effectively, certain co–ordination needs to be transacted. It is also of importance that the capacities of the different transport modes are co–ordinated.

- Sorting: when the flow of goods in the terminal is stopped, it is suitable to perform such value–adding operations that are possible to perform in other places than in the plant.

- Kiting: the incoming transport must be re–sorted in order for goods with the same destination to be brought together in the same unit, i.e. destination sorting.

- Sequencing: at the outgoing deliveries from the terminal, there is an increasing extent of demand for the goods to be sorted in a sequence adapted to the customers' requirements, such as sequencing the similar articles.

- Commercialisation: in many cases, it takes place on the goods that will be delivered out from the terminal for immediate sale. The goods then must be put in order in some way so that it can be immediately taken over by the final consumer.

[23] Kenth R. Lumsden, (2002), *"Fundamentals of Logistics"*, Chalmers University of Technology

- Storing: normally the goods passing through the terminal from one transport mode to another must be stopped for a short period of time, i.e. short time storing. And some types of goods use the terminal for long time storing.

3.3 Summary

As a general guideline, the theory of warehouse site selection method is appropriate to refer to throughout the study since selecting a site is the major aim of this study. The theories of Hoover's tapered transportation rates as well as facility location decisions are of assistance to understand the principle properly.

To identify the location of distribution centre, exact centre of gravity method is appropriate to be employed. In addition of this, PEST Model is applicable to measure alternative locations.

In association with the theories such as warehouse functionality, warehouse ownership classification, the theory of carrier selection criteria may contribute to estimate and identify suitable logistics service providers.

Understanding functions of a terminal will assist spreading all potentials and / or avoiding risks. Therefore, the capability of a distribution centre will be sufficiently amplified.

Part Two

The second part of the thesis contains information needs, analyses of the three empirical studies, conclusions and suggestions. The research model created in the first part is applicable to solve a real problem in the second part.

4 Information Needs

This chapter is dedicated to identifying the information needed for empirical studies in the three following chapters. The specifications of required information are addressed for each research question. According to Christopher and Wills (1972)[24], nine sorts of data are required in preparation of the study.

4.1 Data for Research Question 1

According to the exact centre of gravity method and the PEST model, four sorts of data are required in order for the empirical study to be carried out. In particular, the accuracy of market data is critical to the practical calculation of location.

- Market data
  - Allocation of each customer or customer group
  - Allocation of supply unit
  - Demand volume and number of orders at each customer or customer group
  - Transport rate from the facility to be located to each customer or customer group
  - Distance from the facility to be located to each customer or customer group

- Social data
  - Geography
  - Demography

- Political data
  - Policies and privileges for foreign companies, and the future trend
  - Specific support from local government and how they solve problems

- Traffic data
  - Local infrastructure situation
  - Road, rail and sea accessibility

[24] Martin Christopher & Gordon Wills, (1972), *"Marketing Logistics and Distribution Planning"*, George Allen & Unwin Ltd, UK

4.2 Data for Research Question 2

In order to objectively measure logistics service providers, three sorts of data are necessary for the study. Service performance, distribution cost and lead–time are major parameters.

- Company data
  - History
  - Ownership
  - Existence
  - Facility and resource
  - Management group
  - Key customers
  - Future development

- Service performance data
  - Scope of service
  - Service area of geographic coverage
  - Information processing and handling
  - Tracking and Tracing
  - Documentation accuracy
  - Claims handling

- Warehousing and distribution data
  - Inbound transport cost and lead–time (FCL)
  - Inbound transit time
  - Inbound transport frequency
  - Break container cost
  - Loading / unloading cost
  - Storage cost
  - Outbound transport cost and lead–time (LCL)
  - Outbound transit time
  - Outbound transport frequency

4.3 Data for Research Question 3

In this section, representative factors that might influence the physical distribution of MODUL Service AB will be reviewed. They are associated either from an external dimension or from an internal dimension.

- Sensitivity analysis from external environment
  - Logistics rate
  - Infrastructure development
  - Labour cost
  - Land price
  - Energy price

- Sensitivity analysis from internal organisation
  - Demand / Supply variation
  - Co–operation between MODUL Service AB and IKEA units

5 Empirical Study & Analysis – Location of Distribution Centre

This chapter aims to deal with the first research question: where should the distribution centre be located. It initially identifies a locational extent for the distribution centre. In the next, possible locations are selected and studied in depth. Based on comprehensive measurement, the optimal location for the day–to–day operations of distribution centre will be determined.

5.1 Identification of Locational Extent

In the northern part of China, MODUL Service AB has 20 customers that are allocated in 12 cities in FY04. These customers are to be supplied from the branch unit of MODUL Service AB in the Far East. Their locations are pinpointed in Figure 5.1.

Figure 5.1: Allocation of Branch Unit of MODUL Service AB and Customers in North China
Source: MOUDL Service AB

By means of overlaying a grid on Figure 5.1, the relative locations of the branch unit of MODUL Service AB and its customers in the northern part of China could be expressed as geometric coordinate points. (See Figure 5.2)

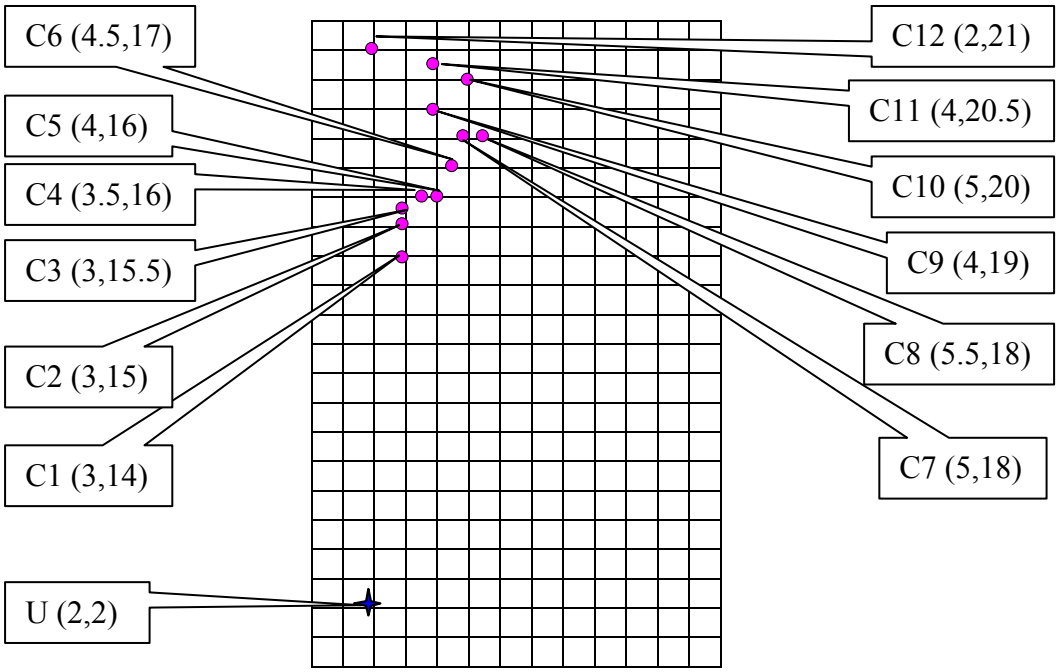

Figure 5.2: Grid Location Map of Branch Unit of MODUL Service AB and Customers in North China
Source: Own

According to sales budget of MODUL Service AB in FY04, total shipped tonnage to the customers in North China could be forecasted. (See Chapter 1) In association with transport rate applied on each customer as well as on branch unit, all factors involved in identifying location point are listed in Table 5.1.

Table 5.1: Volume, Transport Rates, Coordinate Locations for Supply and Customer Points

Point (i)	Location	Value (Sales Budget FY04) (RMB)	Volume (Ton)	Distance to Shenyang	Transport Rate (RMB/Ton/KM)	Coordinate X	Y
U	Shenzhen	13,550,000	872.6	3,300	0.087[25]	2	2
C1	Dalian	800,000	51.6	420	0.4[26]	3	14
C2	Anshan	1,000,000	64.4	100	0.4	3	15
C3	Liaoyang	3,000,000	193.2	65	0.4	3	15.5
C4	Shenyang	1,000,000	64.4	20	0.4	3.5	16
C5	Fushun	300,000	19.3	45	0.4	4	16
C6	Helong	300,000	19.3	650	0.3[27]	4.5	17
C7	Hailin	550,000	35.4	840	0.3	5	18
C8	Suifenhe	600,000	38.6	1010	0.3	5.5	18
C9	Harbin	1,300,000	83.7	570	0.3	4	19
C10	Yichun	3,900,000	251.2	930	0.3	5	20
C11	Wudalianc	500,000	32.2	1000	0.3	4	20.5
C12	Yakeshi	300,000	19.3	1230	0.3	2	21

Source: Own

According to Exact Centre of Gravity Method, an initial or approximate location point for the distribution centre could be found. Calculations are displayed in a tabular form in Table 5.2.

