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Study on the marketing strategy of Tianjin port logistics center

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STUDY ON THE MARKETING STRATEGY OF TIANJIN PORT LOGISTICS CENTER

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MASTER OF SCIENCE

In

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation: STUDY ON THE MARKETING STRATEGY OF TIANJIN PORT LOGISTICS CENTER

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As trade barriers are dismantled and logistics service requirements and costs increase, companies have been changing the ways they source material, manufacture and distribute products owing to the economic and logistics globalization. Tianjin port, as the generator of Binhai new area, which is third growth pole in Chinese national economy, is vying to attract international business and generate high cargo flow and information flow. The value-added activities in the port sector play a key role in ensuring the lasting economic growth of a port and its hinterland. TBNA enjoys the comprehensive advantage of functioning as an international port, highly open function zones, and large tracts of land open for development.

Due to the high growth of the economy and trade in TBNA, large investments have been or will be put into logistics center in Tianjin port. To meet the challenges of logistics globalization and keep pace with the development of top world ports, Tianjin port is planning to increase the logistics function and build a logistics center to improve high value-added logistics services.

Through literature review on port logistics functions, and market segmentation, this dissertation analyzes the status quo of Tianjin port and segment market by strategic business units. After collecting and analyzing the historical data of Tianjin port, this dissertation positions four business units into BCG-matrix. Since the cash cow market generates major profit to support other business and question mark market brings about attractive potential economic growth, this dissertation concentrates more efforts on these two market segments. DEA approach is employed as a quantitative tool in cash cow market to identify and target container logistics companies which are DEA-efficient to house in TPCLC. AHP approach is used as qualitative and quantitative tool in question mark market to distinguish and target suitable strategic partners with TPCLC to operate container logistics business in joint venture.

Due to logistics globalization and rapid development of IT technologies, market environment changes substantially. The downward pressure of logistics cost and upward pressure of logistics value from customers bring fierce challenge for TPLC

in long run. To gain and maintain core competence, this dissertation makes out marketing strategies for TPCLC's consideration, which includes strategic alliance with container logistics companies and liner shipping companies, customer relationship management, and establishment of five supporting platforms and so on.

Key word: port logistics center, BCG, market segmentation, DEA, AHP

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LIST OF ABBREVIATIONS

AHP	Analytical Hierarchy Process
BCG	Boston Consulting Group
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
ESCAP	Economic and Social Commission for Asia and Pacific
JIT	Just In Time
KAM	Key Account Management
MNC	Multinational Corporation
PLC	Product life cycle
SBU	Strategy Business Unit
TBNA	Tianjin Binhai New Area
TEDA	Economic Technological Development Area
TPCLC	Tianjin port container logistics center
TPL	Tianjin port International Logistics Development Co., Ltd.
VAL	Value added logistics

1 INTRODUCTION

1.1 Advantage of Tianjin Binhai New Area

I. Unique Geographic Location

Tianjin Binhai New Area (TBNA) is located at the intersection of the Beijing-Tianjin city belt and the Circum-Bohai Sea Region belt, which serves as a main hub connecting China with overseas and links North China and Northwest based on North China, Northeast and Northwest China. TBNA has the largest comprehensive seaport in the North. It consist of Tanggu District, Hangu District, Dagang District, Tianjin Technological Development Area, the Tianjin Port Free Trade Zone, Tianjin Port Area and Dongli District and some part of South Tianjin. The planning area is about 2270 square kilometers. With broad hinterland and numerous air-routes and liners, TBNA has established trade intercourse with over 300 ports in 170 countries and regions. It is the nearest starting point of the continental bridge from Asian to Europe in North China. Please refer to Figure 1 to form a geographical concept of TBNA.

Figure 1 Tianjin Binhai New Area

II. Highly-opened Economy

TBNA is now the only area in China combining the functions of Seaport, Economic Technological Development Area, Port Free Trade Zone, Marine High-tech Development Area, and large-scale Industrial Base. Due to close relations and mutual reliance, TBNA has been generating its gigantic and conglomeration effects. After several decades of construction, the TEDA area now covers an area of 19 kilometers and the comprehensive economic indicator takes the lead among 49 technological development areas in China. Due to its swift and fierce development, TBNA has been developed into an economic growth locomotive in North China region opening up to the outside world. TBNA is for the time being gathering and releasing huge economic energy. In recent years, TBNA has attracted investment

from both Chinese and foreign investors, which make it enjoy the reputation as "exceptional treasure land in China."

III. Sound Industrial Foundation

After years of development and construction, TBNA has been built into an industrial base, with industries of marine chemistry, petrol-chemistry, metallurgy, machinery, electronics, bio-chemistry, and foodstuff as its pillars. In 2005, the Gross Industrial Output of TBNA reached RMB yuan 160.863 billion. The accumulative actually utilized overseas investment has reached 15.9 billion dollars. More than 100 Multinational corporations listed in World's top 500 have invested in 152 enterprises in the TBNA. TBNA now has the foundation and capability for serving the regional economy.

IV. The favorable environment of the Tianjin Port in TBNA

By basing itself upon Tianjin, depending upon Beijing and Hebei Province, serving the Circum-Bohai Region, radiating its influence into the North China, Northeast China, and Northwest China, and facing the Northeast Asia, Tianjin New Coastal District is to be turned into an advanced modern manufacturing and R&D transformation base, an international shipping center and logistics center in the north of China, and an eco-city with ideal setting for human existence. (Source: http://www.bh.gov.cn)

A statement released on Jun.5.2006 by the State Council, China's cabinet, said TBNA has been designated an experimental zone for comprehensive reforms and will be built into a third economic powerhouse after Shenzhen and Pudong of Shanghai. The statement said that the area, covering 2,270 square kilometers, would become the sea gateway to North China, a modern manufacturing and research base and an international shipping and logistics center. The new coastal area, dubbed "Pudong of North China", will launch a series of reform initiatives including financial reforms, land administration methods, a bonded area and preferential tax policies. TBNA will open more of its financial institutions to foreign investors and adopt pilot reforms in sectors related to financial services and the capital market. It will also launch experimental schemes in the venture capital market, foreign exchange administration and offshore banking. The high-tech enterprises in the area will get a 15 percent tax cut, while the central government also decides to earmark funds to aid the construction of the area. Tianjin Dongjiang Bonded Area, covering an area of ten square kilometers, will be set up in the new area with focuses on international distribution, global procurement and export processing. The development of Binhai New Area was written into the 11th Five-Year Program (2006-2010) for national economic and social development in March this year. The gross domestic product of Binhai New Area stood at 160.8 billion yuan (about 20.1 billion U.S. dollars) in 2005 and is expected to reach 1,000 billion yuan (about 125

billion U.S. dollars) in 2020. (source: http://teda.gov.cn)

V. One major goal of TBNA: To build itself into an international shipping and logistics center

This goal mainly consists of the following tasks:

a. Constructing the 250,000-ton deep water channel and the 300,000-ton crude oil dock in the Tianjin Port
b. Expending the total area of the Tianjin Port from 30 km^2 to 100 km^2
c. Constructing Dongjiang Free Trade Port Area, which covers an area of 30 km^2 (See Figure 2)
d. Building Tianjin Binhai International Airport into an air freight center of North China

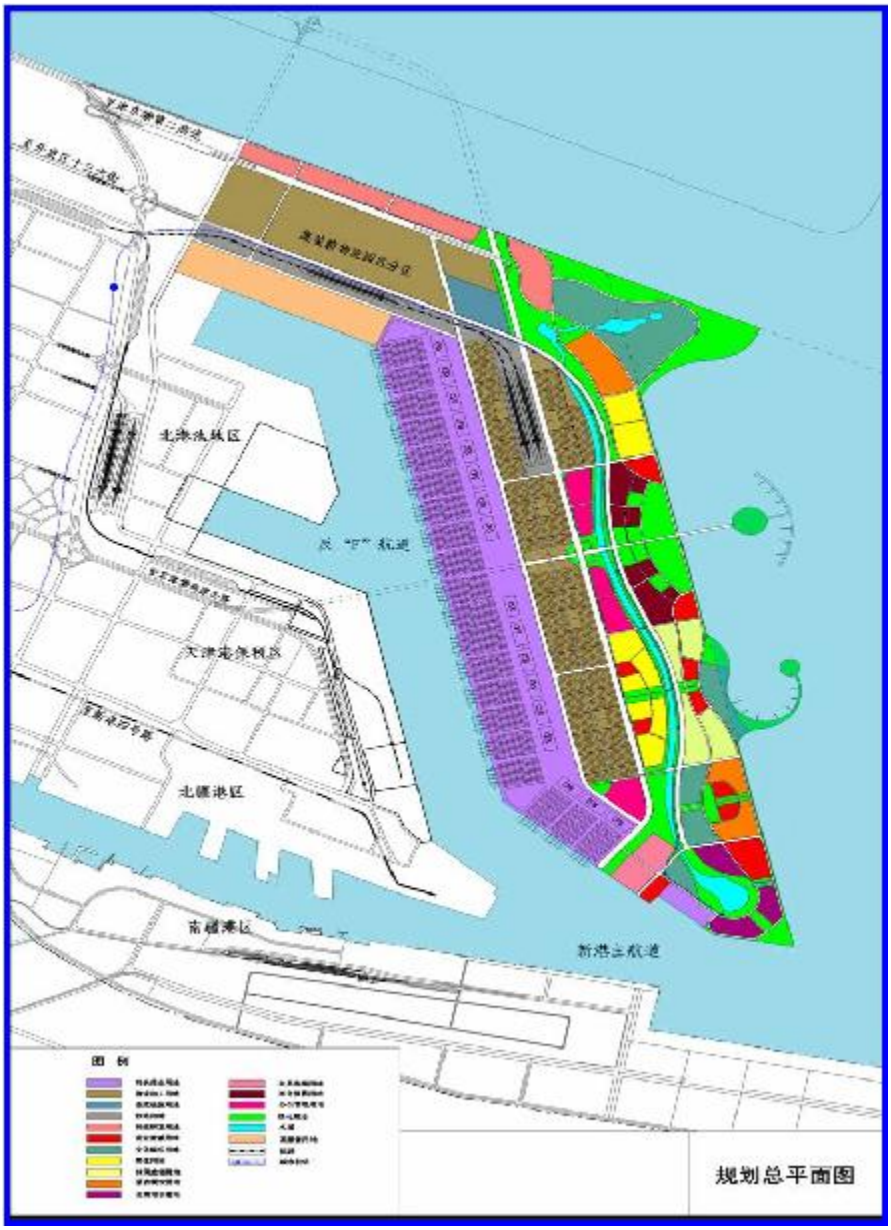

Figure 2 Planning map of Dongjiang Free Trade Area of the Tianjin Port

1.2 Reasons for building the Tianjin Port Logistics Center

TBNA is a hot point of investment and is listed in the Chinese national eleven-five economic and social development plan. With the rapid development of economic globalization, port authorities highlight modern logistics and containerization. In 2010, the cargo throughput will be 300 million tons, container throughput will exceed 10 million TEUs and port channel class will reach 200,000-tonnage. The Tianjin Port authorities fully recognized the historical opportunities and made strategic plan in attempt to construct the Tianjin port into international deep-depth port. Efforts will be made to become a container pivotal port facing Northeast Asia, the biggest container hub port of bulk cargo in North of China, the greatest comprehensive port in Circum-Bohai Sea Region as well as the first-class major port in the world. To meet the challenge of logistics integration, downward pressure of cost and increasing expectation of customer delivery value, the Tianjin port group corporation is plotting an international container logistics center to enhance value added logistics function like container stacking, repairing, transporting, distributing, information processing, logistics service support and so forth. The logistics center also undertakes the task in an effort to perfect the international logistics function for Tianjin municipality. The layout maps of the Tianjin port and container logistics center are illustrated by Figure 3 and 4.

Compared with Shanghai, Shenzhen and Qingdao, the corresponding logistics capacities of stacking and distributing are rather low, which are becoming a bottleneck of increasing the throughput of container terminals. The stocking capacity of three mentioned ports is above 110,000 TEUs, but that of the Tianjin port is only 48,900 TEUs. Inefficiency of supporting logistics facilities will increasingly hamper the healthy development of container terminals. To enhance competitive advantage, fully utilize the limited resources, enlarge market share and satisfy the customers' needs, the Tianjin port makes endeavor to build the container logistics center in a bid to optimize modern port supply chain and maximize logistics add-value services.

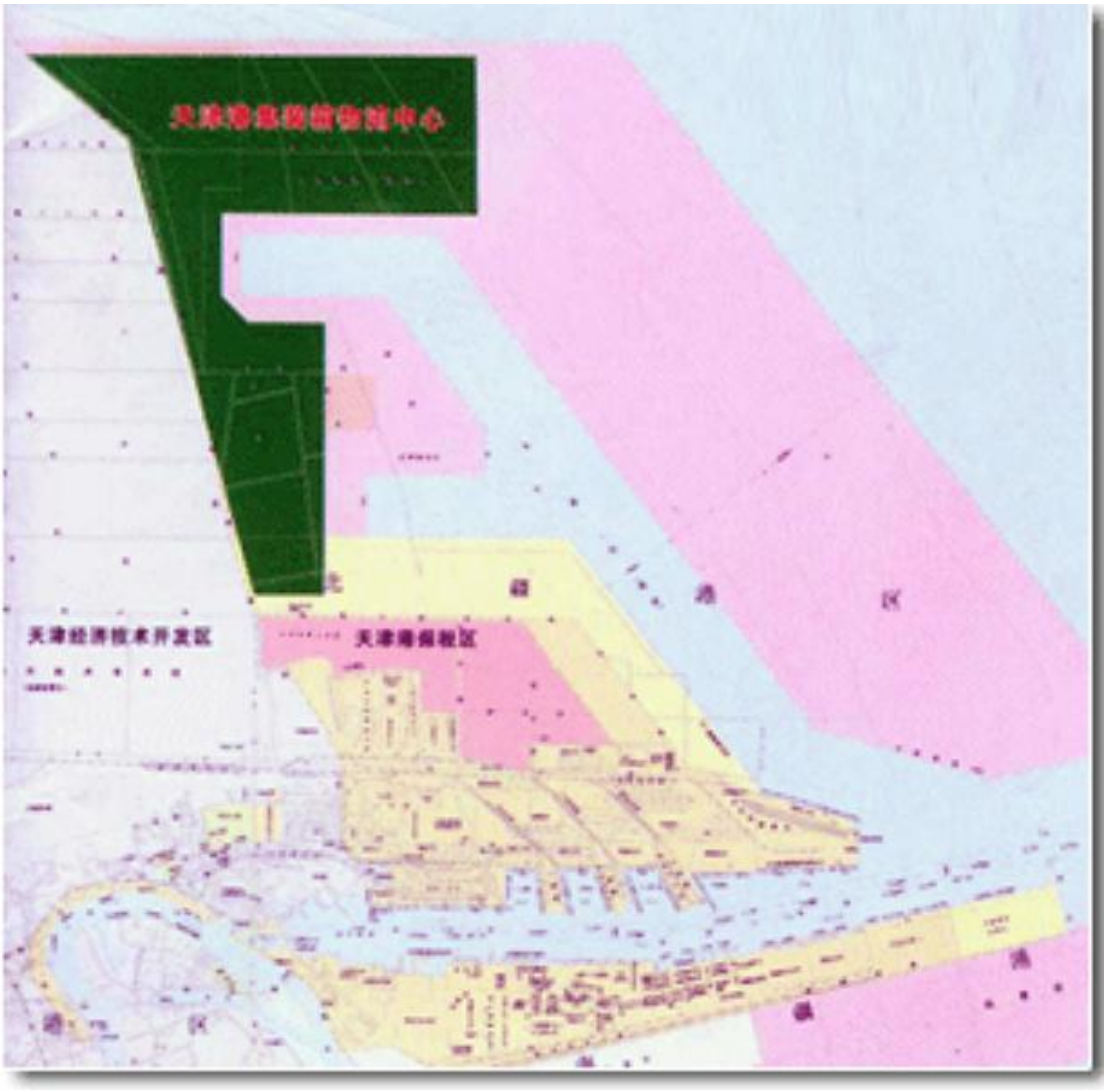

Figure 3 Layout map of the Tianjin port
(Source: http://www.ptacn.com/index.asp)

