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WORLD MARITIME UNIVERSITY

Shanghai, China

**Research and analysis on the competence of China's
chemical shipping enterprise**

By

Yu Huan

China

A research paper submitted to the World Maritime University in partial fulfillment of
the requirements for the award of the degree of

MASTER OF SCIENCE

(INTERNATIONAL TRANSPORT AND LOGISTICS)

2007

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DECLARATION

I certify that all the material in this research paper 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 research paper reflect my own personal views, and are not necessarily endorsed by the University.

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At the very beginning, I am very grateful having this opportunity to express my sincere thanks to WMU and SMU, who have given me the chance to write here.

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ABSTRACT

Title of Dissertation: **Research and analysis on the competence of China's chemical shipping enterprise**

Degree: **Master of Science in International Transport and Logistics**

With the rapid development of petrochemical industry in our country, the increasing demand for transportation of chemical products puts forward more advanced requirements to shipping transportation, which is one of the transportation. Because the later start of our chemical shipping and the tremendous gap with foreign counterparts, most of our shipping enterprises can only do domestic transportation for chemical products. Its current condition cannot satisfy the requirement of chemical shipment. How to promote the competence of such enterprises in order to meet domestic needs and participate in global competition, which has become the subject studied by many specialists and scholars in shipping fields is still a long way to go.

The chemical shipping enterprises in our country not only have the commonness of general company's competence but its industrial characteristics. To research these enterprises' competence, we should find out the factors effect and determine these enterprises' competence and build up a system to evaluate it.

The article uses the criterion analysis and the demonstration analysis to study the competence of chemical shipping enterprise in china. Firstly, the article discusses the basic theory of enterprise competence and the influential factors on the basis of its connotation. Secondly, the article analyses foreign and domestic chemical shipping markets, using SCP analysis model to get the characteristic of structure、conduct and performance of china chemical shipping market. Thirdly, the article builds the evaluation index system for the chemical shipping enterprise according to the characteristics of chemical shipping from three main influence factors that are marketing competence, managing competence and continual developing competence.

In the end, the article gives study to the competence of China oil field service —Sea transportation department chemicals operation company, and put forwards some countermeasures and suggestions on competence improving for enterprises. All of this is reference and guidance to our chemical shipping enterprise during its policymaking and competence improving.

KEYWORDS: Chemical Shipping Enterprise, Competence, Index System

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LIST OF ABBREVIATIONS

IMO	International Maritime Organization
GDP	Gross Domestic Production
ISM	International Safety Management Code
SCP	Structure, Behavior and Performance
MARPOL	International Convention for the Prevention of Pollution from Ship
SMC	Safety Management Certificate
AHP	Analytic Hierarchy Process
SWOT	Strength, Weakness, Opportunity and Threat

CHAPTER 1 INTRODUCTION

Competence is the only capital that every enterprise needs to survive. In the steep competition market environment, only those enterprises which can make managements to be nimble, unceasingly innovates, then they can survive for a long period. Compared with them, those with slow reflections and few innovations do not have enough competitive ability, the only results waiting for them is market elimination.

Shipping industry is the national foundation industry which guaranty national economy stable movement. It has very vital significance to the national foreign trade, industrial development, international payment balance and safe defense. Therefore, each country pays much attention to its own shipping industry and its development. In recent years, above 90% of the foreign trade commodities were completed transporting by ocean shipping. It is easily seen what an important role the shipping plays in China. Competence of international shipping enterprise directly affect economy stable movement of our country, as well as national appearance, industry, international payment balance and national defense security.

International shipping is a service industry, the core is taking customer (shipper) as the guidance, providing services with low cost and high attached value. As the intense competition exists in the world shipping market today, if international shipping enterprise (carrier) wants to survive and develop well, they should use its synthesizing capacity and provide highly precise, reliable and in time transportation, breaking the limits, to make their services opened up in many areas, to satisfy cargo owners' different requests. Thus, besides marine transportation service, the modern international shipping enterprise should also provide high attachment value synthesis service diligently.