Table 5.2: Initial Coordinate Location for the Distribution Centre

i	X	Y	V	R	VR	VRX	VRY
P	2	2	872.6	0.087	75.92	151.84	151.84
C1	3	14	51.6	0.4	20.64	61.92	288.96
C2	3	15	64.4	0.4	25.76	77.28	386.4
C3	3	15.5	193.2	0.4	77.28	231.84	1,197.84
C4	3.5	16	64.4	0.4	25.76	90.16	412.16
C5	4	16	19.3	0.4	7.72	30.88	123.52
C6	4.5	17	19.3	0.3	5.79	26.06	98.43
C7	5	18	35.4	0.3	10.62	53.1	191.16
C8	5.5	18	38.6	0.3	11.58	63.69	208.44
C9	4	19	83.7	0.3	25.11	100.44	477.09
C10	5	20	251.2	0.3	75.36	376.8	1,507.2
C11	4	20.5	32.2	0.3	9.66	38.64	198.03
C12	2	21	19.3	0.3	5.79	11.58	121.59
Sum					376.99	1,314.23	5,362.66
X = 1,314.23 / 376.99 = 3.49							
Y = 5,362.66 / 376.99 = 14.22							

Source: Own

[25] Transport rate is determined by dividing a representative quoted rate by the distance over which the rate applies. Shenzhen–Shenyang sea transport cost = 4,300 RMB/TEU; Shenzhen–Shenyang distance = 3,300 KM
4,300 RMB/TEU / 3,300 KM / 15 Ton/TEU = 0.087 RMB/Ton/KM

[26] In north China, road transport cost = 0.4 RMB / Ton (distance < 500 KM)

[27] In north China, road transport cost = 0.3 RMB / Ton (distance > 500 KM)

Using the initial location point found in Table 5.2, the grid coordinates for the distribution centre could be revised. Calculations based on the revised coordinates are repeated twice until the coordinates change in a very small extent. (See Table 5.3 and Table 5.4)

Table 5.3: First Revised Coordinate Location for the Distribution Centre

i	X	Y	V	R	d (KM)	VR/d	VRX/d	VRY/d
P	2	2	872.6	0.087	1477.26[28]	0.051	0.1	0.1
C1	3	14	51.6	0.4	64.44	0.32	0.96	4.484
C2	3	15	64.4	0.4	110.53	0.233	0.699	3.496
C3	3	15.5	193.2	0.4	164.47	0.47	1.41	7.285
C4	3.5	16	64.4	0.4	213.6	0.121	0.422	1.936
C5	4	16	19.3	0.4	222.19	0.035	0.139	0.556
C6	4.5	17	19.3	0.3	354.93	0.016	0.073	0.277
C7	5	18	35.4	0.3	488.45	0.022	0.109	0.391
C8	5.5	18	38.6	0.3	513.74	0.023	0.124	0.406
C9	4	19	83.7	0.3	576.86	0.044	0.174	0.827
C10	5	20	251.2	0.3	716.88	0.105	0.525	2.1
C11	4	20.5	32.2	0.3	756.08	0.013	0.051	0.262
C12	2	21	19.3	0.3	833.02	0.007	0.014	0.146
Sum						1.46	4.8	22.26
X = 4.8 / 1.46 = 3.29								
Y = 22.26 /1.46 = 15.25								

Source: Own

Table 5.4: Second Revised Coordinate Location for the Distribution Centre

i	X	Y	V	R	d (KM)	VR/d	VRX/d	VRY/d
P	2	2	872.6	0.087	1597.52	0.048	0.095	0.095
C1	3	14	51.6	0.4	38.91	0.53	1.591	7.426
C2	3	15	64.4	0.4	45.95	0.561	1.682	8.409
C3	3	15.5	193.2	0.4	45.95	1.682	5.045	26.068
C4	3.5	16	64.4	0.4	93.46	0.276	0.965	4.41
C5	4	16	19.3	0.4	123.93	0.062	0.249	0.997
C6	4.5	17	19.3	0.3	255.31	0.023	0.102	0.386
C7	5	18	35.4	0.3	388.6	0.027	0.137	0.492
C8	5.5	18	38.6	0.3	423.36	0.027	0.15	0.492
C9	4	19	83.7	0.3	457.99	0.055	0.219	1.042
C10	5	20	251.2	0.3	605.81	0.124	0.622	2.488
C11	4	20.5	32.2	0.3	635.74	0.015	0.061	0.311
C12	2	21	19.3	0.3	707.15	0.008	0.016	0.172
Sum						3.438	10.934	52.788
X = 10.934 / 3.438 = 3.18								
Y = 52.788 / 3.438 = 15.35								

Source: Own

[28] $d = 120\sqrt{(2-3.49)^2 + (2-14.22)^2} = 1477.26$

Therefore, the optimal location point (3.18, 15.35) for distribution centre of MODUL Service AB is found on the grid location map. (See Figure 5.3)

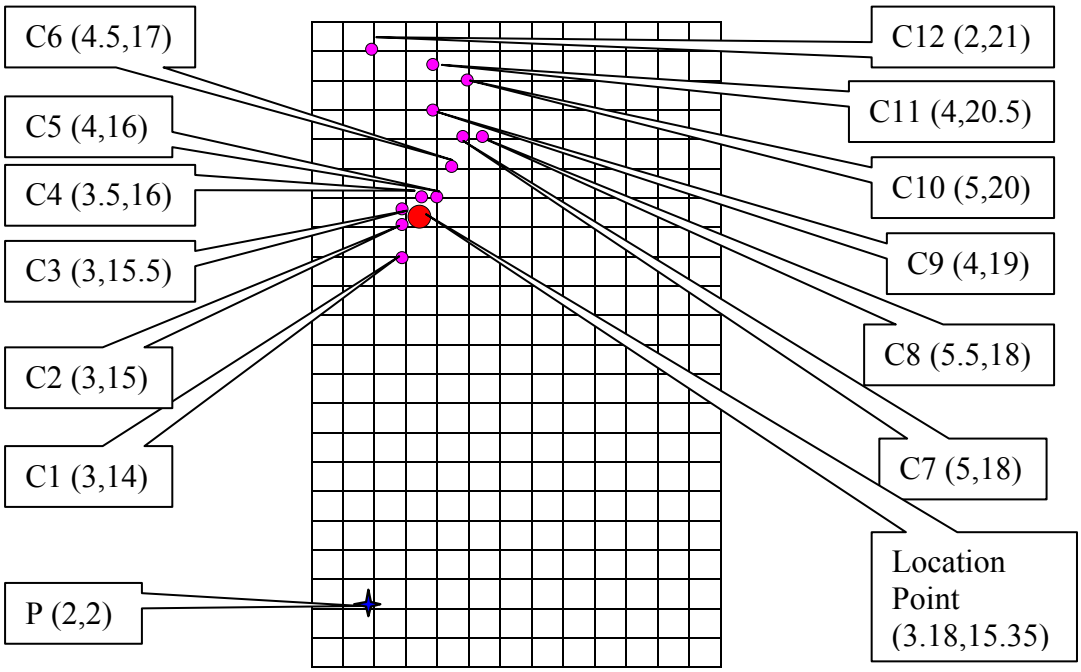

Figure 5.3: The Optimal Location Point for Distribution Centre
Source: Own

After transferring the location point from grid map to real map, the geographic location of distribution centre is found in middle–south of Liaoning province in North China. In consequence, a feasible locational extent for the distribution centre of MODUL Service AB could be identified in a region within Liaoning province. (See Figure 5.4[29])

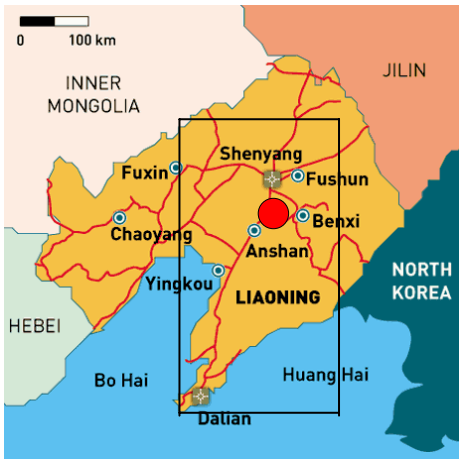

Figure 5.4: The Locational Extent for the Distribution Centre
Source: http://www.lniipc.com

[29] http://www.lniipc.com, visited on 2003-11-06

5.2 Selection of Possible Locations

Regarding the calculated locational extent, three cities within Liaoning Province, i.e. Dalian, Yingkou, and Shenyang are selected. (See Figure 5.5) Their social, political, and traffic environment will be investigated according to the PEST Model.