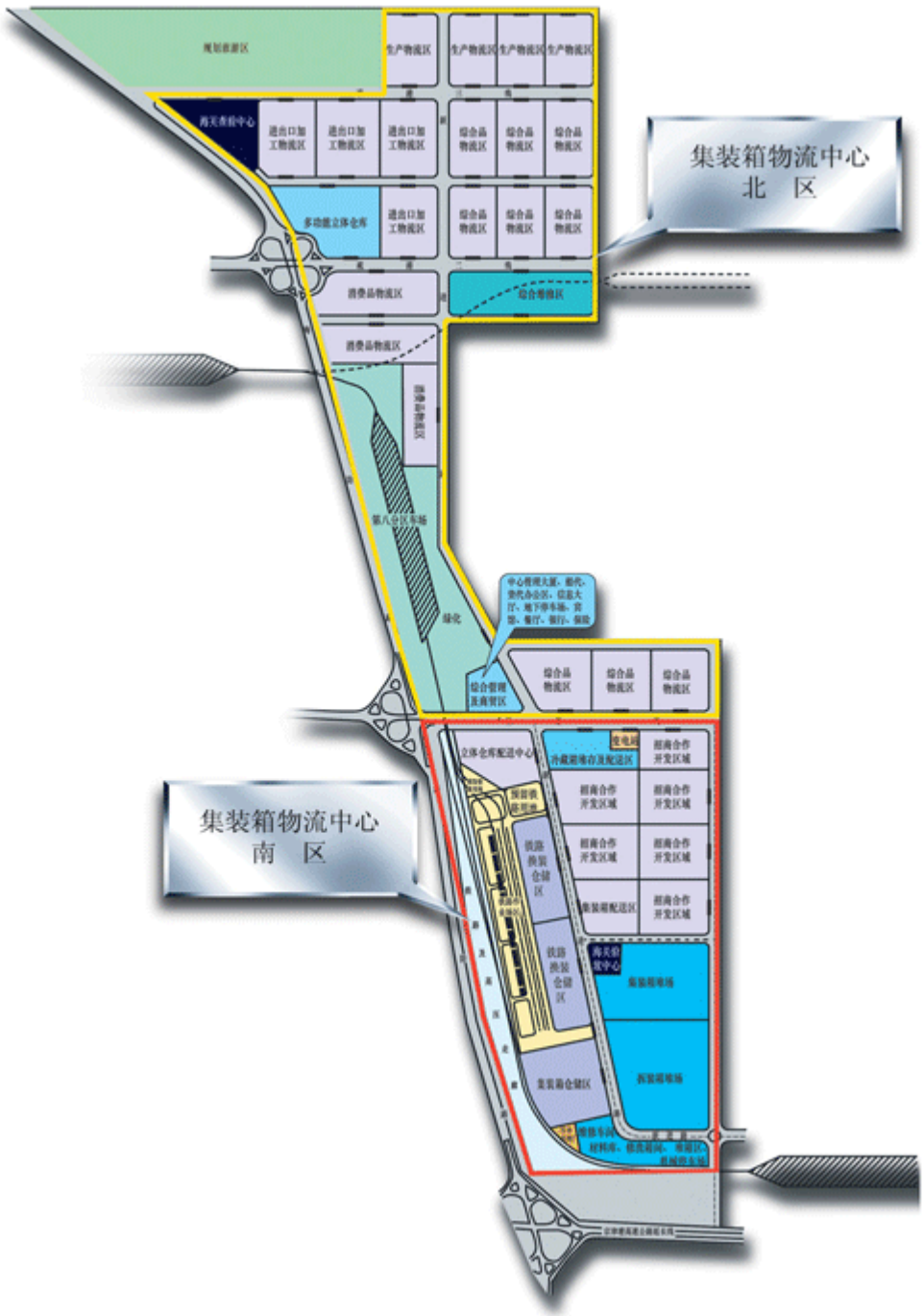

Figure 4 Layout map of the Tianjin port container logistics center
(Source: http://tpil.cn/Info/index.asp)

1.3 Problem formulation

Tianjin Port International Logistics Development company (TPL), an entity which is established and designated by the Tianjin port Group Corporation to manage TPCLC, invites Nankai University and other academic institution to do feasibility and strategic planning research on the development of Tianjin port container logistics center (TPCLC). To get the firsthand information about TPCLC, the author visited the business manager of TPL sever times. Fortunately, in view of support of academic research, the business manager, Mr. Guo Fuxin lent me the feasibility research report and strategic planning report for reference. After reading the strategic planning report, the author find that marketing segmentation and logistics function design are not elaborated in detail. They are only stated in general description. How to identify the market segments and target the segments in reasonable criteria becomes an urgent problem to solve. How to meet the challenge of logistics globalization and high expectation of value added logistics (VAL) services demanded by customers is another issue to answer. More important to be answer is what of marketing strategy plan should be made to adapt to the historical development opportunity of BNTA.

1.4 Purpose and research method

This dissertation's purpose is to segment container logistics market of the Tianjin Port and position various business segments into the BCG's growth-share matrix. Because the cash cow and question mark markets are significant business units for TPCLC, the author will further segment two segment markets and do in-depth analysis. Then, employ DEA approach to segment cash cow market according to certain criteria and rank efficient container logistics companies according to efficiency. Next, employ AHP approach to segment question mark market and distinguish the valuable liner shipping companies who are qualified as its strategic partners to operate container logistics in TPCLC.

2 Literature Review

2.1Port logistics center and logistics functions

2.1.1 Concept of logistics and logistics center

There are many concepts concerning logistics defined by some scholars. Anon (1995) said Logistics is getting the goods in right quality, right quantity from where they arise to the right place, in the right form, at the right time, at the right cost. Martin Christopher (1997) said Logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment of orders.

The Council of Logistics Management has defined the concept of logistics:
Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements.

As for the concept of logistics center, there are also many definitions like below:
Logistics center --- a territory where activities related to transportation, logistics and product distribution concentrate. (European Association Freight Village 2000)
Logistics center ---a contact point of various transportation types where the distribution of cargo streams is concentrated and performed (Prokofveja, A.T 2001).

From perspective of TPL, logistics center is a large-scale, advanced, value-added logistics complex with comprehensive facilities for distribution operations at a single location, which is connected directly to container terminals and multimodal transport facilities for transit shipment, employing the latest information and telecommunication technology (Feasibility research report for TPCLC, 2005).

In fact, logistics center provides not only traditional activities such as transport,

storage, moving, packing but also value-added logistics services such as labeling, assembly, semi-manufacturing and customizing. It combines logistics and industrial activities effectively in major port areas to create country specific and/or customer specific variations for generic products (UN report on Commercial Development of Regional Ports as Logistics Centers, 2002).

The main terms for logistics centers known in the world can be categorized by countries below:
In United Kingdom logistics centers are called Freight Villages",
In France ---"Plate Forme Logistique" or "Plat Forme Multimodales",
In Germany--- "Guterverkehrszentrum",
In Italy---"Interporto",
In Denmark---"Transport Center".
In Japan--- "Distribution Park"

Although there is no unanimous opinion on a single term, the most common and widely used term in Singapore, China and USA is "logistics center". The main research subject of this dissertation is seaport logistics center which is a significant function component in modern port.

2.1.2 Evolution of sea port

Since this dissertation mainly focus on sea port logistics centers, it is necessary for us to review the evolution of the sea port. Generally speaking, the viewpoint that port evolved from three generations is commonly accepted in shipping and port industries.

(a) First generation port
Until 1960, ports played a simple role as the junction between sea and inland transportation systems. At that time, the main activities in the port region were port construction, maintenance, cargo loading, discharging and cargo storage, leaving other activities away. Ports are isolated from shipping companies and international traders. Such a way of thinking severely influenced related persons in the government and local administration. Also, it even influenced decision makers with the port industry, so it was considered that it was enough to develop and invest in only port facilities, as the main functions of the port were cargo handling, storage and navigation assistance. It was for these reasons that important changes in transportation technology were neglected.
This rather limited function of the port also determined the mentality of the various

people who did business in the port. Except from the above mentioned port activities, the different parties did not really feel concerned with the commercial business activities which were yet on the basis of the port activities. In this way, the port was isolated from the transport and trade activities. Often in a monopolistic situation (the typical liner ports are here an excellent example), these ports rarely concerned about the port users' needs. Participation of trade and transport interests in port decision-making process was limited and port marketing promotion was rarely considered. Usually these ports had their own system of information, documentation and statistics, and had no regard for their compatibility with port users' systems.

Another characteristic of a first generation port is that the different port activities or port companies were isolated from each other. This means that at the commercial level the different port activities rarely acted in unison, but made their decisions independently. As a consequence productivity was low and cargo movement was slow. Port users were more familiar with individual sectors of different port services, rather than with the port in its entirety. The actual customers of the ports were the ship owners and not the international traders who are the initiators of all port activities.

"There was no interest for the socio-economical role of the ports and as a result the relationship with the region was not always optimal. The port organization was isolated from the municipality where the port located in. There was no cooperation and each one's plans were carried out separately."(Ma Shuo *shipping and port market analysis and marketing* 2005)

(b) The second-generation port

The second-generation ports are those built between 1960 and 1980, and had a system comprising of government and port authority, so the port service providers could understand each other and cooperate for mutual interests. The activities in these ports were expanded ranging from packaging, labeling to physical distribution. A variety of enterprises have also been founded in ports and hinterlands. Compared to first-generation ports, the second-generation ports have a characteristic that freight forwarders and cargo owners had a tighter relationship. We can say that the second-generation ports had begun to notice the needs of customers only in short-term, but the port authorities and port enterprises took a passive attitude to keeping a long-term relationship with customers.

"Industrial facilities are built up within the port area. The port develops and expands towards its hinterland. The port operators are eager to enhance the cooperation relationship with industries in hinterland such as iron and steel, heavy metallurgy, refineries and basic petrochemicals, aluminum, paper pulp making, fertilizers and various agro-foods. This evolution is called the "maritimization of the industry". Some ports evolved to become industrial complexes, and as a consequence second

generation ports are also called “industrial ports”. On the basis of this evolution is the increase of quantities of raw materials imported into industrialized countries, together with the use of large tankers and dry bulk carriers in the maritime transport.” (Ma Shuo *shipping and port market analysis and marketing* 2005)

(c) The third-generation ports

The changing role of ports: from traditional services to value-added logistics services （ESCAP report to UN 2002）

From 1980, container transportation has been developed quickly, and the new multimodal transport system emerged. The activities of production and transportation have linkage to form an international network. The former services function has been enlarged to include logistics and distribution services. The environment protection facilities are becoming more important, so the ports are developing closer relationships with those in their surrounding neighborhoods. Compared to the past, today’s port operators are focusing on logistics services. In the third-generation ports, the needs of customers were analyzed in detail and port marketing has been actively engaged.

Take the port of Rotterdam as an example, three distriparks have been established in the Port of Rotterdam. A distripark is a large-scale, advanced, value-added logistics complex with comprehensive facilities for distribution operations at a single location, which is connected directly to container terminals and multimodal transport facilities for transit shipment, employing the latest in information and telecommunication technology. Distriparks provide space and facilities for purpose of warehousing and distributing, including the storage and transshipment of cargo and the stuffing, stripping and repairing containers. They also provide a comprehensive range of value-added services to fulfill highly heterogeneous customer demand. These value-added services include assembly, labeling, testing/examination, packaging and repackaging, sorting, invoicing and so on. The Port of Rotterdam and the Europe Combined Terminals jointly developed the Delta 2000-8 Plan, the objective of which is to construct eight distriparks in the Delta terminal at the Port of Rotterdam by the end of 2000. Delta 2000-8 is the most advanced logistics concept ever developed in the Port of Rotterdam. A major advantage of the distripark concept is that the distribution center is located very close to the cargo transport terminal, making transport between these two places fast and cheap. JIT delivery and quick response to customer needs play an important function in the design of distripark. In addition, from the distribution center customers may choose among a variety of transport modes, depending on time pressures, costs and destinations. More than 6,700 multinational corporations have operations located in the Netherlands. The Netherlands has been very successful in attracting business headquarters, distribution

centers, and call centers of multinational corporations. In fact, among the estimated total 955 European Logistics Centers (ELCs), more than half of all American and Asian logistics centers are located in the Netherlands. As host to the majority of logistics centers in Europe, the Netherlands may provide useful lessons for countries in the Chinese ports to learn. In order to find the major factors that multinational corporations considered when choosing to locate in the Netherlands, the author found 67 companies appearing in the publications of the Netherlands Foreign Investment Agency. The companies were broken down into three groups: companies which operate ELCs (20), companies operating European headquarters (27), and companies operating call centers (20). The most common attributes for these companies are listed in Table 1. This dissertation suggests that these factors contribute to the selection of port of Rotterdam as the top companies' logistics centers.

Table 1 Main features of the port of Rotterdam

Factors	Main features
Port infrastructure	• Adequacy of port facilities • Spaciousness of port area • Availability of feeder vessels
Land/Land prices	• Availability of land • Affordability of land prices • Low rental fees for land
Labour	• Availability of English speaking port workers • Availability of specialized technicians • Availability of trained or nor-trained technical labours • Labour costs in distribution center
Technology/Information	• Level of port information service • Supply of information infrastructure
Market factors	• Distance between port and hinterlands • Distance between port and major cities
Related industries	• Ease of access to parts and raw materials • Distance between port and industrial complex
Back-up city	• Existence of large consumer city behind port areas • Quality of workers in DC
Institutional factors	• Incentive programmes offered by host country • Simplicity, ease and efficiency of administrative procedures needed in operating distribution centres • Financial assistance in constructing distribution centres • Free trade system and related law provided by the host countries
Connecting transport System	• Airport access to provide speedy linkage between the distribution centre and major markets • Effective land transport system • Establishment of feeder service (hub and spoke system)

(Source: UNCTAD Commercial Development of Regional Ports as Logistics Centers, 2002)

For the companies operating logistics centers, the most frequently cited features are:

- Acceptable land price to locate in
- Central and strategic location in relation to the European market
- Highly skilled and productive labor force with exceptional work ethic
- Developed logistics and transport infrastructure, and excellent connections to foreign market
- Multimodal transport facilities
- High level of information infrastructure
- Qualified man power specializing in logistics
- Language skills in a variety of languages

- Strong professionalism of the logistics industry

In addition, factors such as "friendly international business environment" and "support from central and local government departments" also play a major role in this group's location decisions." Generally speaking, the key influencing factors of port logistics centers are illustrated as Table 2.

Table 2 Determinate Factors in Location Selection of Distribution Centers, Headquarters and Calling Centers

Factors	DC	HQ	CC
Clustering of related and supporting industries	2	6	5
Central and strategic location	6	16	7
Superior international business environment	5	12	6
Efficient and professional logistics industry	5	1	-
Highly productive labour with work ethic	7	14	8
Multilingual work force	6	15	17
Flexible regulation and favorable tax incentives	3	4	1
Flexible labour system	4	3	4
Assistance by government dept. operating in a business manner	5	6	3
Superb infrastructure well-connected to foreign markets	6	5	1
Sophisticated telecommunications infrastructure	2	4	8
Convenient access to ports, airports, railways and roadways	3	9	-
Total	**20**	**27**	**20**

Source: Il-Soo Jun, *A New Paradigm for a National Development Strategy: Building a Logistics Center in the east Asia,* Korea Transport Institute, *Nor* te, 2001.
Note: DC, HQ and CC represent distribution center, headquarter, and calling center respectively.

In the third generation ports, the commercial success of a port could stem from a productivity advantage in traditional cargo-handling service, from value-added service, or from a combination of the two. Productivity advantages, coming mainly from economies of scale and economies of scope, suggests that the most productive ports will be those that are equipped to handle large cargo volumes and/or significantly reduce unit costs through efficient management. Shippers and carriers select individual ports not only based on their cargo handling service capabilities, but also on the benefits they are capable of "delivering". Unless a port can deliver benefits that are superior to those provided by its competitors in a functional aspect, port customers are likely to select ports based merely on price. This fact raises the question of how a port can increase value added services. Figure 5 illustrates three categories of port services in two dimensions: productivity and value-added services. We can see the most competitive port should be the

superior service port which is able to provide integrated value-added service with large productivity.

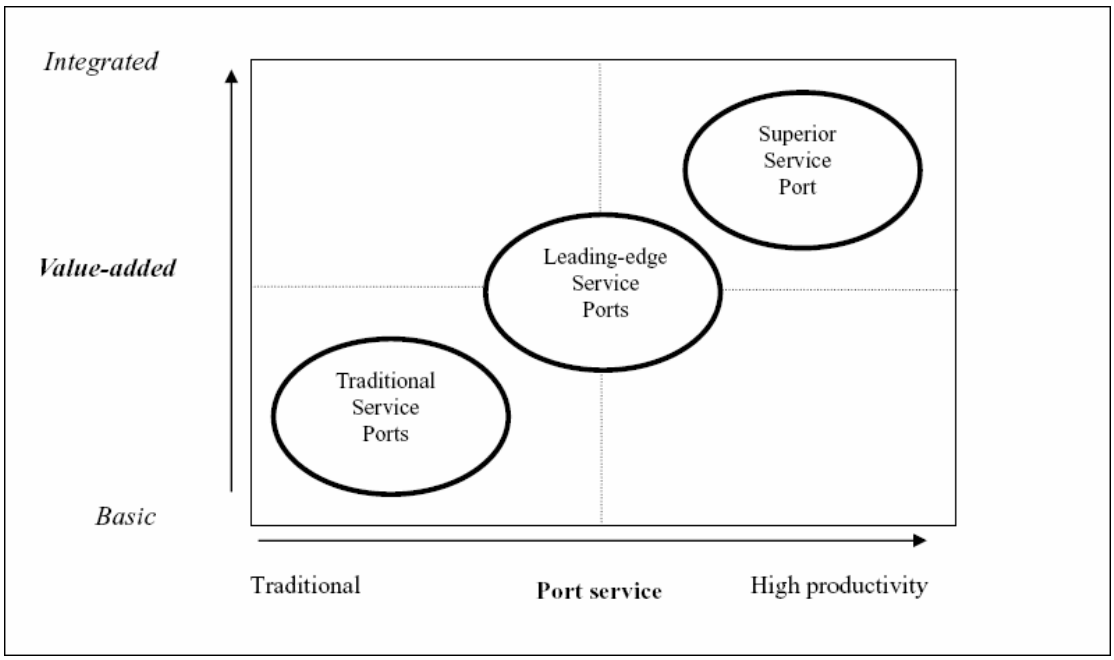

Figure 5 Matrix of competitive advantage

2.1.3 Value-added logistics services of port logistics center

Logistics function of port is highly emphasized by port authorities and operators. In addition to loading and discharging area, a dedicated area within port is separated for logistics activities mainly for purpose of providing value-added logistics services. These trends in international logistics are likely to continue into the future. It is the reason for the formulation of logistics center. Logistics center provides not only traditional activities such as storage, but also transit, transshipment, containerization, and distribution. Gerhardt Muller (2005) suggests that logistics centers combine traditional logistics and industrial activities like: labeling, assembly, semi-manufacturing and customizing effectively in port logistics center to create country specific and/or customer specific variation products.

The main VAL activities within port area are illustrated by Figure 6.