Nowadays the international shipping industry has obtained the unprecedented development by the impetus of world economics and international trade. It has become the foundational industry which impulse world economic integrating and the

international trade globalizing. Whatever is the country developed or developing, all of them realize that shipping is the main method to realize the industrialization and the important condition to enter into international market. Therefore, so many countries invested in shipping and this action made the competition in international market be more fierce than ever.

International chemical tanker shipping industry is a very important constituent in world shipping industry. World tanker shipping fleet holds the extremely important status in marine transportation fleet. To a country, its chemical tanker developing scale has enormously affected its entire shipping industry development; As the main body in chemical tanker shipping competition-- the chemical tanker shipping enterprise's competition power will greatly affect the local chemical tanker shipping or even the entire shipping industry.

After China joins WTO, our national shipping industry is facing the unprecedented opportunity and huge challenge. The foreign shipping enterprise lands Chinese market relying on its abundant economic potentiality and advanced management. If Chinese shipping enterprises want to survive and develop, they must capture the surviving space both in domestic and international market, compete with the enterprises of developed country. After joining WTO, more foreign capital enters our country shipping market, mainly displays in: 1. In the opening domain, the foreign market share increases day by day; 2. Partial of some closed area in the past will gradually open especially in logistic and ship agency area. After foreign merchant enter these domains, its market competition strength will be directly improved. Shipping enterprise overall strength faced with serious impact, the domestic shipping enterprise will face more competition pressure, and its market share will reduce gradually. Facing with such kind of aspect, how should Chinese enterprise suppose to be? All these problems are concerning to enterprise's competitive ability. The overall strength faced with serious impact. How can we improve our quality and enlarge opportunity to get final win in this competition? What should the Chinese government do for the shipping enterprise? All the questions are the entrepreneur and government extremely concerning about and all are involving to the shipping enterprise's competitive ability.

Besides having the general shipping enterprise's basic characteristic, chemical tanker shipping enterprise also has its own characteristic. This article will carry on thorough analysis and research on the relating influence of competence of chemical tanker shipping enterprise.

As we know, it is an international current rule that coastal transportation right is managed by the national carrier and national flag fleet. The promise that our country gives after joining WTO seaborne transportation negotiation do not includes the relating promise of opening coastal and inland water transportation right. However, there must be its own reason for the opening of our national chemical conveyance market. The most important one is to introduce advanced management and technology from the foreign companies in order to develop our national fleet productiveness and satisfy the continuously increasing demand as referring to transportation of chemical products. The articleual core is to seek and find competence evaluating methodology of China's chemical enterprise and also takes a great effort to get a clear scene about the status of our country's chemical shipping market. Lastly a study on China oil field service company, marine transportation operation department will be given to clarify the competitive power situation.

CHAPTER 2 BASIC THEORIES OF COMPETENCE

In the human developing history, western country completed Industrial Revolution and stepped into the market economy era at the earliest stage. Putting forward to the business competence problem and going deep into the research also comes from west originally. From the Adam Smith's theory of "ability division" to Marshall's "difference division", and then Cocu's "transaction cost" theory, economists have been all probing into creation and development problem of business enterprise all the time. In the view of traditional new classical economist, enterprises are just a special production function—A "black box" with "no friction" inside. Obvious contrast exists between such classical environment and economic reality. Take Cocu's theory of modern business enterprises as the basis: Property right theory, transaction cost theory, entrust agency theory become the mainstream theories for modern enterprises. Though they opened the black box of modern business enterprises, they can't nicely explain many phenomena in reality. In the 80's, Mike Porter put forward competition strategic theory based on industry research and it became the mainstream of the strategic theory, but it is still weak to guide the activity in production from micro aspect. In the 90's, a batch of business strategy researchers proposed re-recognizing and analyzing enterprises. They cast their angle of view on the special ability that enterprises have: the core competence of one enterprise. Through obtaining the researching and analysis of many large companies, they came to one conclusion: Competence is the key to enterprise's success or failure. And this becomes fashionable over the world in a very short period.