Figure 5.5: Three Alternative Cities in the Locational Extent
Source: http://www.lniipc.com

5.2.1 Social Environment

Liaoning province is situated in the southern part of northeast China. Liaoning is a vital gateway to and from North China. It is also a linkage between the western part of China and the northern part of China. (See Figure 5.6[30]) Currently, the population of Liaoning has reached 40.9 million, and more than half of inhabitants reside in urban areas.

[30] http://www.moc.gov.cn, visited on 2003-11-06

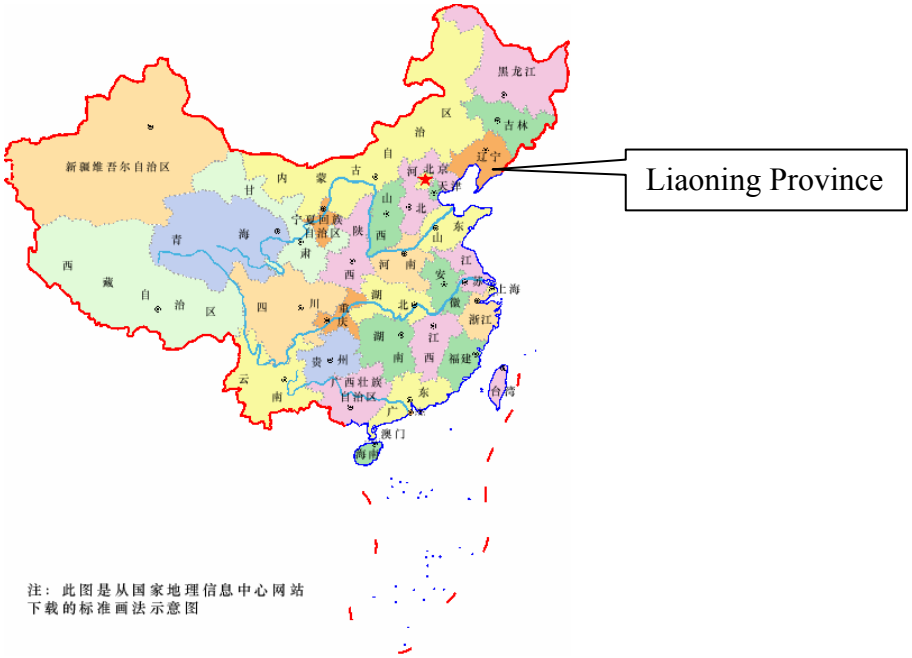

Figure 5.6: Liaoning Province in China
Source: http://www.moc.gov.cn

Dalian[31] is located in the southern tip of the eastern Liaoning. Dalian has a convenient coastal location. Dalian covers an area of 13,800 square kilometres, and has a population of 5.9 million.

Yingkou[32] is located in the middle of Dalian and Shenyang in the southern Liaoning. Yingkou is a coastal city closest to Liaoning inland area. Yingkou has a total urban area of 5,365 square kilometres, with the population of 2.26 million.

Shenyang[33] is located in the middle of Liaoning. Shenyang is the hub of the provincial transportation network. The land area of Shenyang is 12,980 square kilometres with a population of 6.9 million.

5.2.2 Political Environment[34]

Today, Liaoning provincial government has paid great attention to the perfection of soft investment environment. In order to create an excellent external environment for foreign investment, the provincial government has put the focus on improving work efficiency, such as simplifying some approval procedures,

[31] http://www.dalian-gov.net, visited on 2003-11-06
[32] http://www.yingkou.gov.cn, visited on 2003-11-06
[33] http://www.shenyang.gov.cn, visited on 2003-11-06
[34] http://www.lniipc.com, visited on 2003-11-07

establishing regular meeting with foreign enterprises, and implementing registered protection service for foreign enterprises.

According to the commercial laws and regulations of China, more preferential policies for foreign enterprises are applied. A series of financial privileges, such as a favourable tax rate, are provided via local municipalities to foreign enterprises. The department of foreign trade and economic co–operation in certain circumstance also provides co–ordination between foreign enterprises and local authorities, such as the customs bureau, and the tax bureau.

5.2.3 Traffic Environment

Liaoning Province: Liaoning has a comprehensive transportation network associated with ports, railways, highways, and co–ordinated by civil aviation and pipeline. There are 5,159 kilometres of railway in operation, which covers all cities within the province. The total length of road network is over 40,000 kilometres, with 17,200 kilometres of high–level road. Every city and 90 percent of the villages can be reached by road. The provincial highway system with the hub of Shenyang connects major cities and links neighbouring provinces. There are five foreign trade harbours, i.e. Dalian, Yingkou, Bayuquan, Dandong and Jinzhou, which in total have 150 berths with 40 berths of 10,000 tonnages. There are two airports in Dalian and Shenyang. (See Figure 5.7)

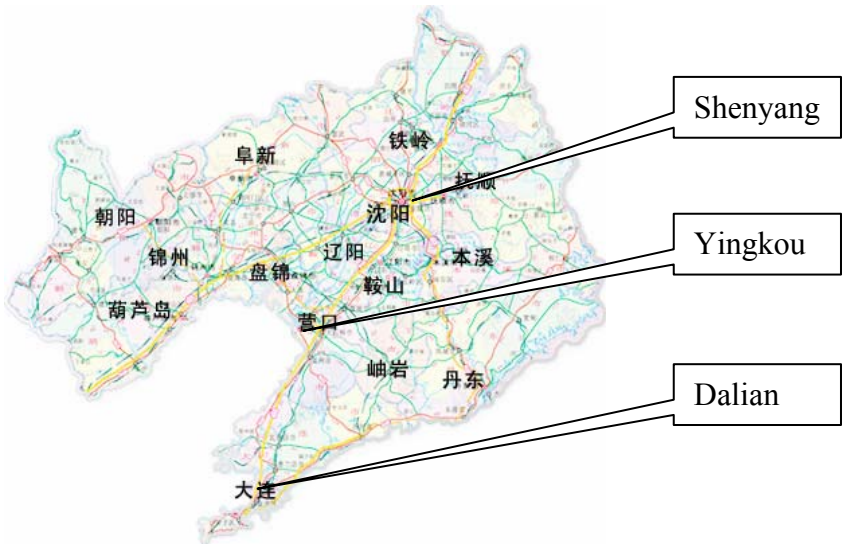

Figure 5.7: Map of Liaoning Province
Source: http://www.lniipc.com

Dalian[35] is the major sea road transport gateway connecting North China with other countries and areas. Dalian has two seaports: Dalian Port and Dayawan Port. Dalian Port is located close to urban area; Dayawan Port is 15 kilometres away from the city. In total, there are more than 70 berths including 40 berths with over 10,000 tons berthing capacity. Dalian is connected to the railway network in North China. Dalian has one airport, Dalian Zhoushuizi Airport, which is 10 kilometres away from the city. Dalian is also reachable through the provincial highway system. However, the highway between Dalian and Shenyang are out of use, although it will be in operation by the end of 2004.

Yingkou[36] is a coastal city with convenient land transportation to North China. The provincial railway as well as highway systems pass through the city. Yingkou has two seaports: Yingkou Port and Baiyuquan Port. Yingkou Port is close to city area with 8 berths; Baiyuquan Port is located 70 kilometres away from the city, which has 9 berths.

Shenyang[37] is the hub and centre of railway as well as highway transport network in Liaoning. Shenyang has two railway stations: Shenyang Railway Station and Shenyang North Railway Station. There are 236 kilometres of highway, which surround and link Shenyang with other areas. There are also 7 consolidation terminals for cargo transhipment. Shenyang Taoxian Airport is 18 kilometres to the city.

5.3 Determination of Optimal Location

In order to determine an appropriate city as the optimal location for the distribution centre, three alternative cities are evaluated comprehensively. (See Table 5.5)

Table 5.5: Evaluation of Three Alternative Cities[38]

riteria / City	Social Environment	Political Environment	Traffic Environment			Sum
			Road Access	Rail Access	Sea Access	
Dalian	4	4	3	4	5	20
Yingkou	4	4	4	4	5	21
Shenyang	4	4	5	5	4	22

Source: Own

[35] http://www.dalian-gov.net, visited on 2003-11-07
[36] http://www.yingkou.net.cn, visited on 2003-11-07
[37] http://www.shenyang.gov.cn, visited on 2003-11-07
[38] Satisfaction Measure is scored as: 1 Extremely dissatisfactory, 2 Somewhat dissatisfactory, 3 Slightly dissatisfactory, 4 Satisfactory, 5 Very satisfactory

According to geographical positions, three cities have different transport accessibility. Dalian and Yingkou are convenient portals to and from North China by sea, whereas Shenyang has ideal road as well as rail transport access and wide coverage to the surrounding areas due to its hub position in the transport network of Liaoning.