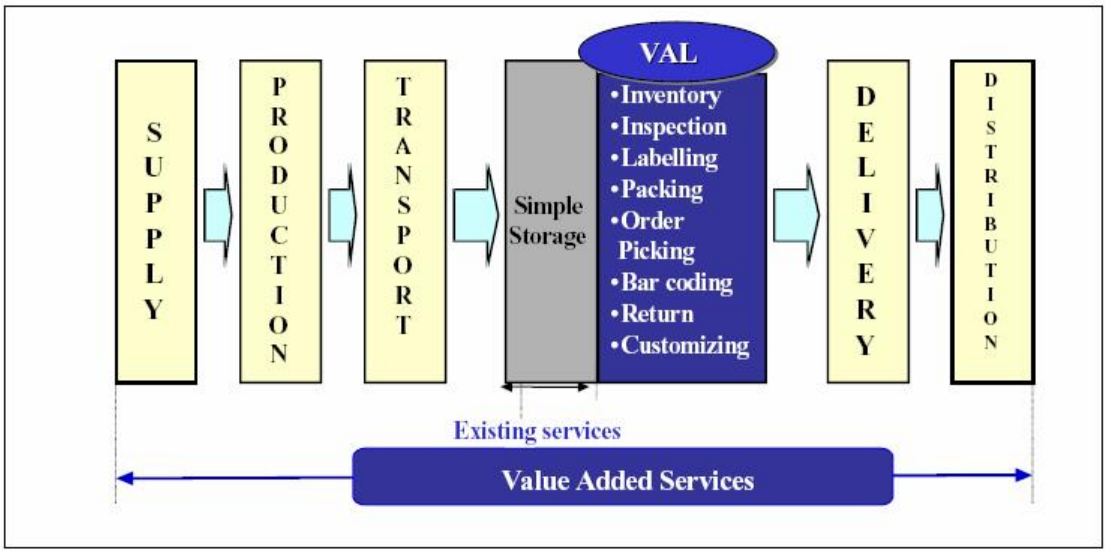

Figure 6 VAL service of logistics enters in port area

A. **Assembly in warehouse**:
"Assembly" is often cited as the semi-manufacturing function of logistics center within port areas. In order to decrease cost, the shipper's interest in assembly activities in port area increases considerably. Catering for this trend, a new type of logistics center, called a "manufacturing type warehouse," within port area is emerging throughout the world to provide assembly facilities for customers dispatching cargo.

B. **Labeling and Packaging:**
Logistics centers have been introducing labeling packaging functions to satisfy the end user's demand before export oversea or after import towards hinterland region. The requirement of patterns for labeling and packing will differ according to geographical locations such as countries, regions, cities.

C. **Localizing and Customizing**:
In international trade, shippers are placing greater emphasis not only on the quality of goods but also on customer needs and country regulations. Recognizing this new customer's demand for customizing, more and more shippers have resorted to providing these services by tailor-made offering.

D. **Installation and instruction**:
In modern ports, installation and instruction services have emerged as important functions in logistics centers. Shippers have either independently or jointly designated a warehouse in the port logistics centers for installing spare parts, which they have received from the suppliers. Some division of logistics centers

have also become involved in training and instruction and turned themselves into customer service centers for end users.

E. **Quality control and testing of products:**
In world class ports, logistics centers have been providing quality control and product testing services in addition to assembly services. Quality control and product testing services are very important part of semi-manufacturing activities in the third generation port.

F. **International trade and shipping service**
Port logistics center offers the omni-directional services to facilitate international trade which is the origin of transport and logistics. A center area may particularly be set up to realize functions of trade promotion and facilitation like: port enterprise consultation, customs and inspection clearance, shipping agency service, freight forwarding service, banking and financial support, , information service, maritime arbitration, call center support, commodity exhibition and so forth.

2.1.4 Economic efficiency of logistics service

Logistics is a procedure to optimize all activities to ensure the delivery of cargo through a transport chain from one end to the other. The comparative efficiency of a country's trade logistics chain is of crucial importance in enhancing competitiveness of its industry and commerce. In this regard, international differences in trade logistics efficiency determine to large extent in efficiency and sustainability of the national economies. In developed countries such as the U.S. and Japan, logistics costs are about 10 per cent of GDP. However the same costs of developing nations exceed 30 per cent. Moreover, the gap among countries appears to be widening.

According to the European Logistics Association the logistics costs in relation to annual turn over can amount to more than 30 per cent in the food industry, 27 per cent in the metal industry, 23 per cent in the chemical industry, 15 per cent in the automotive sector (Juhel, 1999). The percentages may differ from country to country and industry by industry, but many of the critical cost factors are influenced by logistics supply chain. The logistics chain consists of activities that facilitate the movement of goods from supply to demand. As many such activities require the use of ports, port authorities and enterprises have taken a particular interest in the various port activities. Logistics costs are not limited to costs consumed in carrying out logistics activities. Rather, they should be understood as all costs input into a given logistics system. As can be seen in Figure 7, raising the level of logistics service from (S1) to (S2) requires an increase in logistics costs, from (C1) to (C2).

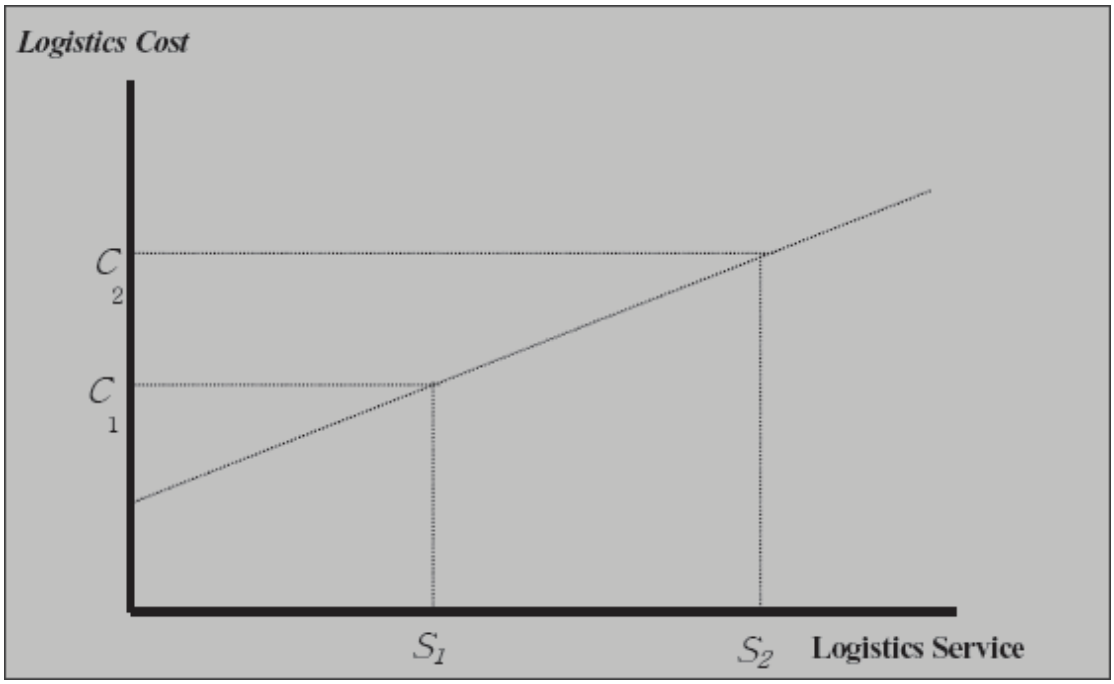

Figure 7 Relationships between Logistics Costs and Logistics Service

However, as shown in Figure 8, when the overall efficiency of the logistics system improves from logistics system (A) to logistics system (B), a higher level of service can be provided from (S_1^A) to (S_1^B) at the same cost level (C_1^A), or the same level of service (S_1^A) can be provided at a lower cost from (C_1^A).to (C_1^B).

In general, logistics systems improve not by lowering logistics costs, but rather by achieving better service level (C*, S*), at a lower cost level, by shifting the costs-service curve itself from A to B.

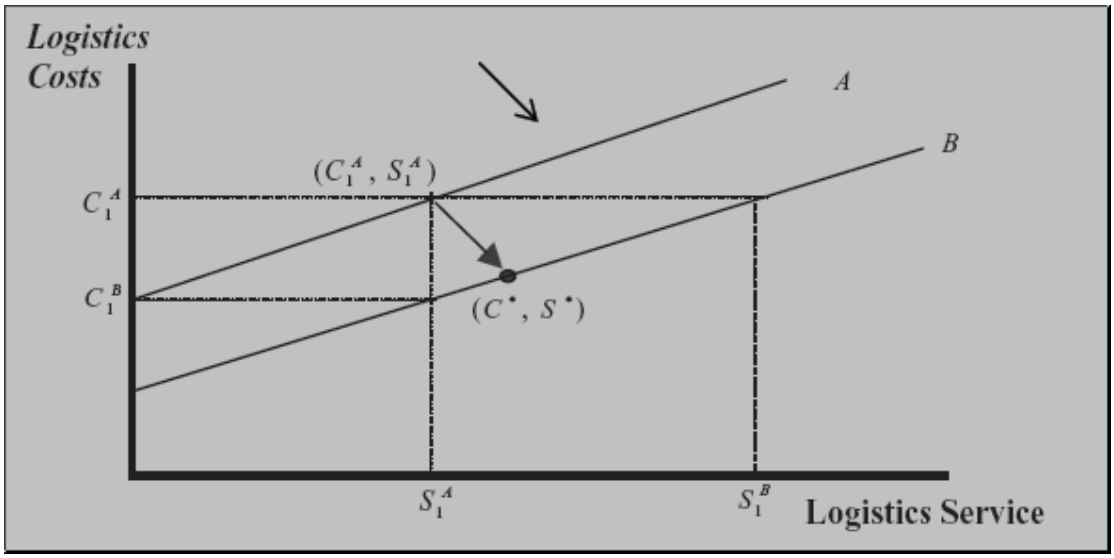

Figure 8 Reduction of logistics cost due to the left-shift of the cost- service curve

2.2 Market segmentation

2.2.1 Marketing concept

Marketing is a social and managerial process whereby individuals and groups obtain what they need and want through creating, offering, and freely exchanging products and services of value with others (*Philip Kotler).*
Peter Drucker, a leading management theorist, put it this way:

There will always, one can assume, be need for some selling. But the aim of marketing is to make selling superfluous. The aim of marketing is to know and understand the customer so well that the product or service fits him and sell itself. Ideally, marketing should result in a customer who is ready to buy. All that should be needed then is to make the product or service available.

The core marketing concept can be illustrated as Figure 9.

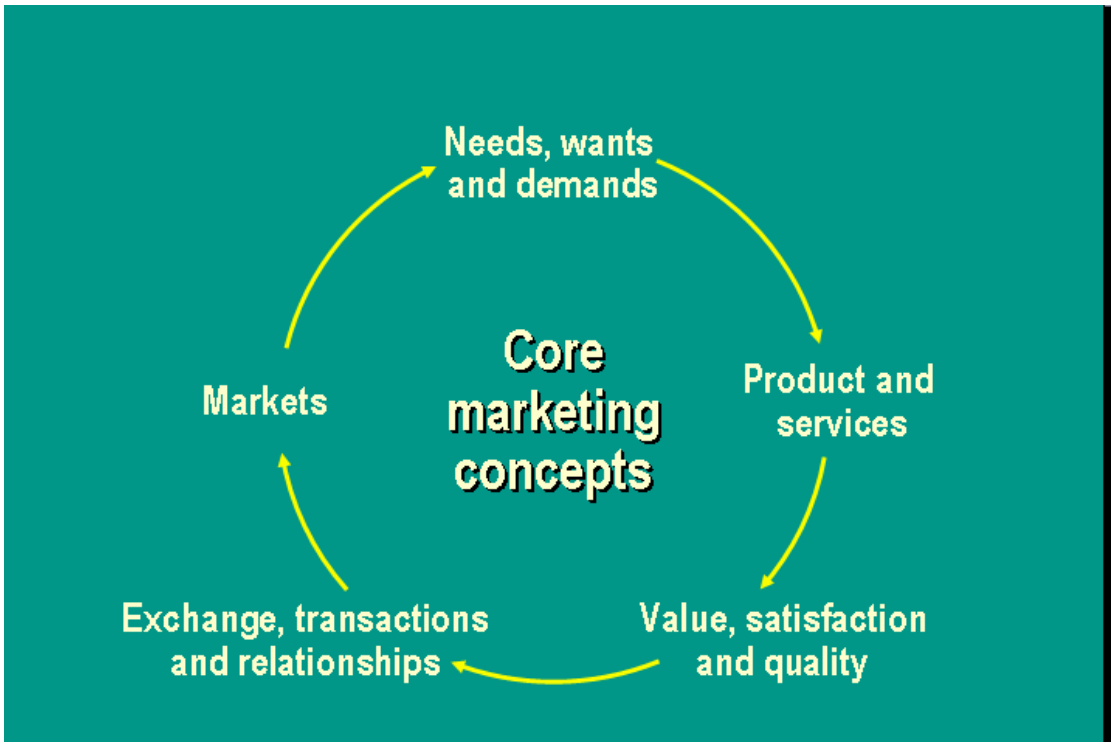

Figure 9 Core marketing concepts

The American Marketing Association defines marketing is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, services to create exchanges that satisfy individual and organizational goals. We see marketing management as the art and science of choosing target markets and getting, keeping, and growing customers through creating delivering, and communicating superior customer value. From the definition, we can see the marketing is much like a process in which flows of products, money, information, cash are exchanged between sellers and buyers in interactive ways. Figure 10 demonstrates the marketing process.

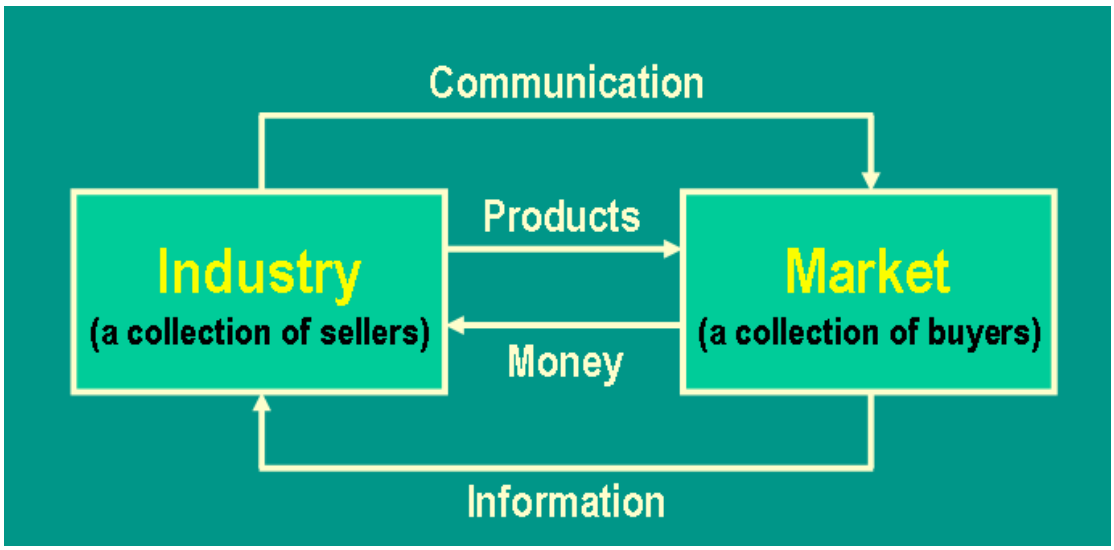

Figure 10 The marketing process

2.2.2 Identifying market target markets and selecting target markets

A company cannot serve all customers in a broad market due to limited resources. The customers are too numerous and diverse in their buying requirements. The company needs to identify the market segments that it can serve more effectively with its limited resource. Here we will examine levels of segmentation, patterns of segmentation, market segmentation procedure, bases for segmenting customer and business markets, and requirements for effective segmentation.

Many companies are embracing target marketing. Here sellers distinguish the major market segments, target one or more of those segments, and develop products and

marketing programs tailored to each. Instead of scattering their marketing effort (a "shortgun" approach), they can focus on the buyers they have the greatest chance of satisfying (a "rifle" approach).

The advantages of segmentation can be summarized as following stated by McDonald M., I Dunbar (2004):

1) Recognizing customer's differences is the key to successful marketing, as it can lead to a closer matching of customers' needs with the company's products or services;
2) Segmentation can lead to niche marketing, where appropriate, where the company can meet the needs of customers in that niche segment resulting in segment domination, something which is often not possible in the mass market;
3) Segmentation can lead to the concentration of resources in markets where competitive advantage is greatest and returns are high;
4) Segmentation can be used to gain competitive advantage by enabling you to consider the market in different ways from your competitors;
5) By means of segmentation, you can market your company as a specialist in your chosen segments, with a better understanding of customers' needs, thus giving your products or services advantages over those of your competitors.

2.2.3 Rules for segmentation

The criteria used for segmentation must have the following characteristics:

A. Each segment should consist of customers who are relevant to the same situation in that they are responsible for making the decision or can affect buying behavior;
B. Each segment should have sufficient potential size to justify the time and investment involved in planning specifically for this business opportunity;
C. Each segment should be distinguishable from other segments, such that each has a distinctive set of requirements and can be served by an equally distinctive marketing strategy;
D. Each segment should be reachable by sales and distribution channels currently being used or which could be used;
E. Each segment should be capable of being identified by a set of characteristics, such that the customers in that segment can be reached by a distinctive and cost effective marketing strategy;
F. The company must be capable of making the necessary changes to its structure, information and decision-making systems to focus on the new segments.

2.2.4 Levels of market segmentation according to Philip Kotler

- Segment marketing
  A market segment consists of a large identifiable group within a market with similar needs, purchasing power, geographical location, buying attitudes, or buying habits. Segment marketing offers several benefits over mass marketing.
- Niche marketing
  A niche is a more narrowly defined group, typically a small market whose needs are not well served. Marketers usually identify niches by dividing a segment into sub-segments or by defining a group seeking a distinctive mix of benefits. Whereas segments are fairly large and normally attract several competitors, niches are fairly small and normally attract only one or two competitors. An attractive niche is characterized as follows: The customers in the niche have a distinct set of needs; they will pay a premium to the company that best satisfies their needs; the niche is not likely to attract other competitors; the niche gains certain economies through specialization; and the niche has size, profit, and growth potential.
- Local marketing
  Target marketing is leading to marketing programs being tailored to the needs and wants of local customer groups arising from the geographical location. Geographical differentiation calls for dividing the market into different geographical units such as nations, states, regions, counties, or cities. The patterns of packaging, selling or channels will differ according to geographical locations.
- Individual marketing
  The ultimate level of segmentation leads to “segments of one”, “customized marketing,” or “one-to-one marketing.” The tailor made the suit and the designed shoes for the individual. Much business-to-business marketing today is customized, in that a manufacturer will customize the offer, logistics solutions, trading terms and financial loans for each major account. New technologies --- computers, databases, internet, robotic production, e-commerce ---- permit companies to return to customizing marketing, or what is called “mass customization.”