2.1 Competence theory of enterprise

1. Michael E. Porter's theory:

Porter's competition trilogy sweeps all over the world. He used the "SCP" form started from the industrial organization theory, investigating enterprise's competition behavior in terms of enterprise's strategic management, proposing a new model consist of five forces in enterprise's competitive advantage analysis. Such as figure 2-1, Porter thought the key to gain long-terms competitive advantage is analyzing the

structural characteristic of specific industry and choose the corresponding competition strategy on this basis.

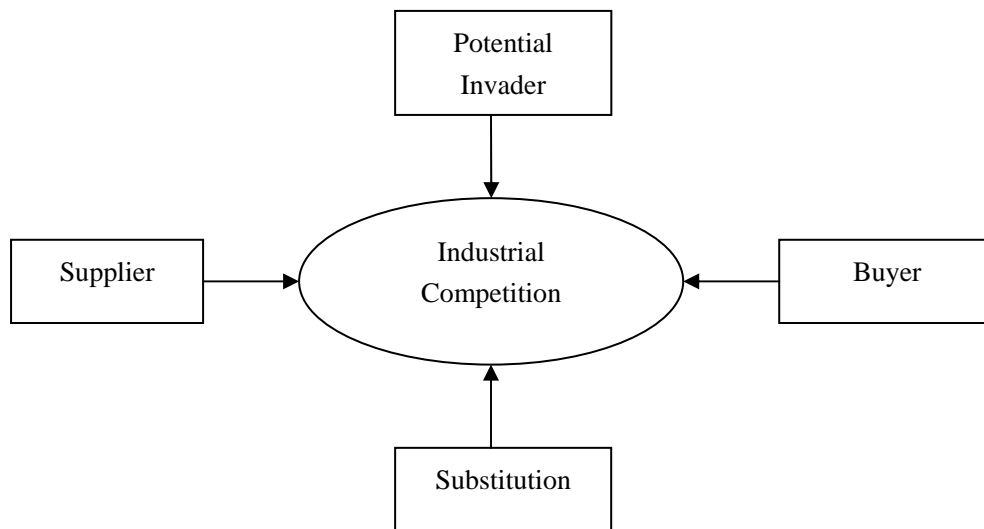


Figure 2-1 five forces influencing competence

In his book "competitive strategy", Porter proposed three common competitive strategies. To his understanding, in the process of fighting with those five forces, there exist three successful strategy routes. Respectively they are:

- (1). Total cost leadership strategy;
- (2). Differentiation strategy;
- (3). Specialization strategy.

As he thought, the goals of these strategic types are to make the management of enterprises superior to others in industry's competition: In some industry, this means enterprises can obtain more income. While in some others, they may get more opportunities. Sometimes one enterprise may chase more than one target. However, Porter thought the possibility of the realizing of this situation is very small. For each company carries any kinds of a strategy will exhaust all his efforts. And an organizational arrangement is necessary to support this strategy. If the basic target for an enterprise is more than one, resources on this aspect will be dispersed. Getting more competences could make a enterprise in an unbeaten position, and Porter told us how to make an enterprise full of competence in terms of strategy. We should say, Porter's competition trilogy gives us a deep analysis on internal and external

competitive environment relating to strategy in terms of internal activity costs, external industry structures, region industry groups from different levels. Among these factors, differentiation strategy is full of vigor even more, and is the most wonderful role in strategy of orientation circle.

2. Capacity theory:

In 1990, after the publish of “The Core Competence of the Corporation” in < Harvard Business Review > written by C.K.Prahalad and G.Hamel, study and application of Core Competence is lifted in America and Europe. According to the core competence theory, each enterprise will have varies abilities (such as manufacturing capacity, retailing ability and technology ability), and of course will have its own specialization. However, different ability and specialization do not play the same important role for different enterprises. Those which can bring long-term competitive advantage and super profit can be recognized as the core competence. In order to cultivate the competitive advantage of an enterprise, core competence must be found and strengthened. Through core competence, other resources in enterprises can be made more functional. Therefore, sustainable developing capacity and competitive advantage can be obtained. The accumulation, keep and use of core competence is long-term fundamental strategy for enterprises.