According to the evaluation, Shenyang is the optimal city for MODUL Service AB to locate its distribution centre. At present, the distribution assignment of MODUL Service AB to North China is characterised by high frequency and small volume in each shipment. Good road transport access may assist logistics service providers to distribute freight in the shortest time. Moreover, logistics service providers may arrange shipment better since more than one transport routes, either through Dalian or pass Yingkou, are available. Besides, selecting Shenyang as an appropriate city in North China to locate the distribution centre is also approved by the experienced people from IKEA Group from the practical point of view.

6 Empirical Study & Analysis – Logistics Service Provider

This chapter intends to deal with the second research question: how should the logistics service providers be employed? First of all, an overview of logistics service providers that exist in North China is presented. Afterwards, a number of representative logistics service providers are discussed and evaluated. In consequence, one or a group of appropriate logistics service providers will be recommended to co–operate with the related city.

6.1 Overview of Logistics Service Providers in North China

Generally speaking, the logistics industry in North China is still under–developed. Most of Chinese logistics service providers here have obsolete ideas about contemporary logistics. Utilisation of third party logistics is rather limited since most of the Chinese large enterprises, whether collective or private, have their own transport and warehousing capacity. In combination with the lack of technology, capital, and complex regulatory hurdles, both foreign and Chinese logistics service providers need a long time to develop.

At present, four types of logistics service providers exist in North China.

- Chinese State–Owned Logistics Service Providers: The biggest logistics service providers in North China are state–owned logistics enterprises, such as China Ocean Shipping Group Company (COSCO), China Shipping Group Company, China Post, and China National Materials Storage & Transportation Corporation. Most of them have categorised core business on sea transport, road transport, or warehousing. After deregulation from the planned economy, they are reducing costs and / or improving the service level in order to become more competitive. However, the change is rather slow due to their bureaucratic organisation structure as well as the enormous fixed assets.

- Chinese First Party Logistics Service Providers[39]: Many large enterprises in North China have developed their own transport and warehousing departments since the era of the planned economy, in order to support their commercial performance. Like the state–owned logistics service providers, they normally have a large number of warehouse facilities and transport means. After the planned economy shifted to the market economy in China, these enterprises have started reorganising transport and warehousing

[39] http://www.handels.gu.se/epc/archive/00002736/01/gbs_thesis_2002_29.pdf, visited on 2003-11-09

departments and have begun opening to external demand. Nevertheless, most of them currently have limited capacity to provide cost efficient logistics services to external customers.

- Chinese Private Third Party Logistics Service Providers: There are a number of small and middle sized private third party logistics companies in North China. They usually have good knowledge about logistics and provide relatively cost efficient logistical solutions in certain circumstances. Some of them operate in the form of road haulier, warehouse operator, or freight forwarder. And most of them are capable of co-ordinating with each other in order to widen their business scope.

- Foreign Logistics Service Providers: They entered the Chinese logistics market in the 1980s. Many of them have established strategic partnerships with Chinese logistics service providers, since they are restricted to operate independently in China. FedEx, UPS, Maersk, APL are the first group of foreign entrants. Compared to Chinese logistics service providers, they have such advantages as advanced technology, rich experience, professional service performance, and sufficient capital. They are able to provide integrated, value–added service with high efficiency. But their operational costs are also higher than Chinese private third party logistics service providers.

6.2 Selection of possible logistics service providers

In this section, seven prospective logistics service providers are investigated in terms of service performance, inbound as well as outbound transport cost and lead–time, and many non–economic factors.

6.2.1 Maersk Logistics[40]

Company Profile: one of the world leading logistics service providers that has great progress in China. (See Table 6.1)

[40] http://www.maersk-logistics.com/sw68.asp, visited on 2003-11-12

Table 6.1: Company Profile of Maersk Logistics

History	Start operating in 1998
Ownership	Danish company under Maersk Group, Maersk Logistics (China) Co. Ltd. was the first European logistics company granted incorporation in China, registered as a wholly owned foreign enterprise
Existence	Head office located in Shanghai; 16 branch offices located in Beijing, Chengdu, Chongqing, Dalian, Guangzhou, Nanjing, Ningbo, Qingdao, Shenyang, Shenzhen, Tianjin, Wuhan, Xiamen, Fuzhou, Harbin
Facility and Resource	3 Chinese warehouse subcontractors provide 9 subcontracted warehouses in Shenyang, Tianjin, Qingdao, Nanjing, Shanghai, Xiamen, Guangzhou, Chongqing; 3 Chinese bonded warehouse subcontractors provide 8 bonded warehouses in Shenyang, Dalian, Tianjin, Qingdao, Shanghai, Xiamen, Guangzhou, Shenzhen; a large number of Chinese trucking subcontractors provide inland haulage
Management Group	Professional management and operation team with experienced co–workers
Key Customers	Most of customers are foreign enterprises: IKEA Group, Federated Merchandising Group, Carrefour Global Sourcing Ltd, CVS/pharmacy Corp, Levi Strauss & Co, Perseco
Future Development	Ambitious to set up 60 offices with 8000 employees

Source: http://www.maersk-logistics.com/sw68.asp

Service Performance: may provide a wide range of logistics service in a professional way. (See Table 6.2)

Table 6.2: Service Performance of Maersk Logistics

Scope of service	Supply chain management, international forwarding, warehousing & distribution, airfreight, value–added service
Service area of geographic coverage	Whole areas across China
Information Processing and Handling	High level of informationalisation: provide internet platform and extranet facility, able to implement such program as EDI, VMI, Barcoding, T&T online
Tracking and Tracing	Provide internet platform to customers, use telephone and/or mobile phone to track cargo
Documentation Accuracy	High level of documentation accuracy
Claims Handling	Quick reflection via claims management team, cost benefit analysis approved by chief manager

Source: http://www.maersk-logistics.com/sw68.asp

Warehousing & Distribution: operational cost is in high level and lead–time is usual. (See Table 6.3)

Table 6.3: Warehousing & Distribution of Maersk Logistics

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Yingkou/Dalian – Shenyang	5250 RMB/TEU, 8 – 12 days
Break Container Cost	Shenyang	
Loading/Unloading Cost		22 RMB/Ton
Storage Cost		0.8 RMB/Ton/Day
Outbound Transport Cost and Lead–time (LCL)[41]	Shenyang – Dalian	324–342–360 RMB/Ton, 1 day
	Shenyang – Anshan	258–282–300 RMB/Ton, 2 days
	Shenyang – Liaoyang	221–247–260 RMB/Ton, 1 day
	Shenyang – Shenyang	104–117–130 RMB/Ton, 1 day
	Shenyang – Fushun	156–182–195 RMB/Ton, 1 day
	Shenyang – Helong	374–402–424 RMB/Ton, 2–3 days
	Shenyang – Hailin	397–426–460 RMB/Ton, 3 days
	Shenyang – Suifenhe	473–506–534 RMB/Ton, 3–4 days
	Shenyang – Harbin	294–324–360 RMB/Ton, 2 days
	Shenyang – Yichun	473–506–534 RMB/Ton, 3–4 days
	Shenyang – Wudalianchi	600–622–644 RMB/Ton, 3–4 days
	Shenyang – Yakeshi	605–620–644 RMB/Ton, 2 days
Outbound Transit Time	Shenyang	1 – 2 days

Source: http://www.maersk-logistics.com/sw68.asp

6.2.2 China Shipping Container Lines (Dalian) Co.,Ltd[42]

Company Profile: one of the biggest Chinese state–owned logistics service providers in China with the core business on ocean shipping. (See Table 6.4)

[41] Transport price is determined by shipment volume of less than 2 tons, 2–5 tons, and over 5 tons.
[42] http://www.csl.com.cn/, visited on 2003-11-12

Table 6.4: Company Profile of China Shipping Container Lines (Dalian) Co.,Ltd

History	Reorganised in 1997
Ownership	Chinese state–owned logistics service provider
Existence	One of CSCL's regional companies with the head office in Dalian; 11 branch offices located in Yingkou, Jinzhou, Dandong, Shenyang, Changchun, Harbin, Mudanjiang, Qiqihaer, Yanji, Benxi, Anshan
Facility and Resource	Has a fleet of 10 container vessels and a large number of trucks; cooperate with a number of local hauliers
Management Group	Capable management group with great willingness to improve
Key Customers	Most of customers are Chinese enterprises
Future Development	Wish to become a competitive international third party logistics service provider

Source: http://www.csl.com.cn/

Service Performance: may provide a wide range of logistics service in normal level. (See Table 6.5)

Table 6.5: Service Performance of China Shipping Container Lines (Dalian) Co.,Ltd

Scope of service	International and domestic container transportation, shipping agency, freight forwarding, value–added service
Service area of geographic coverage	Covering 3 provinces i.e. Liaoning, Jilin, Heilongjiang, in North China
Information Processing and Handling	Normal level of informationalisation
Tracking and Tracing	Use telephone and/or mobile phone to track cargo
Documentation Accuracy	Normal level of documentation accuracy
Claims Handling	Slow reflection to customer claims