2.2.5 Target market segments:

I. Evaluating the market segments:
In evaluating different market segments, the company must look at two factors: the segment's overall attractiveness and the company's objectives and resources. First, the company must justify a potential segment has the characteristics that make it generally attractive, such as scale, growth, profitability, efficiency, risk status. Second, the company must consider whether investing in the segment makes sense given the company's objectives and resources.

II. Selecting the market segments:
According to the market attractiveness and business strength, the company can select suitable market segment portfolio to maximize the profit of the company.
The business strength commonly includes:

A) Relative market share
B) Reputation/Image
C) Bargaining leverage
D) Ability to match quality/service
E) Investment and employed capital.

The following factors have significant impacts on market attractiveness as follows:

A) Market share and growth rate
B) Profit perspective
C) Intensity of competition
D) Seasonality and cyclicality
E) Social, technical, legal impact
F) Opportunities and threat

Usually, five patterns of selection method may be considered: single-segment concentration, selective specialization, product specialization, market specialization, full market coverage. The patterns of market segment selection are illustrated by Figure 11 according to the market attractiveness and business strength.

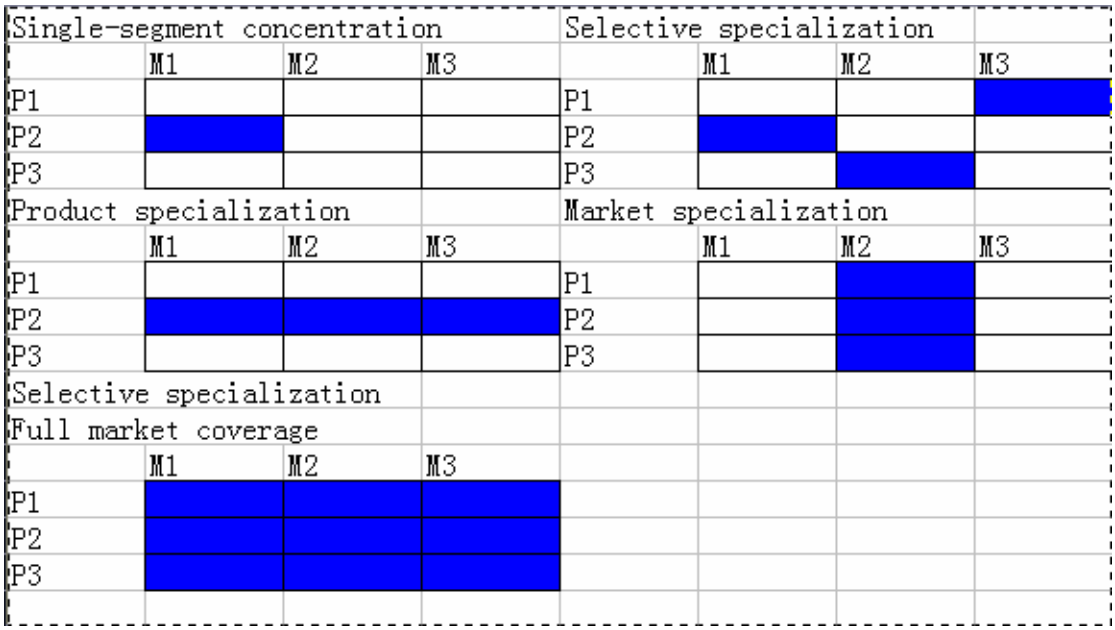

Figure 11 Patterns of market segment selection

2.3 Logistics market segmentation of the Tianjin Port Container Logistics Center

2.3.1 Establishing strategic business units according to BCG Model

The BCG Growth-Share Matrix is a portfolio planning model developed by Bruce Henderson of the Boston Consulting Group in the early 1970's. It is based on the observation that a company's business units can be classified into four categories based on combinations of market growth and market share relative to the largest competitor, hence the name "growth-share" portfolio analysis. Market growth serves as a proxy for industry attractiveness, and relative market share serves as a proxy for competitive advantage. The growth-share matrix thus maps the business unit positions within these two important determinants of profitability.

The BCG Matrix method is the most well-known portfolio management tool. The BCG Matrix can be used to determine what priorities should be given in the product portfolio of a business unit. To ensure long-term value creation, a company should have a portfolio of products that contains both high-growth products in need of cash inputs and low-growth products that generate a lot of cash. The BCG-Matrix is a useful analysis tool to evaluate the performance of business units.

Most companies operate several businesses. The purpose of establishing the strategic business units is to precisely allocate resources of the companies to meet the demand of market sements. Levitt argued that market definitions of a business are superior to product definitions. Business marketing must be viewed as a customer-satisfying process, not a goods-producing process. Products are transient, but basic needs and customer groups endure forever. Levvit encouraged companies to redefine their business in terms of needs, not products.

Large companies normally manage quite different businesses, each requiring its own strategy. General Electric classified its business into 49 strategic business units (SBUs). An SBU has three characteristics:

A. It is a single business or collection of related businesses that can be planned separately from the rest of the company.

B. It has its own set of competitors.
C. It has a manager who is responsible for strategic planning and profit performance and who controls most of the factors affecting profit.

2.3.2 Assigning resources to each SBU

Another purpose of identifying the company's strategic business units is to develop separate strategies and assign appropriate funding. Segment portfolios should be singled out by analytical tools for clarifying its business by profit potential. This dissertation applies BCG as an analytical tool to establish the growth-share market portfolio matrix. The Boston Consulting Group (BCG), a leading management consulting firm, invented and popularized the growth-share matrix shown in the Figure 12. The market growth rate on the vertical axis indicates the annual growth rate of the market in which the business operates. In the Figure 12, it ranges from 0 per cent to 20 per cent. A market growth rate above 10 per cent is considered high. Relative market share, which is measured on the horizontal axis, refers to the SBU's market share relative to that of its largest competitor in the segment. It represents a measure of the company's strength in the relevant market segment. A relative market share of 0.1 means that the company's sales volume is only 10 percent of the leader's sales volume, a relative share of 10 means that the company's SBU is the leader and has 10 times the sales of the next-strongest competitor in that market. Relative market share is divided into high and low share. For the purpose of convenience and simplification, we can use the absolute market share often called market share instead of relative market share or define different market growth rate according to type s of the industries the researcher studies.

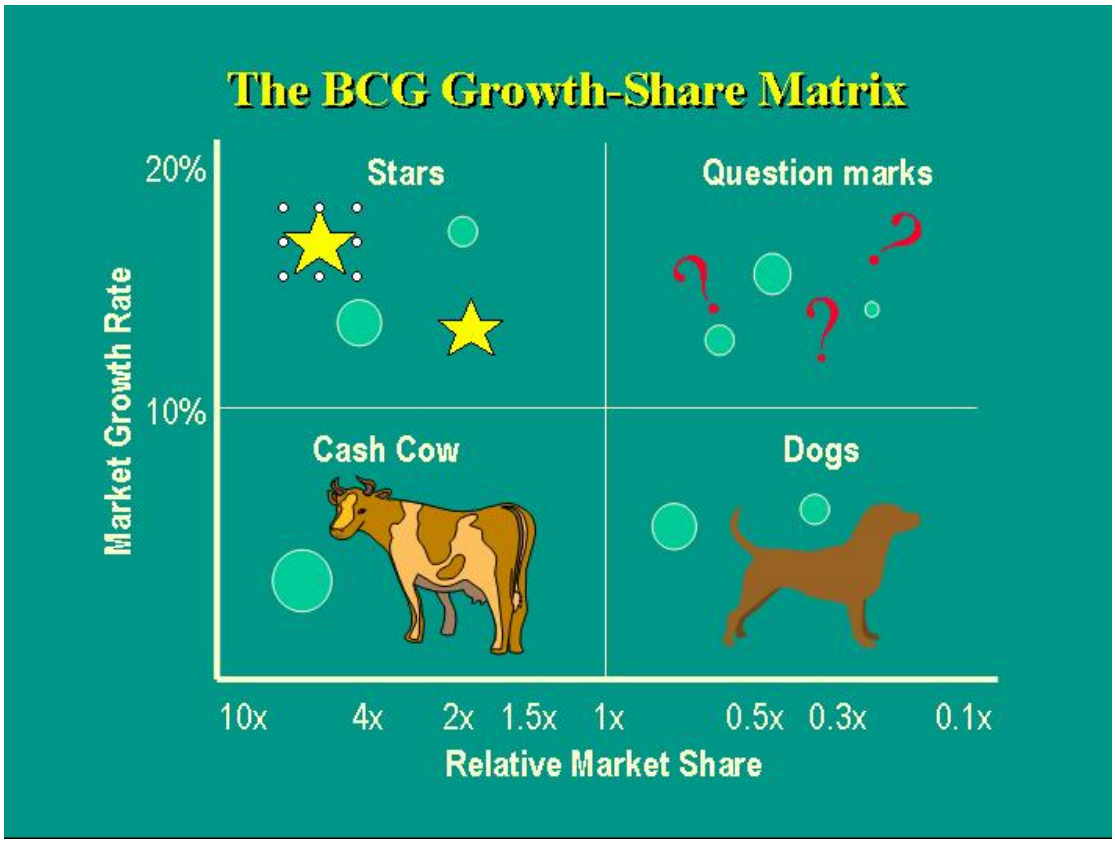

Figure 12 BCG Growth-Share Matrix

From the figure above, the matrix can be divided into four categories as follows:

i. Question marks: Question marks are business that operate in high-growth markets but have low relative market shares. Most business starts off as question marks as the company tries to enter a high-growth market in which there is already a market leader. A question mark requires a lot of cash because the company has to invest the money on plant, equipment, and employees to keep up with fast-growing market, and because it wants to become the leader. The term question mark is appropriate because the company has to think hard about whether to kept pouring money into this business or may invest the same cash into other business units to pursuit more profits. A question mark (also known as a "problem child") has the potential to gain market share and become a star, and eventually a cash cow when the market growth slows. If the question mark does not succeed in becoming the market leader, then after perhaps years of cash consumption it will degenerate into a dog when the market growth declines. Question marks must be analyzed carefully in order to determine whether they are worth the investment required to grow market share.

ii. Stars: If the question-mark business is successful, it becomes a star. A star is the market leader in a high-growth market. A star does not necessarily produce a positive cash flow for the company. The company must spend substantial funds to accompany with the high market growth and fight off competitors' attacks. If a star can maintain its large market share, it will become a cash cow when the market growth rate declines. The portfolio of a diversified company always should have stars that will become the next cash cows and ensure future cash generation.

iii. Cash cows: When a market's annual growth rate falls to less than certain percentage usually 10 percent, the star becomes a cash cow if it still has the largest relative market share. A cash cow produces a lot of cash for the company. The company does not have to finance capacity expansion because the market's growth rate has slowed down. Because the cash cow business unit is the market leader, it enjoys economies of scale and higher profit margins. The company is able to utilize its cash-cow business to milk cash and pay the outlays to support the other business units of the company.

iv. Dogs: Dogs are businesses that have weak market shares in low-growth markets. They usually yield low profits or losses. However, the dogs can become the cash cows if a large mount of money invested in this portfolio. There are also some opportunities for the dogs become a question mark if the market grows rapidly.

2.3.3 Business unit strategies

Competition between companies does not take place at the corporate level. Rather, a business unit in one company competes with a business unit in another one. The top management of the company does not generate profit by itself; revenues are yielded and costs are incurred mainly in the business units. Business unit strategies deal with how to create and maintain competitive advantage in each of the market segments in which a company has chosen to participate. Rober N. Anthony (2002) suggested that the strategy of a business unit depends on two interrelated aspects: (1) its mission ("what are its overall objective?") and (2) its competitive advantage ("how should the business unit compete in its market segment to accomplish mission").

After planning its diversified businesses in the growth-share matrix, a company must determine whether its portfolio can maximize profit. An unbalanced portfolio would have too many dogs or question marks and/or too few stars and cash cows. The company's next task is to determine what objective, strategy, and budget to assign to each SBU and obtain the maximum profit. Four strategies can be pursued at business unit level:

A. Build: It is appropriate for question marks whose market shares must grow and much more cash should be poured into this SBU if they want to become stars, even forgoing short-term earnings to achieve this objective.
B. Hold: Here the objective is to preserve market share. This strategy is appropriate for strong cash cows if they are to continue yielding a large positive cash flow.
C. Harvest: In this situation, the objective is to increase short-term cash flow regardless of long-term effect. Harvesting involves a decision to withdraw from a business by reducing investment. The company plans to cash in on its "crop," to "milk its business." Harvesting generally involves eliminating R&D expenditures, not replacing the physical plant as it wears out, not replacing salespeople, reducing advertising expenditures and so on. The hope is to reduce costs at a faster rate than any potential drop in sales, thus resulting in an increase in positive cash flow. This strategy is appropriate for weak cash cows whose future is dim. Harvesting can also be used with question marks and dogs.
D. Divest: Here the objective is to sell or liquidate the business because resources can be better used elsewhere. This strategy is appropriate for dogs and question marks that are acting as a cash trap or drag on the company's profits.

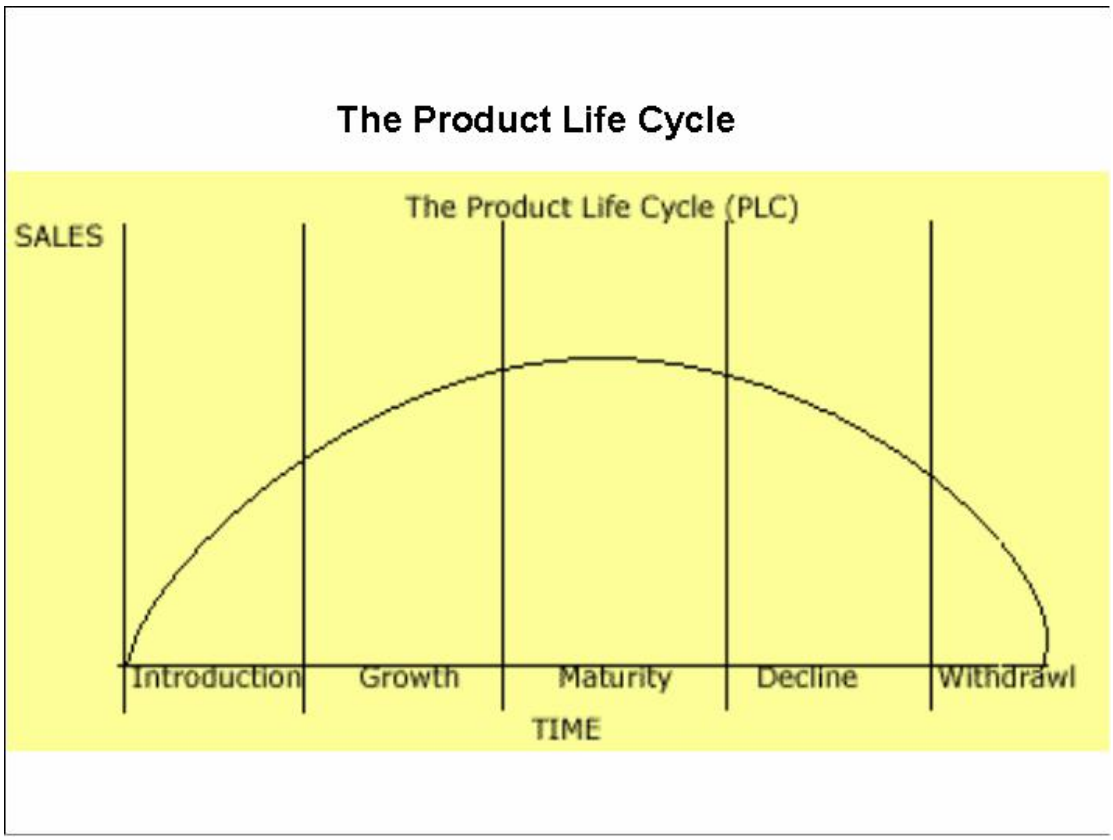

Figure 13 The product life cycle (PLC)

Since SBUs are established to meet the demand of market segments by providing products or service, there are correlative relationship between SBUs and corresponding products. According to product life cycle theory shown by Figure 13, every product should experience four stages including introduction, growth, mature, decline. As times passes, SBUs change their positions in the growth-share matrix. SBUs also have similar life cycle. They start as question marks, becomes stars, then cash cows, and finally dogs. Figure 14 shows the process each SBU may evolve. For this reason, companies should examine not only their business units' current positions in the growth-share matrix but also their expected moving positions in their life cycle. Each business should be reviewed as to where it was in past years and where it will probably move in future years. If a given SBU's expected trajectory is not satisfactory, the company should ask its business unit manager to propose a new strategy and the likely resulting trajectory.

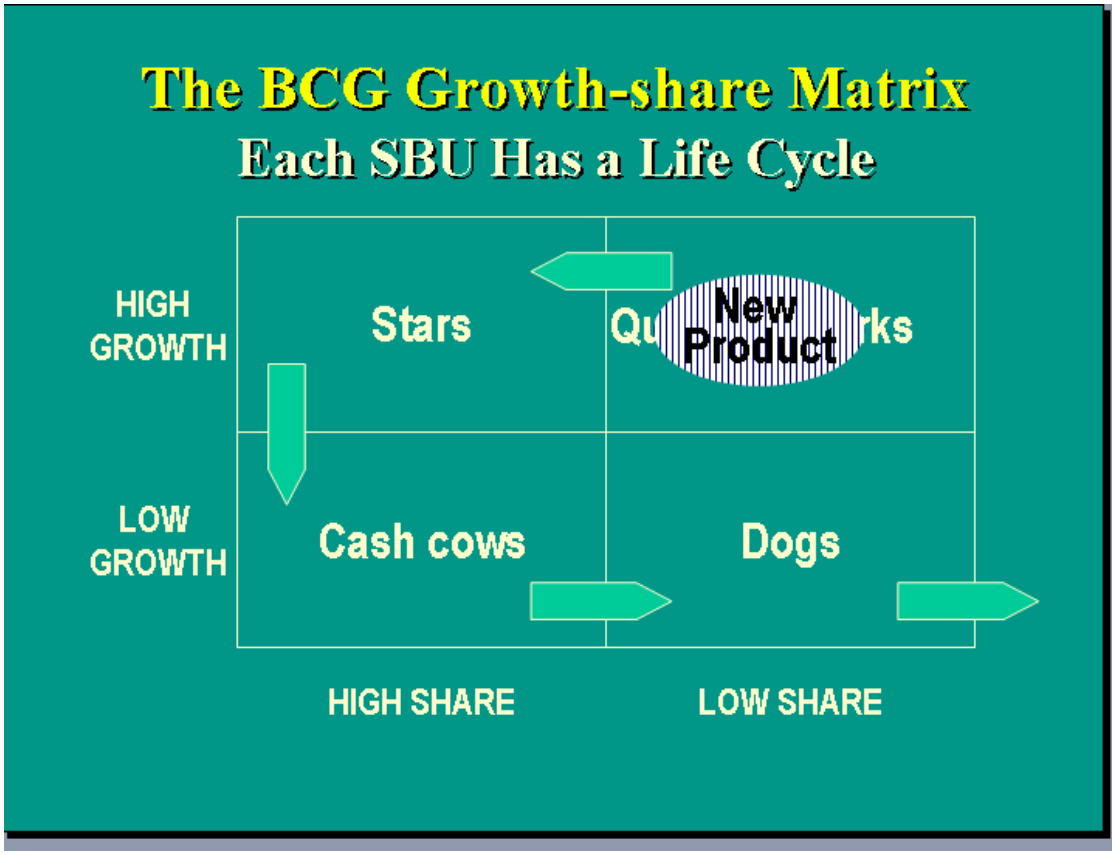

Figure 14 SBU's life cycle

2.3.4. The criteria of market segmentation by types of business

The main strategic business units of TPCLC may be classified into four business units: international trade and shipping service, container stacking area leasing, container logistics operation, general cargo storage and transshipment.
We can define the growth rates under the following rules into 4 classes (Strong Growth, Moderate Growth, Status Quo, Decline) as projected for year 2010 after taking into account the market trend from 1995.

- SG: growth rate at 25% and more;
- MG: growth rate at 5% and up to 25%:
- SQ: growth rate at 0% and up to 5%;
- DCL: growth rate above -10 and up to 0%.

This dissertation divides the market share status into 4 categories according to rules below after taking into account the assumption that the past development of share patter continues under normal circumstances.

- Very weak: absolute market share below 5%;
- Weak: absolute market share at or above 5% but below 15%;
- Fair: absolute market share at or above 15% but below 50%;
- Strong: absolute market share at or above 50%.

Table 3 shows the statistics of the Tianjin Port and TPCLC.

Table 3 Statistics of the Tianjin Port and TPCLC

	1995	2000	2005	
Container throughput of Tianjin port	70.200	170.00	480.00	
(in 10 thousand TEUs)				
General cargo throughput of Tianjin port	1,730	1,782	1,934	
(in 10 thousand tons)				
	1995	2000	2005	
Containers stored and distributed by TPCLC.	31.59	81.60	206.40	
(in 10 thousand TEUs)				
General cargoes stored and distributed by TPCLC	346.00	320.76	270.76	
(in 10 thousand tons)				
		1995/2000	2000/2005	Trend to 2010
Market growth of container cargo		142.17%	182.35%	SG
Market growth of general cargo		3.01%	8.53%	SQ
	1995	2000	2005	Share trend
Container cargo market share of TPCLC	45.00%	48.00%	43.00%	Fair
General cargo market share of TPCLC	20.00%	18.00%	14.00%	Weak

(Source: business department of TPCLC)

Because the establishment of international trade and shipping service area dating from last year is solely authorized to operate by Tianjin government last year, the growth rate and market share are both 100%. Obviously this business is a star

business, which no one can compete with it. The author analyzes the other businesses and positions the four categories into the BCG matrix according to data collected from TPCLC, which is listed by Table 4. Below each SBU, there is a cash flow analysis, which symbolizes the cash generated and cash used.

As we can see the dog general cargo warehousing and transshipment business will surely diminish gradually. Resources will mainly allocated into cash cow and question mark market. To do in-depth analysis of two markets, this dissertation is to sub-segment "cash cow" and "question marks" markets. DEA approach is applied to segment cash cow market by measuring customers' efficiency in Section 3. AHP approach is employed to segment question mark market according to multiple criteria in Section 4.

Table 4 BCG-Matrix of the Tianjin Port Container Logistics Center

MARKET SHARE / MARKET GROWTH	**HIGH**	**LOW**
HIGH	International trade and shipping service	Container yard operation with qualified shipping companies
	Cash generated:+++ Cash used: --- Cash flow: 0	Cash generated:+ Cash used: ---- Cash flow: ---
LOW	Container yard area leased to container logistics companies	General cargo warehousing and transshipment
	Cash generated:+++++ Cash used: -- Cash flow: +++	Cash generated:+ Cash used: - Cash flow: 0

3 Cash cow market segmentation by using DEA approach

3.1 Mathematical model of DEA

DEA is a quantitative technique that derives the utilization efficiency of a specific unit's use of inputs (resources such as labor hours space used, materials consumed) relative to specified outputs. It computes, through iterative processes the "efficiency score" of each unit evaluated. It also ranks and compares each unit's performance relative to the other units; where each DMU represents an entity with multiple inputs and multiple outputs. DMUs may include hospitals, banks, libraries, universities, companies and other for-profit and non-profit organizations. Generally, each DMU is regarded as the entity responsible for converting inputs into outputs and whose performances are to be evaluated.

The CCR model used in this study is the basic DEA model initiated by Charnes, Cooper, and Rhodes (1978). This CCR model is used to estimate the relative efficiency score of each DMU, rank the performance of DMU in terms of efficiency performance.

The CCR originally derived from a fractional programming problem to obtain values for weighted inputs v_i (i=1,2,…m) and weighted outputs u_r (r=1,2,…s). The objective here is to obtain weights (v_i) and (u_r) that maximize the ratio of DMU_0 being evaluated, while satisfying the inputs vs. outputs ratio constraints, which should not exceed 1.

Let the DMU_j to be evaluated on any trial designated as DMU_O (where o = 1,2…n), then this model is presented as follows:

$$(FP_o)\ \text{Max}\quad \theta = \frac{u_1 y_{1o} + u_2 y_{2o} + \ldots + u_s y_{so}}{v_1 x_{1o} + v_2 x_{2o} + \ldots + v_m x_{mo}} \Rightarrow \frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}} \qquad (3\text{-}2\text{-}1)$$

Subject to:

$$\frac{u_1 y_{1j} + u_2 y_{2j} + \ldots + u_s y_{sj}}{v_1 x_{1j} + v_2 x_{2j} + \ldots + v_m x_{mj}} \le 1 \Rightarrow \frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \le 1 \qquad (3\text{-}2\text{-}2)$$

for $j = 1,2,3 \mathbf{L}\, n$;

for $i = 1,2,3 \mathbf{L}\, m$;

for $r = 1,2,3 \mathbf{L}\, s$.

$v_1, v_2, \ldots v_m \ge 0$;

$u_1, u_2, \ldots u_s \ge 0.$

Where:

θ is the objective function value that maximizes the ratio of DMU_O, which is also called the "relative efficiency score".

v_i : weight for input *i*

u_r :weight for output *r*

x_{io} :value for input *x* of DMU_O

y_{ro} :value for output *y* of DMU_O

n: the number of DMU_O

This fractional program (FP_O) then replaced by the following linear program

(LP_O) Max $q = \sum u_r y_{ro}$ (3-2-3)

Subject to $\sum u_r y_{rj} - \sum v_i x_{ij} \le 0$ (3-2-4)

for $j = 1,2,3 \mathbf{L}\, n$;

$v_i \geq 0, u_r \geq 0,$

for $i = 1,2,3 \mathbf{L}\, m;$

for $r = 1,2,3 \mathbf{L}\, s.$

In order to obtain the relative efficiency scores, q^*, this linear program must run *n* times, and the optimal solution of the above linear program (LP_O) is represented by (q^*, v^*, u^*) where v^* and u^* are the optimal weights for each DMU, and q^* is the relative efficiency score of the DMUs.

DMU_O is called CCR-efficient if q^*=1 and there exist at least one optimal solution (v^*, u^*), with $v^* \geq 0$ and $u^* \geq 0$. Otherwise, DMU_O is CCR-inefficient. Thus, there are two possibilities for CCR-inefficiency: (a) q^*<1 or (b) q^*=1 and at least one element of (v^*, u^*) equals zero for every optimal solution of (LP_O).

3.2 The establishment of index system to define input and output of DMU_O

TPCLC needs to segment the "cash cow" business according to logistics companies' relative efficiency. Obviously, the container logistics company is the decision marking unit (DMU). The benchmarks of input indices, which are used to measure the efficiency of DMU are something like: investment capital, stacking capacity, logistics facilities and equipment, IT application capacity, and the ratio of logistics professionals. Average throughput per year, return on investment, profit margin, business reputation, and customer satisfaction degree are chosen as output indices. Input data and output data of 10 container logistics companies are shown in Table 5 and Table 6.Their total market share dominate 95% in the Tianjin port.

Table 5 Input data of 10 container logistics companies in the Tianjin port

Input indices and data	Input 1	Input 2	Input 3	Input 4	Input 5
	Investment capital (million yuan)	Stacking capacity (hectare)	Logistics facilities and equipment (million USD)	IT application capacity (per cent)	Ratio of logistics professionals (per cent)
Zhenhua container stacking yard	100	10	5	90	85
Jinshi container stacking yard	80	7	4	79	81
Shengshi container stacking yard	70	8	3	71	70
Jinri container logistics company	60	6	3.5	65	61
Guilong container logistics compay	50	5	3	50	65
Tianhai container transportation company	55	6.5	4	55	67
Jinfeng container service	60	6	5	50	55
Gangjia container logistics	30	3	3	40	45
Keyun container stacking company	45	6	4	51	51

Yongkang container stacking company	52	5.5	6	56	54

(Source: TPCLC)

Table 6 Output data of 10 container logistics companies in the the Tianjin port

Output indices and data	Output 1 Average throughput per year (1,000 TEUs)	Output 2 Return on investment (per cent)	Output 3 Profit margin (per cent)	Output 4 Business reputation (10 point)	Output 5 Customer satisfaction degree (10 point)
Zhenhua container stacking yard	500	12	4.8	9	9
Jinshi container stacking yard	450	10.6	4.2	7	8.2
Shengshi container stacking yard	400	9.8	3.3	7	8
Jinri container logistics company	350	7.6	2.1	6	7
Guilong container logistics compay	380	9.3	2.3	6.5	6.8
Tianhai container transportation company	400	8.1	2.4	6.3	6.5
Jinfeng container service	385	7.5	3.4	6.1	5.6
Gangjia container	367	6.3	3.5	5.5	5.2

logistics					
Keyun container stacking company	395	6.2	2.4	5.3	5.3
Yongkang container stacking company	365	5.5	2.5	5.4	5

(Source: TPCLC)

This is LP problem with 10 variables. The author will use excel spreadsheet to evaluate and rank logistics companies are relative efficient in the process of converting their multiple inputs into multiple outputs.

3.3 Spreadsheet solution

To determine whether a company is efficient, we define a price per unit of each output and a cost per unit of each input. Then the efficiency of a company is defined to be:

Efficiency of company = value of company's outputs / value of company's inputs

The DEA approach uses the following four ideas to determine whether a company is efficient:

A) No company can be more than 100% efficient. Thus the efficiency of each company is constrained to be less than or equal to 1. To ensure that this is a linear constraint, we express it in this form: Value of company's outputs $\leq$ Value of company's inputs

B) When we are trying to determine whether a company is efficient, it simplifies matters to scale input prices so that the value of the company's inputs equals 1. Then the efficiency of the company will simply equal the value of the company's outputs.

C) If we are interested in evaluating the efficiency of a company, we attempt to choose input and output prices that maximize the company's efficiency. If the company's efficiency equals 1, then the company is efficient; if the company's efficiency is less than 1, then the company is inefficient.

D) We must ensure that each input and output is non-negative.

3.3.1 Determining whether company 1 is efficient as an example:

Table 7 contains the spreadsheet used to determine whether company 1 is efficient. To develop this model, the author proceeds the optimal implementation as follows:

a) Input given data. Enter the input and output information for each company in the range:B5:K14.

b) Input costs. Enter any trial values for the input costs in the range B18:F18.

c) Output values. Enter any trial values for the output values in the range G18:K18.

d) Input costs for each company. In the range B21:B30 compute the cost of the inputs produced by each company. Begin by entering the formula
=SUMPRODUCT($B$18:$F$18,B5:F5)
in cell B21 for company 1. Then copy this formula to the range B22:B30 for the other companies.

e) Output values for each company. In the range D21:D30 compute the value of the outputs produced by each company. To begin, enter the formula
=SUMPRODUCT($G$18:$K$18,G5:K5)
in cell D21 for company 1. Then copy this formula to the range D22:D30 for the other companies.
Recopy input cost and output value for company 1. Recopy the value of company 1's input by entering the formula
=B21
in cell B32 and 1 enter 1 in cell D32. Also recopy the value of company 1's outputs by entering the formula
=D21
in cell B33.
Using the Solver to determine whether company 1 is efficient

i. Objective. Select cell B33 as the target cell to maximize. Since the cost of company 1 inputs equal 1, this will cause the Solver to maximize the efficiency of company 1.

ii. Changing cells. Choose the range B18:K18 (input and output) as the changing cells and constrain these to be non-negative.

iii. Company 1 input cost constraint. Add the constraint B32=D32. This sets the value of company 1 inputs equal to 1.

iv. Maximum efficiency constraints. Add the constraints B21:B30>=D21:D30. This ensures that no company is more than 100% efficient.

v. Linear model and optimize. Check the Assume Linear Model option and select Solve.

Table 7 Spreadsheet implementation for DEA approach

	A	B	C	D	E	F	G	H	I	J	K
1	DEA for company 10										
2											
3	Quantities used/produced										
4		Input 1	Input 2	Input 3	Input 4	Input 5	Output 1	Output 2	Output 3	Output 4	Output 5
5	company 1	100	10	5	90	85	500	12	4.8	9	9
6	company 2	80	7	4	79	81	450	10.6	4.2	7	8.2
7	company 3	70	8	3	71	70	400	9.8	3.3	7	8
8	company 4	60	6	3.5	65	61	350	7.6	2.1	6	7
9	company 5	50	5	3	50	65	380	9.3	2.3	6.5	6.8
10	company 6	55	6.5	4	55	67	400	8.1	2.4	6.3	6.5
11	company 7	60	6	5	50	55	385	7.5	3.4	6.1	5.6
12	company 8	30	3	3	40	45	367	6.3	3.5	5.5	5.2
13	company 9	45	6	4	51	51	395	6.2	2.4	5.3	5.3
14	company 10	52	5.5	6	56	54	365	5.5	2.5	5.4	5
15											
16											
17		Input 1	Input 2	Input 3	Input 4	Input 5	Output 1	Output 2	Output 3	Output 4	Output 5
18	Unit inputs/	0	0	0	0	0.01852	0.00227	0	0	0	0
19											
20		Input costs		Output Values							
21	company 1	1.57	>=	1.14							
22	company 2	1.50	>=	1.02							
23	company 3	1.30	>=	0.91							
24	company 4	1.13	>=	0.79							
25	company 5	1.20	>=	0.86							
26	company 6	1.24	>=	0.91							
27	company 7	1.02	>=	0.87							
28	company 8	0.83	>=	0.83							
29	company 9	0.94	>=	0.90							
30	company 10	1.00	>=	0.83							
31											
32	company 10 :	1.00	=	1							
33	company 10 (	0.83									
34											

The 1 in cell B33 means that we have been able to find a set of unit costs for the unit values of outputs such that the total value of company 1's outputs equals the total cost of its inputs. In other words, company 1 is efficient.

3.3.2 Determining whether company 2 is efficient

To determine whether company 2 is efficient, we simply replace the formula in cell B32 with the value of company 2's inputs (from cell B22) and replace the formula in cell B33 with the value of company 2's outputs (from cell D22). The optimal solution appears in Table 8. From the value of 0.98 in cell B33, we can see that company 2 is not efficient.

Using the above method we simply replace the corresponding cells for respective company and obtain the corresponding efficiency value of the other companies.

CCR result for the DEA model

Table 8 Optimal solutions in Spreadsheet

No.1	DMU	Score	Rank
1	company1	1	1
2	company2	0.98	6
3	company3	1	1
4	company4	1	1
5	company5	1	1
6	company6	0.89	9
7	company7	0.96	7
8	company8	1	1
9	company9	0.95	8
10	company10	0.83	10

The score of DMU equals to 1 does not mean the assessed DMU is absolutely efficient. This merely means no virtual combination of companies can be found to perform more efficiently than the assessed one. The DMUs which scores lower than 1 are not efficient. From Table 8, we can conclude that company 1, 3, 4,5 and 8 are DEA efficient.

This is a typical situation in DEA since no restriction is placed on the weights of inputs and outputs other than the non-negativity constraints on the components of the multiplier vectors $\boldsymbol{v}$ and $\boldsymbol{u}$. Thus, by imposing additional constraints on the basic DEA model, we can obtain an improved DEA model that takes into account specific information that reflects the significance of specific inputs and outputs.