Source: http://www.csl.com.cn/

Warehousing & Distribution: operational cost is in normal level and lead–time is long. (See Table 6.6)

Table 6.6: Warehousing & Distribution of China Shipping Container Lines (Dalian) Co.,Ltd

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Jinzhou – Shenyang Shenzhen – Jinzhou – Harbin	4500 RMB/TEU, 13–16 days 5500 RMB/TEU, 15–18 days
Break Container Cost	Shenyang	
Loading/Unloading Cost		7.5 RMB/Pallet
Storage Cost		0.45 RMB/Pallet/Day
Outbound Transport Cost and Lead–time (LCL)	Shenyang – Dalian	0.4 RMB/Ton/KM
	Shenyang – Anshan	
	Shenyang – Liaoyang	
	Shenyang – Shenyang	
	Shenyang – Fushun	
	Shenyang – Helong	0.3 RMB/Ton/KM
	Shenyang – Hailin	
	Shenyang – Suifenhe	
	Shenyang – Harbin	
	Shenyang – Yichun	
	Shenyang – Wudalianchi	
	Shenyang – Yakeshi	
Outbound Transit Time	Shenyang	1 – 2 days

Source: http://www.csl.com.cn/

6.2.3 Shenyang Yiyun Industrial Liability Co.,Ltd[43]

Company Profile: state–owned logistics service providers in North China with the core business on road transport. (See Table 6.7)

Table 6.7: Company Profile of Shenyang Yiyun Industrial Liability Co.,Ltd

History	Reorganised in 1998
Ownership	Chinese state–owned logistics service provider within Shenyang Transport Group Co.,Ltd
Existence	Located in Shenyang
Facility and Resource	Has 5 freight terminals surrounding Shenyang and over 100 trucks; cooperate with a number of local hauliers
Management Group	Capable management group with great willingness to improve
Key Customers	Most of customers are Chinese enterprises
Future Development	Wish to become one of the leading third party logistics service providers in North China

Source: http://www.syyiyun.com/

[43] http://www.syyiyun.com/, visited on 2003-11-13

Service Performance: may provide road transport and warehousing service in normal level. (See Table 6.8)

Table 6.8: Service Performance of Shenyang Yiyun Industrial Liability Co.,Ltd

Scope of service	Road freight transportation, value–added service
Service area of geographic coverage	Covering 3 provinces i.e. Liaoning, Jilin, Heilongjiang, in North China
Information Processing and Handling	Normal level of informationalisation: able to establish EDI program according to customer requirement
Tracking and Tracing	Use telephone and/or mobile phone to track cargo
Documentation Accuracy	Normal level of documentation accuracy
Claims Handling	Slow reflection to customer claims

Source: http://www.syyiyun.com/

Warehousing & Distribution: operational cost is in high level and lead–time is short. (See Table 6.9)

Table 6.9: Warehousing & Distribution of Shenyang Yiyun Industrial Liability Co.,Ltd

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Yingkou/Dalian/Jinzhou – Shenyang	
Break Container Cost	Shenyang	150 RMB/TEU
Loading/Unloading Cost		10 RMB/Ton
Storage Cost		2 RMB/Pallet/Day
Outbound Transport Cost and Lead–time (LCL)	Shenyang – Dalian	400 RMB/Ton, 0.5 day
	Shenyang – Anshan	500 RMB/Ton, 0.4 day
	Shenyang – Liaoyang	400 RMB/Ton, 0.4 day
	Shenyang – Shenyang	
	Shenyang – Fushun	400 RMB/Ton, 0.4 day
	Shenyang – Helong	1000 RMB/Ton, 1.5 days
	Shenyang – Hailin	1000 RMB/Ton, 3 days
	Shenyang – Suifenhe	1200 RMB/Ton, 3 days
	Shenyang – Harbin	700 RMB/Ton, 1 day
	Shenyang – Yichun	1200 RMB/Ton, 2 days
	Shenyang – Wudalianchi	1200 RMB/Ton, 3 days
	Shenyang – Yakeshi	1200 RMB/Ton, 3 days
Outbound Transit Time	Shenyang	1 – 2 days

Source: http://www.syyiyun.com/

6.2.4 Huapengfei Logistics Co.,Ltd[44]

Company Profile: Chinese private logistics service provider with the core business on road freight transportation. Currently it has business partnership with MODUL Service AB. (See Table 6.10)

Table 6.10: Company Profile of Huapengfei Logistics Co.,Ltd

History	Founded in November of 2000
Ownership	Chinese private third party logistics service provider
Existence	Head office located in Shenzhen, 25 branch offices located in Beijing, Shanghai, Jiaxing, Guangzhou, Chengdu, Fangcheng, Shenyang, Qingdao, Jinan, Zhengzhou, Nanjing, Wuxi, Fuzhou, Xiamen, Huiyang, Dongguan, Nanjing, Haikou, Kunming, Chongqing
Facility and Resource	Work with 20 freight terminals across China; has over 200 trucks and 200 other transport vehicles; cooperate with a number of local hauliers
Management Group	Competent management group with great ambition
Key Customers	Most of customers are Chinese enterprises: Huawei Technologies Co.,Ltd, ZTE Corporation, Legend Holdings Limited, China Greatwall Computer Shenzhen Co.,Ltd, Foxconn Industry Group
Future Development	Wish to become one of the Chinese leading third party logistics service providers

Source: http://www.huapengfei.com/index.jsp

Service Performance: may provide needed logistics service in a good way. (See Table 6.11)

Table 6.11: Service Performance of Huapengfei Logistics Co.,Ltd

Scope of service	Road freight transportation, value–added service
Service area of geographic coverage	Whole areas across China
Information Processing and Handling	High level of informationalisation: provide internet platform and extranet interface, able to implement such program as EDI, T&T online
Tracking and Tracing	Use telephone and/or mobile phone to track cargo
Documentation Accuracy	High level of documentation accuracy
Claims Handling	Quick reflection to customer claims

Source: http://www.huapengfei.com/index.jsp

[44] http://www.huapengfei.com/index.jsp, visited on 2003-11-13

Warehousing & Distribution: operational cost is relatively low and lead–time is short. (See Table 6.12)

Table 6.12: Warehousing & Distribution of Huapengfei Logistics Co.,Ltd

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Yingkou – Shenyang	4150 – 4350 RMB/TEU, 8 – 12 days
Break Container Cost	Shenyang	150 RMB/TEU
Loading/Unloading Cost		
Storage Cost		
Outbound Transport Cost and Lead–time (LCL)[45]	Shenyang – Dalian	340 – 370 RMB/Ton, 1 day
	Shenyang – Anshan	270 – 280 RMB/Ton, 0.5 day
	Shenyang – Liaoyang	270 – 280 RMB/Ton, 0.5 day
	Shenyang – Shenyang	145 – 190 RMB/Ton, 0.5 day
	Shenyang – Fushun	240 – 285 RMB/Ton, 0.5 day
	Shenyang – Helong	380 – 400 RMB/Ton, 1 day
	Shenyang – Hailin	440 – 480 RMB/Ton, 2 days
	Shenyang – Suifenhe	440 – 480 RMB/Ton, 2.5 days
	Shenyang – Harbin	390 – 440 RMB/Ton, 1.5 days
	Shenyang – Yichun	420 – 490 RMB/Ton, 2.5 days
	Shenyang – Wudalianchi	460 – 500 RMB/Ton, 2.5 days
	Shenyang – Yakeshi	500 – 600 RMB/Ton, 2.5 days
Outbound Transit Time	Shenyang	1 – 1.5 days

Source: http://www.huapengfei.com/index.jsp

6.2.5 Harbin Zhongxin Logistics Co.,Ltd[46]

Company Profile: Chinese private logistics service provider with the core business on road freight transportation. (See Table 6.13)

[45] Transport price is determined by shipment volume of over or less than 2 tons
[46] http://www.jz168.com/, visited on 2003-11-14

Table 6.13: Company Profile of Harbin Zhongxin Logistics Co.,Ltd

History	Founded in 1998
Ownership	Chinese private third party logistics service provider
Existence	One of the regional companies of Zhongxin Logistics Co.,Ltd, head office located in Harbin and branch offices in Shanghai, Wenling etc
Facility and Resource	Has 2 freight stack yards in Harbin and 20 trucks; cooperate with a number of local hauliers
Management Group	Capable management group with great ambition
Key Customers	Most of customers are Chinese enterprises
Future Development	Wish to expand business all over China

Source: http://www.jz168.com/

Service Performance: may provide needed logistics service in normal level. (See Table 6.14)

Table 6.14: Service Performance of Harbin Zhongxin Logistics Co.,Ltd

Scope of service	Road freight transportation, value–added service
Service area of geographic coverage	Covering 3 provinces i.e. Liaoning, Jilin, Heilongjiang, in North China
Information Processing and Handling	Low level of informationalisation
Tracking and Tracing	Use telephone and/or mobile phone to track cargo
Documentation Accuracy	Normal level of documentation accuracy
Claims Handling	Slow reflection to customer claims