3.4 Drawbacks of basic DEA model and improvement methodology

So far, we have used the basic (unrestricted) DEA model as originally presented by Charnes et al. (Charnes 1978). The unrestricted DEA model allows each DMU to choose the weights of its inputs and outputs in order to maximize its efficiency with respect to the others. Since the unrestricted DEA models allow complete flexibility in choosing the weights of each input and output, the model will often assign unreasonably low or unreasonably high weights (multipliers) in the process of trying to drive the relative efficiency scores (Charnes 1978). Many researchers argued that DEA allows too great a flexibility in the determination of the weights on inputs and

outputs when assessing the relative efficiency of a DMU. This can lead to some DMUs being assessed only on a small subset of their inputs and outputs, while their remaining inputs and outputs are all but ignored (Thanassoulis 1988).

According to Golany (Golany 1988), in practical situations some inputs and outputs may be more fundamental and important than others to the DMU being assessed. For example, in a logistics operation, service level is more important than space utilization of the container yard. Thus, imposing weight bounds in DEA ensures that the most important inputs and outputs are attached higher weights than the less important ones.

Although imposing weight restrictions on the DEA model is suggested by many researchers, one must be careful when setting weights since setting severe bounds on a subset of weights may lead to infeasible program (Ray 2004). Some degree of flexibility is desirable, since variation in factor weights may reflect different circumstances and different objectives of the DMUs being assessed, at the same time; total flexibility can disguise serious inefficiencies in some DMUs (Chaparro 1997).

The methodology for incorporating weight restrictions is based on information derived from the organization's mission and objectives, as well as value judgment and expert opinion. The input and output variables can be defined within the performance measurement framework, whilst the degrees of priorities and significance of objectives should also be considered.

4 Question mark market segmentation by using AHP approach

4.1 Segmentation criteria for question mark market

This dissertation determines to segment the question mark market by liner shipping companies in measuring customer's profit contribution. In theory, the for-profit companies should offer high quality service to all customers at the lowest cost. However, due to the limitation of sources the companies possesses, the companies must set customer service priorities to allocate reasonable amount resources to various customers according to the profit contribution by the corresponding customers. This is Pareto Law, which is also called 80/20 rule. It provides us with the basis for developing a more cost-effective strategy. Fundamentally, not all our customers are equally profitable nor are our service or products. Since we can assume that money spent on service is a scare resource then we should look upon the service providing decision as a resource allocation issue. Figure 15 shows how a typical company profits varying by customer and by product.

The curve is usually divided into four categories: the top 20 per cent of customers by profitability are the 'A' category; the next 50 per cent are labeled as 'B'; another 30 per cent of are category 'C'; and the final 30 per cent are the loss.

How can we make use of this important fact to segment question mark market? The first thing is obviously to evaluate the liner shipping market and distinguish the key accounts. The second thing is to collaborate with the most valuable liner shipping companies to operate container logistics business. Hereafter, this dissertation will use AHP to realize the market segmentation.

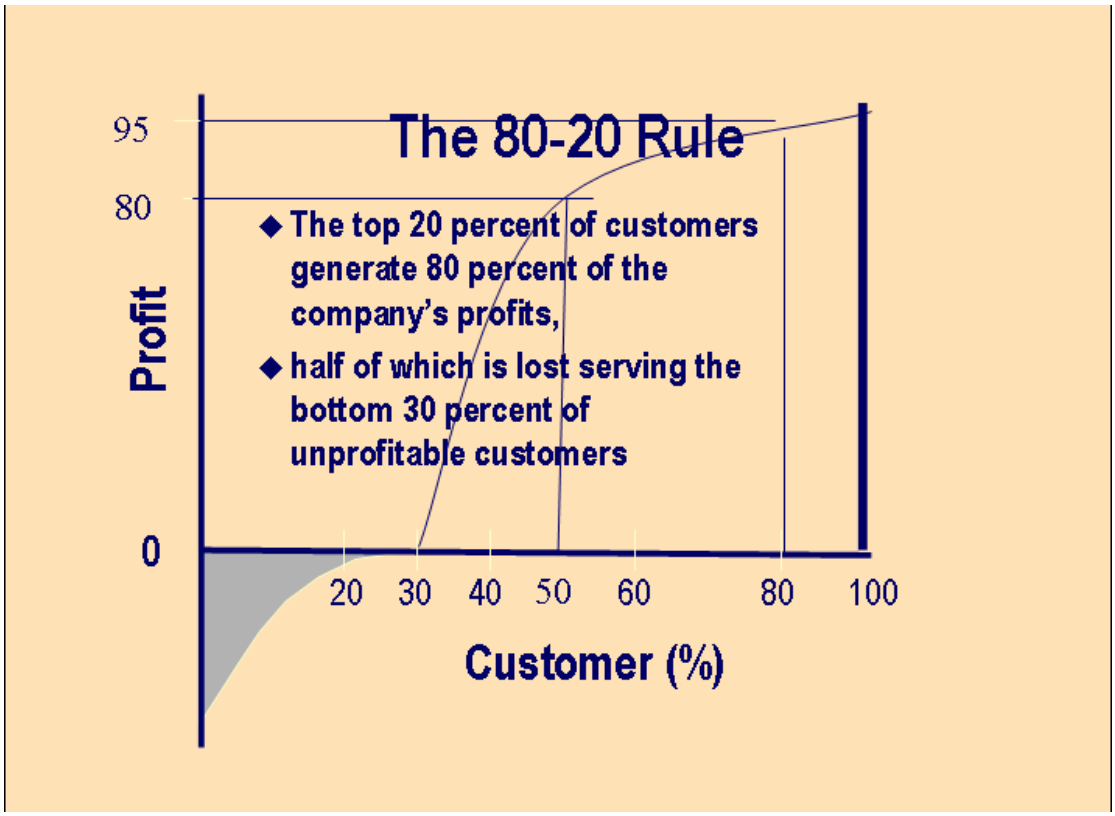

Figure 15 Pareto Law rule

4.2 Mathematic models of AHP approach

When multiple objectives are important to a decision maker, it is often difficult to choose among the DEA-efficient DMUs. For example, one company may yield high throughput per year but need more investment and logistics professionals to be input. Another company may yield low throughput, but need less investment and generate high return. In this case, it might be difficult for you to evaluate the performances of DMUs. Thomas Saaty's Analytic Hierarchy Process (AHP) provides a powerful tool that can be used to make decisions in situations where multiple objectives are paradoxical. It is a multi-objective optimization approach in terms of hierarchy that structures the value system of decision-maker when they make strategic thinking and consider the experts' opinions. Just carrying out simple subjective judgments, decision-maker can choose the most preferred solution among a finite number of decision alternatives.

Using AHP in solving a decision problem involves four steps. This first step is setting up the decision hierarchy by breaking down the decision problem into a

hierarchy of interrelated decision elements until value system of the problem has been clearly defined. At the top of the hierarchy lies the most macro decision objective, such as the objective of making the best decision (or selecting the best alternative). The lower levels of the hierarchy contain attributes (objectives) which contribute to the quality of the decision. Details of these attributes increase at the lower levels of the hierarchy. The last levels of the hierarchy contain decision alternatives or selection choices. The decision schema, hence, has a standard form as depicted in Figure 16. In our case, choosing the best company is the objective in Level 1. Level 2 consists of lower decision criteria.

In setting up the decision hierarchy, the number of levels depends on the complexity of the problem and the degree of detail the analyst requires in attempt to solve the problem. Since each level entails pairwise comparisons of its elements, Saaty (Satty 1990) suggests that the number of elements at each level be limited to a maximum of nine. The intensity of importance comparing two elements scales 9 grades which are illustrated by Table 9.

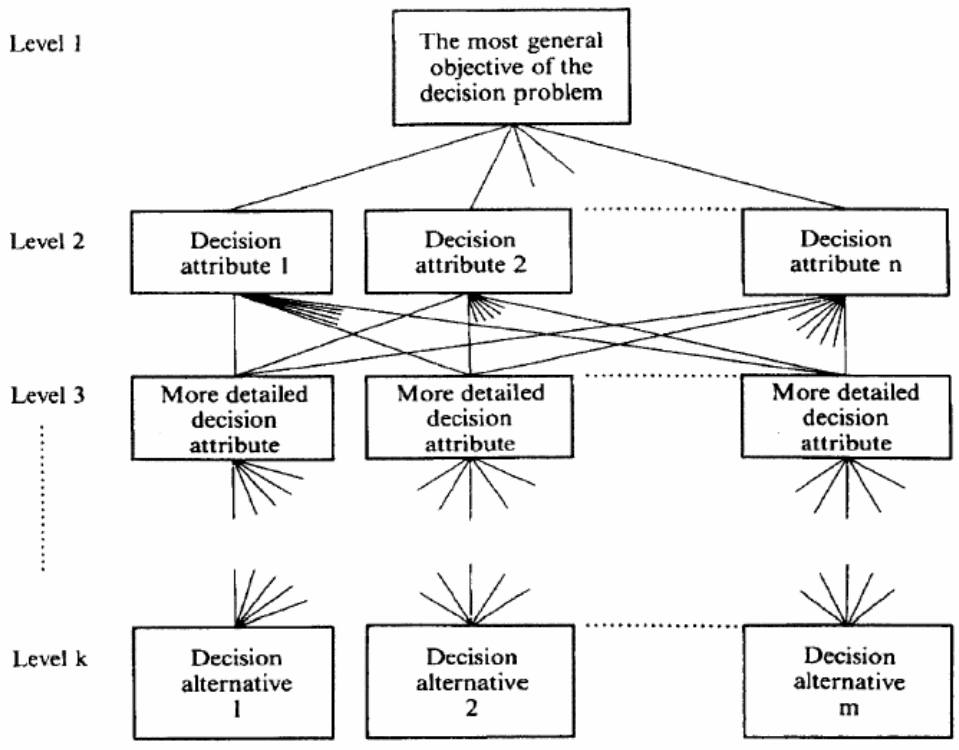

Figure 16 Levels of decision making

Table 9 Intensity of importance comparing two elements

Scale of intensity importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	An element is very strongly favor over another
9	Extreme importance	The evidence favoring one over another is of the highest possible affirmation
2,4,6,8	Intermediate values between two adjacent judgments	When compromise is needed

(Source: Satty 1994 Decision Making in Economics, Political, Social and Technological Environments with AHP)

The second step is collecting input data by pairwise comparisons of decision elements. At the data-gathering step of the AHP, decision-maker is asked to express his relative preference for a pair of elements. Such responses are usually stated by intensity of importance one over another, and then transformed into the numeric score. In this step, the input data for the problem consists of matrices of pairwise comparisons of elements of one level that contribute to achieving or satisfying the objectives of the next higher level.

When compared with itself, each elements has equal importance. Diagonal elements of the input matrix, therefore, always equal one, and lower triangle elements of the matrix are the reciprocal of upper triangle elements. Thus, pairwise comparison data are collected for only half of the matrix elements, excluding diagonal elements.
One may argue that it is possible to assign weights directly to elements of a level. The argument in AHP is that direct assignment of weights is too abstract for the evaluator and leads to inaccuracies. Pairwise comparisons, on the other hand, give the evaluator a basis on which to reveal experts' preference by comparing two elements. Additionally, the expert has the opinion of expressing preferences between the two elements.

The third step is using the "eigenvalue" method to estimate the relative weights of decision elements. In this step, the solution technique of the AHP takes in as input

the above pairwise comparisons and produces the relative weights of elements at each level as output. The right eigenvector method will be analyzed by mathematical model in next section.

As a measure of consistency in the pairwise comparison matrices or reliability of the judgments we can calculate the consistency ratio (CR). Inconsistent pairwise comparison matrices need to be adjusted.

Finally, the fourth step aggregates relative weights of various levels obtained from the third step in order to produce a vector of composite weights which serve as ratings of decision alternatives (or selection choices) in achieving the most general objective of the problem.

Suppose

$$A=\begin{bmatrix} w_1/w_1 & w_1/w_2 & \mathbf{L} & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \mathbf{L} & w_2/w_n \\ w_3/w_1 & w_3/w_2 & \mathbf{L} & w_3/w_n \\ \mathbb{M} & \mathbb{M} & \mathbb{M} & \mathbb{M} \\ w_n/w_1 & w_n/w_2 & \mathbf{L} & w_n/w_n \end{bmatrix} \mathbf{L}\,(4-3-1)$$

$$=\left(a_{ij}\right)_{nxn}(i,\ j=1,2,\mathbf{L},n)$$

$$\left(a_{ij}\right)=\frac{w_i}{w_j}(i,\ j=1,2,\mathbf{L},n)$$

Obviously,

$$\left(a_{ji}\right)=\frac{w_j}{w_i}(i,\ j=1,2,\mathbf{L},n)$$

$$\left(a_{ij}\right)=\frac{1}{\left(a_{ji}\right)}(i,\ j=1,2,\mathbf{L},n)$$

$$\left(a_{ii}\right)=1(i=1,2,\mathbf{L},n)$$

In this case, the relative weights could be trivially obtained from each one of n rows of matrix ***A*** and the following holds:

I. $A*W=n*W\ \mathbf{L}\ \mathbf{L}\ \mathbf{L}\ (4-3-2)$

where $W=(w_1,w_2,\mathbf{L}\ w_n)^T$ is the vector of actual relative weights, ***n*** is the number of elements. In matrix algebra, ***n*** and ***W*** in equation (4-3-1) are called the eigenvalue and the right eigenvector of matrix ***A***. AHP points that the evaluator does not know W and, therefore, is not able to produce the pairwise relative weights of matrix ***A*** accurately. Thus, the

observed matrix A contains inconsistencies. The estimation of $\boldsymbol{W}$ (denoted as $\underline{\boldsymbol{W}}$) could be obtained similarly from the following procedures:

II. $\underline{A} * \underline{W} = l_{\max} * \underline{W}$ **L L L** $(4-3-3)$

where $\underline{\boldsymbol{A}}$ is observed matrix of pairwise comparisons, $l_{\max}$ is the largest eigenvalue of $\underline{\boldsymbol{A}}$, and $\underline{\boldsymbol{W}}$ is its right eigenvector of $\underline{\boldsymbol{A}}$. $\underline{\boldsymbol{W}}$ constitutes the estimation of $\boldsymbol{W}$. In procedure II, $l_{\max}$ may be considered as the estimation of $\boldsymbol{n}$ in procedure I. Saaty (1980) has shown that $l_{\max}$ is always greater than or equal to $\boldsymbol{n}$. The closer the value of computed $l_{\max}$ is to $\boldsymbol{n}$, the more consistent are the observed values of $\underline{\boldsymbol{A}}$. This property has led to the construction of the consistency index (CI).

Assume

$$A = (a_{ij})_{nxn} (i, j = 1,2, \mathbf{L}, n) \qquad (4\text{-}3\text{-}4)$$

$$S_j = \sum_{i-1}^{n} a_{ij}, (j = 1,2, \mathbf{L}, n)$$

$$a_{ij}^{*} = \frac{a_{ij}}{S_j} (i, j = 1,2, \mathbf{L}, n)$$

$$Define \mathbf{K}\ A_{nom} = (a_{ij}^{*})_{nxn}$$

$$W_i = \frac{\sum_{j=1}^{n} a_{ij}^{*}}{n} (i = 1,2, \mathbf{L}, n)\ \mathbf{L}\ \mathbf{L}\ \mathbf{L}\ (4-3-5)$$

$$\underline{W} = [W_1, W_2, \mathbf{L}\, W_i, \mathbf{L}\, W_n]^T$$

$$l_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i}\ \mathbf{L}\ \mathbf{L}\ \mathbf{L}\ \mathbf{L}\ \mathbf{L}\ (4-3-6)$$

By the computation, we can obtain the right eigenvector $\underline{W} = [W_1, W_2, \mathbf{L}\, W_i, \mathbf{L}\, W_n]^T$ and eigenvalue

$$l_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i}$$ of matrix ***A.***

III. The formula of consistency index (CI):

$$CI = (l_{\max} - n)/(n-1) \quad (4\text{-}3\text{-}7)$$

IV. The formula of consistency ratio (CR):

$$CR = (CI / RI) * 100 \quad (4\text{-}3\text{-}8)$$

where RI is the average index of randomly generated weights.
We can get the value of RI from Table 10 below.

Table 10 Value of average random index

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

(Source: Satty 1994 Decision Making in Economics, Political, Social and Technological Environments with AHP)

As a rule of thumb, a CR value of 10 per cent or less is considered acceptable. Otherwise, it is recommended that ***A*** be re-observed to resolve inconsistencies in pairwise comparisons. Saaty (1977) showed that the estimation of ***W*** could be accomplished via an iterative computation. His computational algorithm is now available in a software product called “Expert Choice” which includes consistency checks for input matrices as well.

Finally, the fourth step aggregates relative weights of various levels obtained from the third step in order to produce a vector of composite weights which serve as ratings of decision alternatives (or selection choices) in achieving the most general objective of the problem. The composite relative weight vector of elements at ***k***th level with respect to that of the first level may be computed from procedure V.

V. $$C[1,k] = \prod_{i=2}^{k} B_i \quad (4\text{-}3\text{-}9)$$

where $C[1,k]$ is the vector of composite weights of elements at level ***k*** with respect to the element on level 1, and B_i is the n_{i-1} by n_i matrix with rows

consisting of estimated $\underline{W}$ vectors. n_i represents the number of elements at level ***i*** and is the same as ***n*** in procedure I but is subscripted to show that it belongs to level ***i.***

4.3 Spreadsheet Solution for AHP Model

According to the four steps we discussed in previous sections, this dissertation now shows how to implement AHP by spreadsheet solver to identify and rank the best liner shipping companies.