Source: http://www.jz168.com/

Warehousing & Distribution: operational cost is relatively low and lead–time is short. (See Table 6.15)

Table 6.15: Warehousing & Distribution of Harbin Zhongxin Logistics Co.,Ltd

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Yingkou – Harbin	5100 RMB/TEU, 11 – 14 days
Break Container Cost	Harbin	
Loading/Unloading Cost		
Storage Cost		
Outbound Transport Cost and Lead–time (LCL)	Shenyang – Dalian	
	Shenyang – Anshan	
	Shenyang – Liaoyang	
	Shenyang – Shenyang	
	Shenyang – Fushun	
	Shenyang – Helong	
	Harbin – Hailin	150 RMB/Ton
	Harbin – Suifenhe	150 RMB/Ton
	Harbin – Yichun	150 RMB/Ton
	Harbin – Wudalianchi	200 RMB/Ton
	Harbin – Yakeshi	210 RMB/Ton
Outbound Transit Time	Shenyang	1 – 2 days

Source: http://www.jz168.com/

6.2.6 Liaoning Northern Express Freight Transportation Group Co.,Ltd[47]

Company Profile: Chinese private logistics service provider with the core business on road freight transportation, recommended by Shenyang government. (See Table 6.16)

Table 6.16: Company Profile of Liaoning Northern Express Freight Transportation Group Co.,Ltd

History	Founded in 2001
Ownership	Chinese private third party logistics service provider
Existence	Head office located in Shenyang, 4 branch offices located in Dalian, Dandong, Jinzhou, Yingkou
Facility and Resource	Has 2 warehouse, 2 stack yard, and 200 trucks; cooperate with a number of local hauliers
Management Group	Competent management group with great ambition
Key Customers	Has over 50 Chinese customers
Future Development	Wish to improve competitiveness

Source: http://www.chinacity.net/zgcs/liaoning/shenyang/shen35/shen56.htm

[47] http://www.chinacity.net/zgcs/liaoning/shenyang/shen35/shen56.htm, visited on 2003-11-14

Service Performance: may provide a wide range of logistics service in a good way. (See Table 6.17)

Table 6.17: Service Performance of Liaoning Northern Express Freight Transportation Group Co.,Ltd

Scope of service	Supply chain management, intermodal freight transportation, value–added service
Service area of geographic coverage	Covering 3 provinces i.e. Liaoning, Jilin, Heilongjiang, in North China
Information Processing and Handling	Low level of informationalisation
Tracking and Tracing	Use telephone and/or mobile phone to track cargo
Documentation Accuracy	High level of documentation accuracy
Claims Handling	Quick reflection to customer claims

Source: http://www.chinacity.net/zgcs/liaoning/shenyang/shen35/shen56.htm

Warehousing & Distribution: operational cost is relatively low and lead–time is short. (See Table 6.18)

Table 6.18: Warehousing & Distribution of Liaoning Northern Express Freight Transportation Group Co.,Ltd

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Yingkou – Shenyang	5100 RMB/TEU, days
Break Container Cost	Shenyang	150 RMB/TEU
Loading/Unloading Cost		10 RMB/Ton
Storage Cost		12 RMB/Ton/Month
Outbound Transport Cost and Lead–time (LCL)[48]	Shenyang – Dalian	350 – 400 RMB/Ton
	Shenyang – Anshan	250 – 300 RMB/Ton
	Shenyang – Liaoyang	250 – 300 RMB/Ton
	Shenyang – Shenyang	150 – 200 RMB/Ton
	Shenyang – Fushun	250 – 300 RMB/Ton
	Shenyang – Helong	350 – 400 RMB/Ton
	Shenyang – Hailin	450 – 500 RMB/Ton
	Shenyang – Suifenhe	450 – 500 RMB/Ton
	Shenyang – Harbin	400 – 500 RMB/Ton
	Shenyang – Yichun	400 – 500 RMB/Ton
	Shenyang – Wudalianchi	450 – 500 RMB/Ton
	Shenyang – Yakeshi	500 – 600 RMB/Ton
Outbound Transit Time	Shenyang	1 – 2 days

Source: http://www.chinacity.net/zgcs/liaoning/shenyang/shen35/shen56.htm

6.2.7 LIMA–UBI Transport International Co.,Ltd[49]

Company Profile: Sinoforeign joint–venture logistics service provider with the core business on international shipping. (See Table 6.19)

[48] Transport price is determined by shipment volume of over or less than 2 tons
[49] http://www.ubi-transport.com/, visited on 2003-11-14

Table 6.19: Company Profile of LIMA–UBI Transport International Co.,Ltd

History	Founded in 1997
Ownership	Sinoforeign joint–venture freight forwarder
Existence	Head office located in Shanghai; 22 branch offices located in Dalian, Ningbo, Nanjing, Xiamen, Fuzhou, Chengdu, Chongqing, Zhuhai, Guangzhou, Shenzhen, Hong Kong, Beijing, Tianjin, Qingdao, Jinan, Shijiazhuang, Yingkou, Shenyang, Harbin, Changchun, Qinhuangdao
Facility and Resource	Cooperate with a large number of Chinese trucking subcontractors for inland haulage
Management Group	Competent management group with experienced co–workers
Key Customers	Most of customers are Chinese enterprises
Future Development	Wish to improve competitiveness

Source: http://www.ubi-transport.com/

Service Performance: may provide a wide range of logistics service in a good way. (See Table 6.20)

Table 6.20: Service Performance of LIMA–UBI Transport International Co.,Ltd

Scope of service	International and domestic shipping, warehousing & distribution, value–added service
Service area of geographic coverage	Whole areas across China
Information Processing and Handling	Normal level of informationalisation: able to provide EDI, T&T online
Tracking and Tracing	Use telephone and/or mobile phone to track cargo
Documentation Accuracy	Normal level of documentation accuracy
Claims Handling	Quick reflection to customer claims

Source: http://www.ubi-transport.com/

Warehousing & Distribution: operational cost is relatively low and lead–time is short. (See Table 6.21)

Table 6.21: Warehousing & Distribution of LIMA–UBI Transport International Co.,Ltd

Inbound Transport Cost and Lead–time (FCL)	Shenzhen – Yingkou/Jinzhou/Dalian – Shenyang	4500 RMB/TEU, 10 – 12 days
Break Container Cost	Shenyang	300 RMB/TEU
Loading/Unloading Cost		4 RMB/Ton
Storage Cost		0.4 RMB/Pallet/Day
Outbound Transport Cost and Lead–time (LCL)	Shenyang – Dalian	RMB/Ton, 0.5–1 day
	Shenyang – Anshan	80 RMB/Ton, 0.4 day
	Shenyang – Liaoyang	70 RMB/Ton, 0.4 day
	Shenyang – Shenyang	RMB/Ton, 0.4 day
	Shenyang – Fushun	60 RMB/Ton, 0.4 day
	Shenyang – Helong	350 RMB/Ton, 3–4 days
	Shenyang – Hailin	350 RMB/Ton, 2–3 days
	Shenyang – Suifenhe	600 RMB/Ton, 4–5 days
	Shenyang – Harbin	280 RMB/Ton, 1–1.5 days
	Shenyang – Yichun	400 RMB/Ton, 3–4 days
	Shenyang – Wudalianchi	600 RMB/Ton, 4–5 days
	Shenyang – Yakeshi	700 RMB/Ton, 4–5 days
Outbound Transit Time	Shenyang	1 – 2 days

Source: http://www.ubi-transport.com/

6.3 Determination of appropriate logistics service provider

In order to determine the most appropriate logistics service provider to operate the daily distribution of MODUL Service AB, seven alternative companies are evaluated and scored in terms of combined weighting criteria. (See Table 6.22)

Table 6.22: Evaluation of Seven Alternative Logistics Service Providers[50]

Company / Criteria	Maersk Logistics	China Shipping (Dalian)	Shenyang Yiyun	Huapengfei Logistics	Zhongxin Logistics	Liaoning Northern Express	LIMA–UBI Transport
Geographic Coverage	4	4	4	4	4	4	4
Equipment Availability	4	4	4	4	4	4	4
Pricing	4	4	3	5	5	5	5
Transit Performance	4	3	4	4	4	4	4
Customer Service	5	4	4	5	4	4	5
Billing Accuracy and Timeless	4	4	4	4	4	4	4
Loss and Damage Claims Handling	4	3	4	4	4	4	4
Frequency	4	4	4	4	4	4	4
Transport Time	4	4	5	5	5	5	5
Regularity	4	3	3	4	4	4	4
Goods Comfort	4	4	4	4	4	4	4
Transport Security	4	4	4	4	4	4	4
Controllability	4	4	4	4	4	4	4
Flexibility	4	3	3	4	4	4	4
Ability to expand	4	3	3	4	3	4	4
Sum	61	55	57	63	61	62	63

Source: Own

The comprehensive evaluation indicates that the Chinese private logistics service providers as well as foreign logistics service providers are somewhat more competitive than state–owned logistics service providers. It is mainly due to low transportation cost, short transport lead–time and efficient transit performance. Furthermore, such non–economic factors as co–operating experience with MODUL Service AB, need to be considered when selecting logistics service providers.

According to the result of the evaluation, Huapengfei Logistics Co.,Ltd is the most appropriate logistics service provider for MODUL Service currently to co–operate with. Huapengfei Logistics Co.,Ltd has a rich experience with MODUL

[50] Satisfaction Measure are scored as: 1 Extremely dissatisfactory, 2 Somewhat dissatisfactory, 3 Slightly dissatisfactory, 4 Satisfactory, 5 Very satisfactory

Service AB in China since it started handling the physical distribution for MODUL Service AB throughout China in August of 2000. Besides, Huapengfei Logistics Co.,Ltd has a relatively good information system, and it puts significant effort toward improving its information system.

Besides, both Liaoning Northern Express Freight Transportation Group Co.,Ltd and LIMA–UBI Transport International Co.,Ltd are competitive for MODUL Service AB to consider co–operating with in the future. They have prominent controllability as well as flexibility on road freight transport in North China due to their local existence. In particular, they have great potential to spread transport network and / or improve service performance in line with the expansion of MODUL Service AB.

7 Empirical Study & Analysis – Influencing Factors

This chapter deals with the third research question: what factors will influence the physical distribution of MODUL Service AB to north China? Both from external environment and from internal organisation, selected variables will be discussed.

7.1 Sensitivity Analysis from External Environment

In this section, five factors that arise through external environment are briefly discussed.

7.1.1 Logistics Rate

Broadly speaking, the logistics rate in China will rise gradually in the future. The logistics market will become more regular and mature. Sea transport rate in domestic China will remain stable. However, the road transport rate in China will increase since irregularities such as overload in road vehicle will be legislatively restricted. That is to say, the increasing trend of logistics rate will lead to a higher distribution cost of MODUL Service AB to North China. On the other hand, the more the usage of sea road transport, the more the savings of total distribution cost MODUL Service AB will have. Meanwhile, Chinese logistics service providers will still play the key role in the market due to their competitive logistics rate as well as potent local existence. Foreign logistics service providers will continue penetrating into this region after WTO Accession. These foreign companies will bring a high level of service with lowest possible rate.

7.1.2 Infrastructure Development

Nowadays, the central government of China is putting more focus on economy development in three provinces (Liaoning, Jilin, Heilongjiang) in North China. Local governments tend to seize this opportunity in order to promote local economy development. All types of infrastructure are expected to being further developed step by step. At present, the emphases of infrastructure development in North China are road construction and transport hub construction.[51] Obviously, infrastructure development may facilitate the physical distribution of MODUL Service AB to North China.

[51] http://www.moc.gov.cn/, visited on 2003-11-18

7.1.3 Labour Cost

Labour cost, such as salary and welfare, will not influence the distribution operation of MODUL Service AB to North China. On average, it is more economical in the northern part of China than in the east or south coastal areas of China. For instance, average personal income in Shenyang is 700 RMB/Month, which is less than half of personal income in Shenzhen (1500 RMB/Month). Due to the economic situation, labour cost in North China will remain stable for a long time.

7.1.4 Land Price

Land price currently is not an issue to affect the physical distribution of MODUL Service AB. In China, land–use rights are generally obtained through paid–transfer, which is mainly by means of bidding, auction or agreement. The price of land–use means the price for the maximum tenure for a certain purpose, i.e. 40 years for commercial use, 70 years for residential use, and 50 years for industrial use. In the future, it may become an even more attractive factor for foreign investors.

7.1.5 Energy Price

Generally, energy price differs from area to area according to the local inflation circumstances. Due to the relatively poor economic situation in North China, energy cost will not affect physical distribution of MODUL Service AB within the next few years. In line with economy development, energy prices in China will go up gradually, which may lead to the increase of distribution cost in the future.

7.2 Sensitivity Analysis from Internal Organisation

In this section, the argument focuses on two internal factors that are influential to the physical distribution of MODUL Service AB.

7.2.1 Demand / Supply Variation

Demand / supply variation of MODUL Service AB will obviously influence the actual distribution. Increased demand from customers in North China will promote MODUL Service AB to achieve economic of scale. This may lead to

reduced distribution cost from distribution centre to each customer with improved service performance. In contrast, decreased supply to North China will probably lead to higher distribution cost to the customers in that area.

7.2.2 Co–operation between MODUL Service AB and IKEA Units

Today, a number of IKEA units, including a trading company, trading offices, and distribution centres, are operated in China. Different types of co–operation between MODUL Service AB and IKEA units are feasible, and it will definitely bring benefits to the physical distribution of MODUL Service AB. At present, the most common way of co–operation is to share information and experience. In the future, it might become possible to develop some actual co–operations with IKEA units in the physical level.

8 Conclusions and Suggestions

In this chapter, general conclusions according to theoretical findings and empirical studies are summarised. These conclusions are in relation to the research questions defined in the introductory chapter. In the next, the result of using different distribution solutions is compared. An operational suggestion with an implementing timetable will be presented. Furthermore, three scenarios will be portrayed that might occur in the future.

8.1 General Conclusions

In order for MODUL Service AB to improve distribution performance in the Far East, the study has focused on where and how to establish a distribution centre as an efficient node in the distribution channel of MODUL Service AB to North China. The research purpose is categorised as three research questions and further divided into a number of sub–topics in Figure 1.4. (See Chapter 1)

The first research question is to determine an optimal location for the distribution centre. According to calculations, a locational extent is identified in a region within Liaoning province in North China. (See Figure 5.4, p.43) Afterwards, three cities: Dalian, Yinkou, Shenyang, are selected to study in depth. (See Figure 5.5, p.44) The result of the comprehensive evaluation indicates that Shenyang is the optimal city for MODUL Service AB to locate its distribution centre. (See Chapter 5)

The second research question is to select and employ one or a group of logistics service providers to co–operate with. After an overview of logistics service providers that exist in North China, seven representative ones are investigated and scored. (See Table 6.22, p.62) The result indicates that Huapengfei Logistics Co.,Ltd at present is an appropriate logistics service providers for MODUL Service AB to co–operate with due to its cost–efficient operations as well as rich experience about MODUL Service AB in China. Besides, both Liaoning Northern Express Freight Transportation Group Co.,Ltd and LIMA–UBI Transport International Co.,Ltd are competitive for MODUL Service AB to consider co–operating with in the future. (See Chapter 6)

The third research question is to look upon variables that might influence the physical distribution of MODUL Service AB to North China. From the external perspective, the increasing trend of logistics rate will lead to a higher distribution cost to North China; sea road transport will in turn create more savings to MODUL Service AB. Infrastructure development may facilitate the physical

distribution of MODUL Service AB to North China. Labour cost, land price, and energy price currently are not issues to affect the physical distribution of MODUL Service AB, although they might become important in the long–term. From the internal perspective, demand / supply variation to the customers in North China will lead to different distribution cost and service performance. Different types of co–operation between MODUL Service AB and IKEA units are feasible, and it will bring benefits to the physical distribution of MODUL Service AB. (See Chapter 7)

Another significant contribution of the study is in relation to the design of research model. It could contribute both to academia as a conceptual framework and to provide some guiding principles in order for practitioners to develop or improve their existing or forthcoming facility establishment systems. The model is presented in Figure 2.2 (See Chapter 2), and the relevant theories are interpreted in Chapter 3.

8.2 Comparison to Different Solutions

According to the information from Huapengfei Logistics Co.,Ltd (See Chapter 6), a comparison of distribution cost as well as lead–time from Shenzhen to the customers in North China via different transport modes is illustrated in Table 8.1.