Five factors are chosen as second level objectives to be taken into account as follows:

Factor 1. high container throughput
Factor 2. potentiality of throughput growth
Factor 3. good business reputation
Factor 4. perfect logistics networks
Factor 5. high management skills and employees

Five shipping or agency companies will be assessed as follows:

Company 1. Tianjin Marine Transport
Company 2. COSCO Container Tianjin
Company 3. China ocean shipping agency Tianjin (Penavico Tianjin)
Company 4. Evergreen Tianjin Shipping
Company 5. COSCO LOGISTICS

Step One: In order to get the expert opinion in comparing the importance of corresponding elements, the author handed over questionnaire to managers of TPCLD to fill in. After sorting and categorizing, the author establishes the pairwise comparison 6 matrics as Table 11:

Table 11 Pairwise comparison matrices in spreadsheet

Pairwise comparison matrices among objectives

	factor 1	factor 2	factor 3	factor 4	factor 5
factor 1	1	5	3	2	3
factor 2	0.2	1	2	4	3
factor 3	0.333333	0.5	1	3	0.50
factor 4	0.5	0.25	0.333333	1	3
factor 5	0.333333	0.333333	2	0.333333	1

Pairwise comparisons on objective 1. high container throughput

	Company 1	Company 2	Company 3	Company 4	Company 5
Company 1	1	0.333333	0.166667	0.25	0.20
Company 2	3	1	0.5	1.2	0.8
Company 3	6	2	1	1.5	1.2
Company 4	4	0.833333	0.666667	1	0.6
Company 5	5	1.25	0.833333	1.666667	1

Pairwise comparisons on objective 2. potentiality of throughput growth

	Company 1	Company 2	Company 3	Company 4	Company 5
Company 1	1	0.8	0.333333	0.6	0.4
Company 2	1.25	1	0.333333	0.7	0.8
Company 3	3	3	1	3	2
Company 4	1.666667	1.428571	0.333333	1	0.6
Company 5	2.5	1.25	0.5	1.666667	1

Pairwise comparisons on objective 3. good business reputation

	Company 1	Company 2	Company 3	Company 4	Company 5
Company 1	1	5	0.5	1.2	1.5
Company 2	0.2	1	0.50	0.8	0.7
Company 3	2	2	1	3	2
Company 4	0.833333	1.25	0.333333	1	1.3
Company 5	0.666667	1.428571	0.5	0.769231	1

Pairwise comparisons on objective 4. perfect logistics networks

	Company 1	Company 2	Company 3	Company 4	Company 5
Company 1	1	2	1.5	1.8	3
Company 2	0.5	1	0.50	0.7	2
Company 3	0.666667	2	1	2	4
Company 4	0.555556	1.428571	0.5	1	2.5
Company 5	0.333333	0.5	0.25	0.4	1

Pairwise comparisons on objective 5. high management skills and employees

	Company 1	Company 2	Company 3	Company 4	Company 5

Company 1	1	0.8	0.6	0.9	0.7
Company 2	1.25	1	0.50	1.3	1.5
Company 3	1.666667	2	1	2	3
Company 4	1.111111	0.769231	0.5	1	2.5
Company 5	1.428571	0.666667	0.333333	0.4	1

Step Two: By using spreadsheet we can easily obtain the normalized matrices for the corresponding pairwise comparison matrices. Compute the normalized matrix for the first pairwise comparison matrix in the range H5:L9. Starting with the cursor in cell H5, drag the cursor so that the range H5:L9 is highlighted. Then type the formula
=B5/SUM(B$5:B$9)
And press Control-Enter (both key at once). It's a quicker way then copying and pasting!
Step Three: Calculate the eigenvector W. In the range H5:L5 compute the eights for each objective. We'll again do this the quick way. Starting with the cursor in cell N5, highlight the range N5:N9. Then type the formula
=AVERAGE(H5:L5)
And press Control-Enter.
Step Four: Other pairwise comparison matrices and scores for jobs on various objectives. Repeat the same calculations in Step 2 and 3 for the other pairwise comparison matrices to obtain the normalized matrices in columns H through L and score vectors in column N.
Step Five: Overall company scores: In the range B55:F59 form a matrix of company scores on the various objectives. To get the score vector in the range N13:N17 into the range B55:B59, for example, highlight the range B55:B59, type the formula
=N13
And press Control-Enter. Do likewise for the other four scores vectors in column N. Then to obtain the overall job scores, highlight the range H55:H59, type the formula
=MMULT(B55:F59,N5:N9)
And press Control-Shift-Enter. (Remember that Control-Shift-Enter is used to enter a matrix function. In contrast, Control-Enter is equivalent to copying a formula to a highlighted range.)

Table 12 demonstrates the implementation for AHP approach by spreadsheet.

Table 12 Spreadsheet implementation for AHP approach

Company evalution by AHP approach

Pairwise comparisons among objectives

	factor 1	factor 2	factor 3	factor 4	factor 5
factor 1	1	3	3	2.8	5
factor 2	0.33333	1	2	2.5	3
factor 3	0.33333	0.5	1	3	2.50
factor 4	0.35714	0.4	0.33333	1	2
factor 5	0.2	0.33333	0.4	0.5	1

Normallized matrix

0.44968	0.57325	0.44554	0.28571	0.37037
0.14989	0.19108	0.29703	0.2551	0.22222
0.14989	0.09554	0.14851	0.30612	0.18519
0.1606	0.07643	0.0495	0.10204	0.14815
0.08994	0.06369	0.05941	0.05102	0.07407

Weights

0.42491
0.22307
0.17705
0.10735
0.06763

Pairwise comparisons on 1. high container throughput

	Company	Company	Company	Company	Company 5
Company	1	0.33333	0.16667	0.25	0.20
Company	3	1	0.5	1.2	0.8
Company	6	2	1	1.5	1.2
Company	4	0.83333	0.66667	1	0.6
Company	5	1.25	0.83333	1.66667	1

Normallized matrix

0.05263	0.06154	0.05263	0.04451	0.05263
0.15789	0.18462	0.15789	0.21365	0.21053
0.31579	0.36923	0.31579	0.26706	0.31579
0.21053	0.15385	0.21053	0.17804	0.15789
0.26316	0.23077	0.26316	0.29674	0.26316

Scores

0.05279
0.18492
0.31673
0.18217
0.2634

Pairwise comparisons on 2. potentiality of throughput growt

	Company	Company	Company	Company	Company 5
Company	1	0.8	0.33333	0.6	0.4
Company	1.25	1	0.33333	0.7	0.8
Company	3	3	1	3	2
Company	1.66667	1.42857	0.33333	1	0.6
Company	2.5	1.25	0.5	1.66667	1

Normallized matrix

0.10619	0.10697	0.13333	0.08612	0.08333
0.13274	0.13372	0.13333	0.10048	0.16667
0.31858	0.40115	0.4	0.43062	0.41667
0.17699	0.19102	0.13333	0.14354	0.125
0.26549	0.16714	0.2	0.23923	0.20833

Scores

0.10319
0.13339
0.3934
0.15398
0.21604

Pairwise comparisons on 3. good business reputation

	Company	Company	Company	Company	Company 5
Company	1	5	0.5	1.2	1.5
Company	0.2	1	0.50	0.8	0.7
Company	2	2	1	3	2
Company	0.83333	1.25	0.33333	1	1.3
Company	0.66667	1.42857	0.5	0.76923	1

Normallized matrix

0.21277	0.46823	0.17647	0.17727	0.23077
0.04255	0.09365	0.17647	0.11818	0.10769
0.42553	0.18729	0.35294	0.44318	0.30769
0.1773	0.11706	0.11765	0.14773	0.2
0.14184	0.13378	0.17647	0.11364	0.15385

Scores

0.2531
0.10771
0.34333
0.15195
0.14392

Pairwise comparisons on 4. perfect logistics networks

	Company	Company	Company	Company	Company 5
Company	1	2	1.5	1.8	3
Company	0.5	1	0.50	0.7	2
Company	0.66667	2	1	2	4
Company	0.55556	1.42857	0.5	1	2.5
Company	0.33333	0.5	0.25	0.4	1

Normallized matrix

0.32727	0.28866	0.4	0.30508	0.24
0.16364	0.14433	0.13333	0.11864	0.16
0.21818	0.28866	0.26667	0.33898	0.32
0.18182	0.20619	0.13333	0.16949	0.2
0.10909	0.07216	0.06667	0.0678	0.08

Scores

0.3122
0.14399
0.2865
0.17817
0.07914

Pairwise comparisons on 5. high management skills and emplo

	Company	Company	Company	Company	Company 5
Company	1	0.8	0.6	0.9	0.7
Company	1.25	1	0.50	1.3	1.5
Company	1.66667	2	1	2	3
Company	1.11111	0.76923	0.5	1	2.5
Company	1.42857	0.66667	0.33333	0.4	1

Normallized matrix

0.15489	0.15279	0.20455	0.16071	0.08046
0.19361	0.19099	0.17045	0.23214	0.17241
0.25814	0.38198	0.34091	0.35714	0.34483
0.1721	0.14691	0.17045	0.17857	0.28736
0.22127	0.12733	0.11364	0.07143	0.11494

Scores

0.15068
0.19192
0.3366
0.19108
0.12972

Determining the best company

Matrix of scores

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Overall scores	Rank

43	Pairwise comparisons on 5. high management skills and						Normallized matrix					Scores
44		Company	Company	Company	Company	Company 5						
45	Company	1	0.8	0.6	0.9	0.7	0.1549	0.1528	0.2045	0.1607	0.0805	0.1507
46	Company	1.25	1	0.50	1.3	1.5	0.1936	0.191	0.1705	0.2321	0.1724	0.1919
47	Company	1.6667	2	1	2	3	0.2581	0.382	0.3409	0.3571	0.3448	0.3366
48	Company	1.1111	0.7692	0.5	1	2.5	0.1721	0.1469	0.1705	0.1786	0.2874	0.1911
49	Company	1.4286	0.6667	0.3333	0.4	1	0.2213	0.1273	0.1136	0.0714	0.1149	0.1297
50												
51												
52	Determining the best company											
53	Matrix of scores											
54		Factor	Factor	Factor	Factor	Factor 5	Overall scores		Rank			
55	Company	0.0528	0.1032	0.2531	0.3122	0.1507	0.134		5			
56	Company	0.1849	0.1334	0.1077	0.144	0.1919	0.1558		4			
57	Company	0.3167	0.3934	0.3433	0.2865	0.3366	0.3366		1			
58	Company	0.1822	0.154	0.1519	0.1782	0.1911	0.1707		3			
59	Company	0.2634	0.216	0.1439	0.0791	0.1297	0.2029		2			

We see the company 3 is the preferred of the five companies.

Table 13 Calculation of consistency ratio for six matrices.

Company evalution by AHP approach

Pairwise comparisons among objectives

	factor 1	factor 2	factor 3	factor 4	factor 5	Weights	Prodoct	Ratios
factor 1	1	3	3	2.8	5	0.42491	2.26396	5.32808
factor 2	0.33333	1	2	2.5	3	0.22307	1.19005	5.33496
factor 3	0.33333	0.5	1	3	2.50	0.17705	0.92132	5.2037
factor 4	0.35714	0.4	0.33333	1	2	0.10735	0.5426	5.05467
factor 5	0.2	0.33333	0.4	0.5	1	0.06763	0.35146	5.19706
						CI	0.05592	CI/RI 0.05084

Pairwise comparisons on 1. high container throughput

	Company	Company	Company	Company	Company 5	Scores		
Company	1	0.33333	0.16667	0.25	0.20	0.05279	0.26544	5.02829
Company	3	1	0.5	1.2	0.8	0.18492	0.93097	5.03453
Company	6	2	1	1.5	1.2	0.31673	1.59262	5.02829
Company	4	0.83333	0.66667	1	0.6	0.18217	0.91661	5.03171
Company	5	1.25	0.83333	1.66667	1	0.2634	1.32604	5.0344
						CI	0.00786	CI/RI 0.00715

Pairwise comparisons on 2. potentiality of throughput growt

	Company	Company	Company	Company	Company 5	Scores		
Company	1	0.8	0.33333	0.6	0.4	0.10319	0.51984	5.0376
Company	1.25	1	0.33333	0.7	0.8	0.13339	0.67413	5.05391
Company	3	3	1	3	2	0.3934	1.99715	5.0766
Company	1.66667	1.42857	0.33333	1	0.6	0.15398	0.77728	5.04798
Company	2.5	1.25	0.5	1.66667	1	0.21604	1.09408	5.06427
						CI	0.01402	CI/RI 0.01274

Pairwise comparisons on 3. good business reputation

	Company	Company	Company	Company	Company 5	Scores		
Company	1	5	0.5	1.2	1.5	0.2531	1.36152	5.37934
Company	0.2	1	0.50	0.8	0.7	0.10771	0.55229	5.12764
Company	2	2	1	3	2	0.34333	1.80862	5.26791
Company	0.83333	1.25	0.33333	1	1.3	0.15195	0.79903	5.25862
Company	0.66667	1.42857	0.5	0.76923	1	0.14392	0.75507	5.2466
						CI	0.06401	CI/RI 0.05819

Pairwise comparisons on 4. perfect logistics networks

	Company	Company	Company	Company	Company 5	Scores		
Company	1	2	1.5	1.8	3	0.3122	1.58806	5.08661
Company	0.5	1	0.50	0.7	2	0.14399	0.72634	5.04445
Company	0.66667	2	1	2	4	0.2865	1.45552	5.08037
Company	0.55556	1.42857	0.5	1	2.5	0.17817	0.89842	5.0426
Company	0.33333	0.5	0.25	0.4	1	0.07914	0.3981	5.03004
						CI	0.0142	CI/RI 0.01291

Pairwise comparisons on 5. high management skills and emplo

	Company	Company	Company	Company	Company 5	Scores		
Company	1	0.8	0.6	0.9	0.7	0.15068	0.76895	5.10323
Company	1.25	1	0.50	1.3	1.5	0.19192	0.99155	5.16645
Company	1.66667	2	1	2	3	0.3366	1.74289	5.17793
Company	1.11111	0.76923	0.5	1	2.5	0.19108	0.99873	5.22681
Company	1.42857	0.66667	0.33333	0.4	1	0.12972	0.66156	5.09988
						CI	0.03871	CI/RI 0.0352

Determining the best company

Matrix of scores

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Company	0.05279	0.10319	0.2531	0.3122	0.15068
Company	0.18492	0.13339	0.10771	0.14399	0.19192
Company	0.31673	0.3934	0.34333	0.2865	0.3366
Company	0.18217	0.15398	0.15195	0.17817	0.19108
Company	0.2634	0.21604	0.14392	0.07914	0.12972

Step Six: Computing the consistency Index. It is shown in Table 13. First compute the consistency index *CI* for each of the pairwise comparison matrices. The following processes are relevant for the first level pairwise comparison matrix. The others are done in analogous fashion.

1) Product of comparison matrix and vector of weights (or scores). Compute the product of the first pairwise comparison matrix and the weights vector in the range N5:N9 by highlighting this range, typing
   =MMULT(B5:F9,N5:N9)
   And press Control-Shift-Enter.
2) Ratios. In cell P5 calculate the ration of the two cells to its left with the formula
   = O5/N5
   and copy this to the range P6:P9.
3) Consistency index. Calculate the consistency index *CI* in cell P10 with the formula
   =(AVERAGE(P5:P9)-5)/4
   Then in cell Q10 calculate the ratio of CI to RI (for n=5, RI=1.1) with the formula
   =P10/1.1
   The 1.1 comes from Table 10. For all other five matrices, we use n=5 and RI=1.1

   As Table 13 illustrates, all of the pairwise comparison matrices are quite consistent; the consistency ratio ($CR = CI / RI$) for each is quite a bit less than 0.10.

In conclusion, we can say the overall scores of five companies resulting from Table 12 are effective through computing consistency ratio. The rank of companies is listed below

	Overall scores	**Rank**
Company 1	**0.13396**	**5**
Company 2	**0.1558**	**4**
Company 3	**0.3366**	**1**
Company 4	**0.1707**	**3**
Company 5	**0.2029**	**2**

5 Changes of market environment and marketing strategy

5.1 Challenge of market environment

Over the past 30 years the world trade has grown faster than the world production. During the decade of the 1990s, world trade increased on average twice as fast as world GDP did. Another phenomenon worth noting is the rapid growth of world trade in terms of value rather than in volume. Containerization and economic globalization are driving force behind world market changes. To take full advantage of the costs of labor and raw materials in developing countries like China, India and so on, increasing multination corporations (MNCs) choose to build manufacturing centers to produce commodities and export them to world market.

As a result, global manufacturing and marketing are becoming increasingly organized. More and more MNCs are becoming global companies for they allocate resources globally. Most experts expect the global business environment will undergo greater change over the next ten years than it did over the last one hundred years. As multinational corporations strive to attain a competitive advantage in the marketplace, new distribution systems will emerge. Trade liberalization and information technology are continually advancing forward, national borders are increasingly disappearing, traditional marketing mix are facing challenge and barriers to global trade are falling. To cope with this operational environment, multinational corporations have been searching for new production and logistics architectures as a way of gaining the advantages that come with standardized global production. As a consequence, global production leads to global logistics to implement international transport and distribution. Logistics must be seen as the link between the marketplace and the supply base. The scope of logistics spans the organization, from the management of raw materials through to the delivery of the final product. Figure 17 illustrates the maritime container logistics concept.