Table 8.1: Comparison of Distribution Cost and Lead–time via Different Transport Modes

Customer Location	Sales Turnover FY03 (RMB)	Sales Budget FY04 (RMB)	Shipment Volume (Ton)	Road Distribution Cost (RMB)[52]	Lead-time (Day)	Sea–Road Distribution Cost (RMB)		Lead-time (Day)[53]
						Sea[54]	Road[55]	
Dalian	534,869.45	800,000	51.6	54,180 – 61,920	7 – 8	872.6 Ton / 15 Ton/TEU * (4,300–4,500 RMB/TEU) = 249,400–261,000 RMB	17,544 – 19,092	10 – 14.5
Anshan	318,237.81	1,000,000	64.4	64,400 – 74,060	8 – 9		17,388 – 18,032	9.5 – 14
Liaoyang	2,348,648.62	3,000,000	193.2	193,200 – 222,180	6 – 7		52,164 – 54,096	9.5 – 14
Shenyang	188,550	1,000,000	64.4	63,112 – 72,128	5 – 6		9,338 – 12,236	9.5 – 14
Fushun	162,090.25	300,000	19.3	19,300 – 22,195	6 – 7		4,632 – 5,500.5	9.5 – 14
Helong	94,738.8	300,000	19.3	20,265 – 24,125	8 – 9		7,334 – 7,720	10 – 14.5
Hailin	467,788.39	550,000	35.4	38,232 – 44,250	8 – 9		15,576 – 16,992	11 – 15.5
Suifenhe	278,705.6	600,000	38.6	41,688 – 48,250	8 – 9		16,984 – 18,528	11.5 – 16
Harbin	861,281.93	1,300,000	83.7	88,722 – 102,114	7 – 8		32,643 – 36,828	10.5 – 15
Yichun	4,183,988.7	3,900,000	251.2	271,296 – 314,000	9 – 9		105,504 – 123,080	11.5 – 16
Wudalianchi	388,487.03	500,000	32.2	40,250 – 45,080	9 – 10		14,812 – 16,100	11.5 – 16
Yakeshi	262,578.2	300,000	19.3	26,055 – 31,845	9 – 10		9,650 – 11,580	11.5 – 16
Sum	10,089,964.78	13,550,000	872.6	920,700 – 1,062,147	5 – 10	552,969 – 600,784.5		9 – 16

Source: Own

According to the comparison in Table 8.1, a large difference in distribution cost as well as lead–time by different transport mode can be observed. In FY03, total distribution cost of MODUL Service AB to customers in North China by road was 649,379 RMB, which accounts for 6.44% of sales turnover. In FY04, the distribution cost to customers in North China by road will roughly be 920,700–1,062,147 RMB, which accounts for 6.79–7.84% of sales turnover of MODUL Service AB.

If the distribution mode could shift from trucking to shipping–trucking, total distribution cost to customers in North China will be 552,969–600,784.5 RMB, which is 4.08–4.43% of sales turnover. In this sense, pure savings of the distribution cost to the customers in North China will be 367,731–509,178 RMB, which saves 44% of distribution cost rather than by using road transport. In

[52] Transport price is determined by shipment volume of less than 1 ton, between 1 to 3 tons, or over3 tons.
[53] Sea transport lead–time from Shenzhen to Shenyang is from 8 to 12 days.
[54] In assumption, 1 TEU = 15 Ton.
[55] Transport price is determined by shipment volume of over or less than 2 tons.

parallel, the proportion of distribution cost in sales turnover will be reduced by 2.36–3.76%. Nevertheless, the total distribution lead–time will increase by 4–6 days. (See Table 8.2)

Table 8.2: Distribution Cost and Lead–time Analysis

Fiscal Year	Transport Mode	Distribution Cost (RMB)	Ratio in Sales	Distribution Lead–Time (Day)
FY03	Road	649,379	6.44%	5–10
FY04	Road	920,700–1,062,147	6.79%–7.84%	5–10
	Sea Road	552,969–600,784.5	4.08%–4.43%	9–16
Cost Savings	Sea Road	367,731–509,178	2.36–3.76%	
Lead–time Prolongation	Sea Road			4–6

Source: Own

8.3 Operational Suggestions

In order for MODUL Service AB to optimise its distribution channel, a supportive distribution centre should be established in Shenyang. Together with the logistics service provider – Huapengfei Logistics Co.,Ltd, MODUL Service AB may improve its competitiveness in China from a distribution perspective.

Today, the approximate sales turnover of MODUL Service AB per week has reached sufficient volume to implement intermodal transport solution to supply customers in North China. Meanwhile, MODUL Service AB is able to perform consolidation in its warehouse facility. The last prerequisite before actual implementation of intermodal transport is to get an agreement about lead–time with customers in North China. The collaboration from customers may assist MODUL Service AB to plan, implement, and administrate whole process of distribution.

It is wise to give one to two months to the salesmen of MODUL Service AB to communicate with those customers in North China, in order for them to make more regular orders and be ready for the prolonged lead–time. Therefore, the actual implementation of intermodal transport solution to customers in North China is reasonable to start around March of 2004.

8.4 Scenarios for Future Development

In parallel with the raised purchase of IKEA Group in China, total sales volume of MODUL Service AB in the northern part of China is expected to increase year by year. According to this, three scenarios might be portrayed.

- Scenario one: This is based on increased distribution volume to the customers in North China. MODUL Service AB might supply the customers surrounding Shenyang as well as Harbin (See Chapter 1) respectively, while the shipment volume is sufficient. In this sense, MODUL Service AB may set up another distribution centre in Harbin. Together with the distribution centre in Shenyang, both overall distribution cost and distribution lead–time from Shenzhen to the customers in north China will probably further reduced. In this sense, it is wise to co–operate with such logistics service providers as Liaoning Northern Express Freight Transportation Group Co.,Ltd (See Chapter 6), or LIMA–UBI Transport International Co.,Ltd (See Chapter 6), which has good controllability and expandability in North China.

- Scenario two: It is assumed that MODUL Service AB will start production in the northern part of China. In this sense, there will have more possibilities to arrange distribution locally. MODUL Service AB could perform distribution either through distribution centre or not through it. Meanwhile, sea road transport could continue playing the key role between South China and North China. As in scenario one, it is wise to co–operate with such local logistics service provider that has good controllability and expandability in North China.

- Scenario three: It is assumed that MODUL Service AB will face difficulties implementing consolidation in Shenzhen to its customers in North China. It might occur due to irregular orders and / or unacceptable lead–time from customers, which in turn will affect the effectiveness of sea road transportation. In this case, MODUL Service AB may perform consolidation to the key customers flexibly and make maximum use of sea road transportation to North China.

References

Literature

Ballou, Ronald H. (1998), "Business Logistics Management – Planning, Organizing, and Controlling the Supply Chain – Fourth Edition", Prentice Hall

Bowersox, Donald J. and Closs, David J. and Cooper, M. Bixby (2002), "Supply Chain Logistics Management", McGraw-Hill

Chow, Garland and Poist, Richard F. (1984), "The Measurement of Quality of Service and the Transportation Purchase Decision", Logistics and Transportation Review

Christopher, Martin and Wills, Gordon (1972), "Marketing Logistics and Distribution Planning", George Allen & Unwin Ltd, UK

Creswell, J. W. (1998), "Qualitative inquiry and research design: Choosing among five traditions", London Sage Publication

Gill, John and Johnson, Phil (1997), "Research Methods for Managers – Second Edition", Paul Chapman Publishing Ltd

Green & Tull, (1978), "Research for Marketing Decisions", Paul Chapman Publishing Ltd

Hoover, Edger M. (1957), "Location Theory and the Shoe and Leather Industries", Cambridge, Mass.: Harvard University Press

Johnson, James C. and Wood, Donald F. (1996), "Contemporary Logistics – Sixth Edition", Prentice-Hall

Johnston, Michael L. (1986), "Do Your Measure Up?" Handling & Management

Lumsden, Kenth R. (2002), "Fundamentals of Logistics", Chalmers University of Technology

Mulcahy, David E. (1994), "Warehouse and distribution operations handbook", McGraw-Hill

Zikmund W, (1988), "Business Research Methods", Paul Chapman Publishing Ltd

Lecture Document

Jensen, Arne (1987), “Transport Economics and Management – Lecture Outline”, University of Gothenburg

Report

MODUL Service AB, (2002), “Warehouse and Production Strategy FY03 – FY07”

Internet

http://iwww.modul.ikea.com/, visited on 2003-08-18

http://www.unr.edu/bench/chap04.pdf, visited on 2003-08-21

http://www.apsc.gov.au/fellowships/douglass.pdf, visited on 2003-09-03

http://www.lniipc.com, visited on 2003-11-06

http://www.moc.gov.cn, visited on 2003-11-06

http://www.dalian-gov.net, visited on 2003-11-06

http://www.yingkou.gov.cn, visited on 2003-11-06

http://www.shenyang.gov.cn, visited on 2003-11-06

http://www.handels.gu.se/epc/archive/00002736/01/gbs_thesis_2002_29.pdf, visited on 2003-11-09

http://www.maersk-logistics.com/sw68.asp, visited on 2003-11-12

http://www.csl.com.cn/, visited on 2003-11-12

http://www.syyiyun.com/, visited on 2003-11-13

http://www.huapengfei.com/index.jsp, visited on 2003-11-13

http://www.jz168.com/, visited on 2003-11-14

http://www.chinacity.net/zgcs/liaoning/shenyang/shen35/shen56.htm, visited on 2003-11-14

http://www.ubi-transport.com/, visited on 2003-11-14

http://www.moc.gov.cn/, visited on 2003-11-18