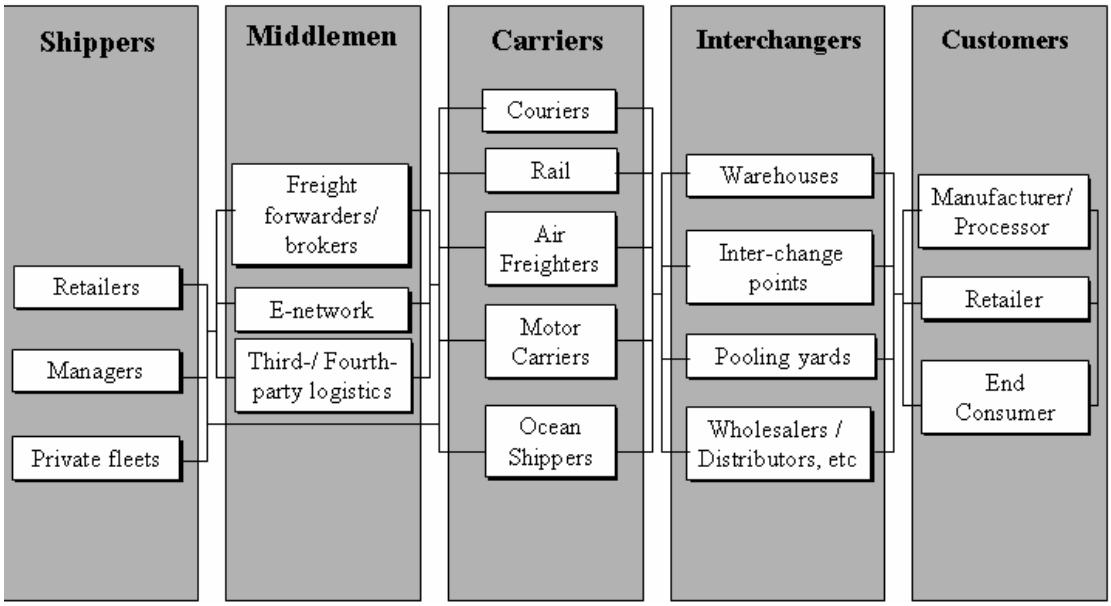

Figure 17 Maritime container logistics interfaces

Logistics management, from this total systems viewpoint, is the means whereby the needs of customers are satisfied through the coordination of the materials and information flows that extend from the marketplace, through the company and its or operations and beyond that to shippers. To achieve this company-wide integration, we should pay more emphasis on the overall logistics pipeline operation to optimize the total process from supplier side to customer end. The objectives of MNCs lie in lowering overall logistics in the supply chain Thus, the competition among MNCs more and more happen among them supply chains rather than one or several suppliers, shipping companies or road haulers.

Customers in all markets, industrial or commercial, are increasingly time-sensitive. In other words they value time and this is reflected in their needs. For example, in industrial markets buyers tend to source from suppliers with the shortest lead times who can meet their quality specification. In consumer markets customers make their choice from amongst the brands available at the time; hence if the preferred brand is out of inventory it is quite likely a substitute brand will be purchased instead. In the past it was the case the price was paramount as an impact on the customer's decision. Now the determinant factor of customer is the total cost of product in the supply chain pipeline. There are many factors influencing the market environment and logistics integration:

- Shortening product life cycles
- Customer's drive for reduced inventories

- Logistics globalization
- E-market emergence
- Requirement of multimodal transportation and transit shipment

A. Shortening the product lifecycles

The theory of product life is a very important and well established in marketing. It suggests that for many products there is a recognizable pattern of sales from the launch to final decline. The passing decades has witnessed the shortening of the products' life cycles. The early mechanical typewriter had a life cycle of about 30 years---meaning that an individual model would be little changed during that period. These mechanical typewriters were replaced by the electro-mechanical typewriters, which had a life cycle of about 10 years. The electro-mechanical typewriters gave way to the electronic typewriter with a four-year life cycle. Now the typewriter is seldom used by people as it is substituted by computer with a life cycle of one year or less.

B. Customers' drive for reduced inventories

Huge inventory often ties up large sleeping capital. Whether the inventory is in the form of raw materials, components, work-in-process or finished products, the pressure has been to release the capital locked up in stock and hence to reduce the holding cost of that stock. Time compression has become a critical management issue. Customers and distributors are ever more willing to accept a substitute product if their first choice is not available.

C. Logistics globalization

According to Martin Christopher (2000), logistics globalization tends to lengthen supply chains as companies move production base oversea or procure raw materials form offshore locations. The impetus for this trend, which in recent years has a accelerated dramatically, is the search and utilization of lower labor cost and raw materials. Therefore the determining cost factor is not the segment cost in the logistics pipeline. Instead it is the overall cost in the supply chain. The globalization of economy, hence the supply chains, is inevitable because of the downward pressure on price from the customers.

D. E-market emergence

With the rapid development of IT technology, the markets regardless of its type across the globe are seamlessly connected together beyond the limitations of space and time. The emergence of e-commerce makes the conventional marketing theory facing fierce challenges because the virtual market in cyber space becomes significantly huge than before. Internet technology has forced companies to redefine their business models so as to improve the extended enterprise performance - this is popularly called e-business. The focus has been on improving the extended enterprise transactions including intraorganizational, Business-to-Consumer (B2C) and Business-to-Business (B2B) transactions.

This shift in corporate focus allowed a number of companies to employ a hybrid approach, the Push-Pull supply chain paradigm (see Figure 18)

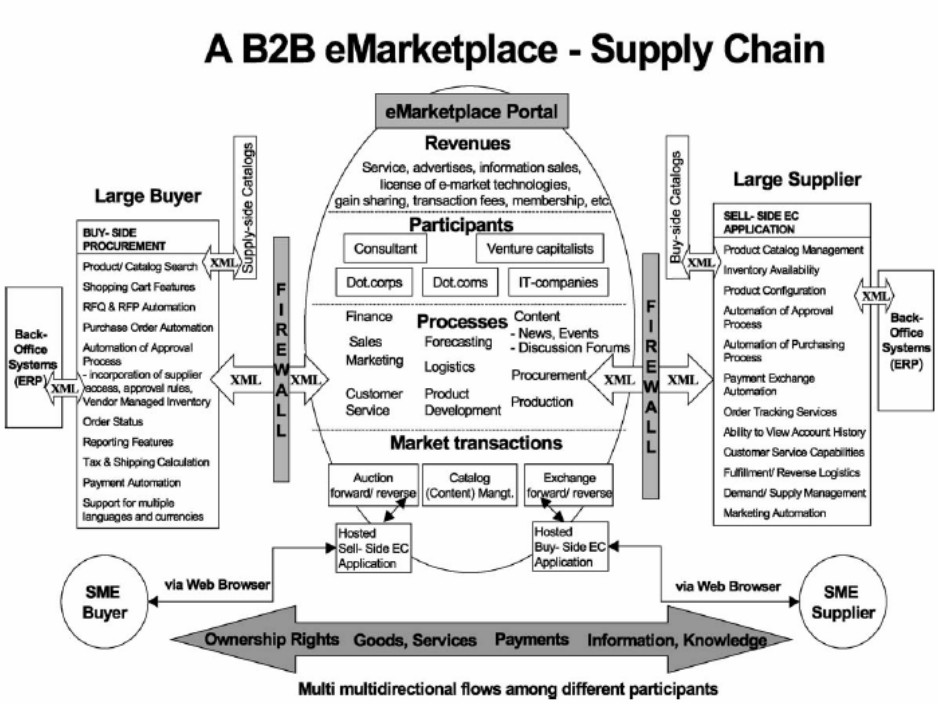

Figure 18 B2B eMarketplace in Supply Chain

E. Requirement of multimodal transportation and transit shipment

The goal of a multimodal transfer is to provide multimodal freight transportation, which is coordinated, seamless, flexible, and continuous from door-to-door on two or more transportation modes. Equally important is the fact that multimodal freight transportation is not just about the hardware or equipment involved with the freight movement, but the process by which they are all connected in a systematic and sustainable way (Gerhardt Muller,2000). Logistics management requires all components of the multimodal freight transportation process to be reliable, offer connectivity with other modes, and have the flexibility to make changes to adapt to demand of customer in the focus in a continuous manner.

5.2 Marketing strategy for TPCLC to meet the challenge

5.2.1 Vertical integration in logistics supply chain

Vertical integration means that a company is expanding its operation either backward into an industry that produces inputs for company's products or forward into an industry that used or distributes the company's products. In logistics industry, as for TPCLC backward vertical integration means collaboration with suppliers in upstream industries such as the liner shipping companies and forward integration means collaboration with customers in downstream industries such as the container logistics companies.

Vertical integration in logistics supply chain is one kind of strategic alliances. Companies enter into strategic alliances with suppliers at the beginning of supply chain or customers at the end of supply chain can achieve a number of strategic objectives. They can share the same business intelligence, their respective logistics facilities for common use and combine their capital together to deal with risk and reduce the overall cost in the logistics supply chain. The strategic alliances can be seen as a way of bringing together complementary skills and assets that neither any one of the alliances could easily develop on its own.

This dissertation suggests that TPCLC enters into strategic alliances with the top 3 liner shipping companies in the question mark market and with top 3 container logistics companies in cash cow market. It is necessary for TPCLC to consider to sign 5 or long contracts with the top 3 liner shipping companies and top 3 container logistics companies. TPCLC, liner shipping companies and container logistics companies could share their resources like information, provide mutual financial support, undertake same risk and pursue the maximum profits in vertical container logistics chain. TPCLC can offer cargo forwarding services like customer formalities clearance, cargo inspection to shippers and offer shipping agency services like customer formalities related to ship and port authorities to facilitate cargo movement between cargo owners and TPCLC. Transport and distribution service can also be provided by TPCLC between TPCLC and container terminals for loading or discharging operation.

5.2.2 Improving Customer Relationship Management (CRM)

- Setting up Business Intelligence Database

Data base should be setup to analyze business intelligence of the customers both carriers and shippers concerning business type, service needed, sales amount in the past. Report structure can be established that allows for the measurement and evaluation of the customers' present situation. Through analysis, the customers' future needs can be analyzed and forecast.

- Setting up CRM evaluation system

The goal of the CRM control system is to give more focused attention to average liner shipping companies and container logistics companies. By constructing a database based on ERP and CRM software, where customer data can be collected and analyzed. A set of measurement indices should be set up to appraise the economic performance. Through data processing, we can evaluate the overall performance of the average liner shipping companies and the average container logistics companies. Fortunately, DEA or AHP methods may be used in assessing procedure. However, other methods like multi-weighted factors assessment could be applied as well. In addition to the parameters used in previous chapters, more parameters such as customer satisfaction, economic contribution in container supply chain could be added in the assessment system. According to the assessment of performance annually, TPCLC could determine to sign one, two or three year contract to lease the land to container logistics companies or liner shipping companies. This benchmark system is beneficial for TPCLC to allocate the valid resources to the most valuable place to generate maximum profit. It can also stimulate the container logistics companies and liner shipping companies to perfect their management level and reduce cost to do better in order to survive in the competition. The container logistics companies and liner shipping companies with vary bad performance should exit from TPCLC to give the space to other companies who can do better.

The challenge of logistics-driven for the Tianjin Port is the changing business environment: globalization in production and distribution. The Tianjin Port is not just a linkage between land and sea; it is also a logistics service provider and can accommodate industrial complexes, cities and warehouses in order to meet the growing demands of customers. Through market segmentation, we clearly recognize different customer groups. How to provide prime logistics services to satisfy the diversified demand of various customers becomes an issue. The Tianjin Port container logistics center as a pivot logistics node, with large construction scale, covers 2 million square kilometer hinterland. The huge hinterland area excluding Tianjin, Beijing and Hebei Province will generate about 3 million TEU throughputs

annually. This dissertation suggests TPCLC should focus the logistics services illustrated as Figure 19 to the port users and establish five logistics platforms including container logistics facilities, transport and distribution, operation management, information management, and policy platform.

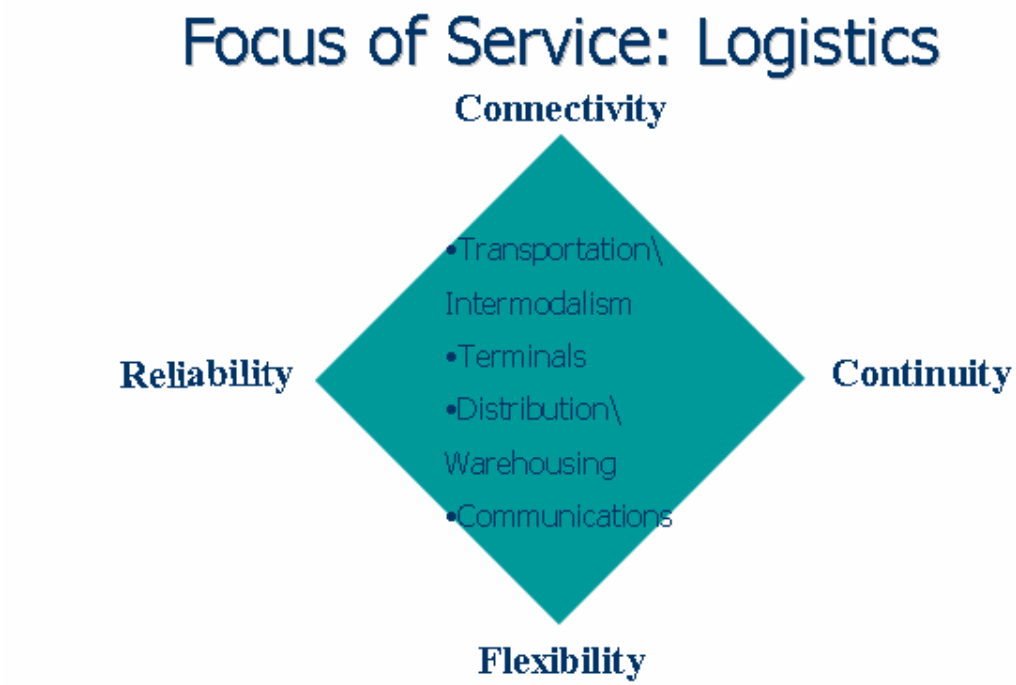

Figure 19 Focus of Service: Logistics

1) Container logistics facilities platform
   Empty container storage area, full loaded container storage area, stuffing and stripping container area and special container like refrigerated container storage area are planned to planned to accommodate various demand of customers. Power supply facilities, sewage system, telecommunication cable and networks are installed in line with international standard. According to the logistics function, the Tianjin Port container logistics center is divided into logistics value added area, container storage area, public auxiliary service area, and future development reserved area. The perfect infrastructure facilities cater to world class container logistics companies to house in.
2) Transport and distribution platform
   There are four transport modes: water, road, railway, and air linking logistics center. Customers can transport containers to hinterland area by road, railway or air. Customers can transport containers aboard by sea or air. The Tianjin Port must take full use of geographical advantages as the most convenient seaport for the vast landlocked area to link northeast, northwest China and north China as a

whole. TPCLC is based upon Tianjin Beijing, and Hebei Province, serving Circum-Bohai Economic Region, radiating Northern China, and facing East north Asia.

3) Operation management platform

Collaboration between the container terminals and logistics center is crucial for the success of port. However, in the past, the planning and development of port and logistics center has been related in an isolated manner. The problem basically leads to an insufficient understanding of logistics center in ports and a lack of integrated planning. There is a need for a systems-oriented approach to planning and developing ports, associated logistics centers in port areas, and city functions to meet the demands of shippers, port users.

4) Advanced information platform

The logistics center should offer perfect public information platform. The application of e-commerce in ports could contribute to the efficiency of international trade. The availability of common-user and robust e-commerce-based administrative and commercial services in the Tianjin Port facilitate cargo flow, fund flow and information flow. Therefore, it will attain twin goals of reducing transaction cost and increasing service value.

5) Laws and regulation supporting platform

Overly complex administrative procedures and bureaucracy are frequently identified as an obstacle to building a logistics center. Consequently, to prosper logistics centers in Circum-Bohai Sea Region, there must be a high level of institutional support, with legal and regulation systems in compliance with international standard. Indeed, ports with high institutional support and few regulations usually exhibit a high degree of development in logistics areas. Therefore, legal and institutional issues must be settled and perfected at a high priority.

6 Conclusion

Owing to the fierce development of TBNA and historical business opportunities resulting from the economic growth of TBNA, the Tianjin Port encounters favorable marketing chance. Not only the Tianjin Port authorities but also Tianjin government realizes the significance of furthering logistics functions and enhancing marketing forces to attract more container cargo from huge hinterland. In order to take full use of the logistics function of the Tianjin Port and meet the demand of high growth rate of container throughput, the Tianjin Port authorities planned and set up new area in the port as container logistics center.

To maximize the profit and utilize the precious land resource more efficiently, TPCLC segments the logistics market into four parts and put the corresponding ones in BCG matrix. Since the cash cow market generates major profit to support other business and question mark market brings about attractive potential economic growth, this dissertation concentrates more attention on these two market segments.

6.1 The attainment of this dissertation and feedback from TPCLC

The author presented the logistics companies selected by DEA method and liner shipping companies chosen by AHP method to the business manager of TPCLC for empirical analysis. The feedback from TPCLC was generally positive. The business manager said the results were very similar to the decision TPCLC would make by qualitative appraisal according to historical experience. He hoped apply DEA and AHP to solve the similar problem in the future. Apart from the business manager, the Vice General Manager of TPCLC also expressed positive evaluation to the marketing strategies designed by this dissertation to meet serious challenge from logistics globalization, rapid development IT technologies and market environment changes.

The top executives explicitly confirm my viewpoints of customer service orientation. They were interested in logistics integration viewpoint because it is beneficial to meeting the downward pressure of logistics cost and upward pressure of logistics value both from suppliers and customers, which will bring fierce challenge for TPLC

in long run. To gain and maintain core competence, top executives of TPCLC will take some of arguments into their strategic plans, which include strategic alliance with container logistics companies and liner shipping companies, customer relationship management, and establishment of five supporting platforms and so on.

6.2 The drawbacks of this dissertation

Tianjin Economic and Technological Area (TEDA) play a very important role in TBNA and Circum-Bohai Region. There are Many Multinational Corporations locating in TEDA such as Mortorala, Toyota SEW and so on. Dominating trade flows and container cargos are generated from this area. Tianjin port Free Trade Zone also is another area where boned trade and logistics activities concentrated to a large extend. However, in-depth market environment analysis and influence on TPCLC have not been studied although they will exert impact on the marketing strategy.

6.3 Prospective research in the future

This dissertation does some marketing research within the Tianjin Port. The hinterland market analysis has not been involved. The Tianjin port, as a starting point on shortest Asian-European land bridge, poses a strategic sea gate to Bohai Sea for the shortest Asian-European land bridge. Further research should be implemented to do in an attempt to analyze the huge hinterland market alongside railways from Xingang to landlocked regions.

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