Capacity theory lays particular emphasis on the investigation of an enterprise’s competence from the angle of ability division. It focuses on searching method and route from inside of enterprise to improve competence and has vital significance for analysis and cultivation of enterprise’s competitive advantages. What the capacity theory emphasis is to explain competitive advantage from each one’s inner sources rather than its market situation. The deficiency of capacity theory lies on too simple analysis on outer factors to an enterprise and the insufficiency understanding to the whole facet of competence. From another aspect, capacity theory does not try to well combine sustainable competitive advantage theory and inherent growth theory together.

3. Environment theory:

Environment theory is also called market structure theory. It rises after the

seventies of 20th century and is important content in strategic management theory. This theory nearly dominates the management theory in the eighties of 20th century. This theory emphasis on analysis from the outside market structure and gives a view that: 1.market structure plays an important role in building up an enterprise's competitive advantages; 2.abstraction of an industry is one of the most important elements to make profits; 3.whether there is an entering barrier determines the owning or not sustainable competitive advantages by enterprise.; 4. enterprise choose production strategy to enter market under present market structure and its own terms, rather than paying too much attention on inner resources and capacity.

This theory turns the research of the competence to outside market from inner environment. Emphasize the influence caused by the changes of structure and environment of market on the competence for a company. It overcomes the deficiency of Capacity theory, further widening the research angle. This theory is under the condition of presuming perfect competition of the market, varies elements in the market could effectively be brought into play and generate realistic influence on enterprise automatically. However, insufficiently considering changeable factors is the most deficiency place. Meanwhile analysis on the link of market condition and inner factors is too simple.

4. Resource theory:

Resource theory is a major school of enterprise's competence of present research. Resource theory proposes generalized views from the aspects of resource, ability and market combination: "The resource and ability of an enterprise includes financial resources, material resources, manpower and organizing resources which are used for developing, producing and distributing products or services to consumers". Resource theory lays particular emphasis on analyzing the advantages of enterprise from different resources. It holds a view that there exist huge differences among tangible resource, intangible resource and accumulated knowledge, and that creates enterprise's competitive advantage. Competence of one enterprise contains the nature of value, rareness and induplication. Therefore, "the key to success is such resources." The expansion view of this theory includes: Regard coordinating and organized

knowledge as main resources; Regard manpower and organizing ability as resources; Take the social capital into resources systems. Therefore, someone calls this theory "new ability theory".

To sum up, enterprise's theory develops on the foundation of science of management, economics and marketing. Though a large number of research results are produced, still there is not a unified theoretical system yet so far. Therefore, a long way is waiting for us to go.

2.2 Concept of enterprise's competence

External environment condition, enterprise resources, rival's state that enterprises face is in changing constantly. The competence between enterprises is also changing frequently. The main factors are not same in different industries and enterprises. So it's impossible to define an intensive conception of enterprise's competence. Obviously, enlargement of intension means the shrinking of epitaxy. The more fine enterprise's competence is defined, the smaller its application scope is. The key to define a conception is not to make it particular but to make it reflecting the essence of the things and meeting demands of researches by catching main point of promoting enterprise's competence. Through the study of forefather's understanding on competence, the author thinks that the concept of enterprise's competence should include two aspects: The first one is the conception of "relative position" which could be presented as reflecting the inter relationships and comparatively positions between specific enterprise and its competitors; The second aspect is the conception of "trend", which means enterprise's competence is reflecting the pace and trend of changes that influence relative competence between specific enterprise and its competitors. Everyone cares not only the position of enterprise in the same industry but also the developing capacity to each enterprise. Hence, author defines the competence as: The synthetic capacity of one enterprise of efficiently providing products and services to the market and keeping sustainable development compared with others.

2.3 The main evaluation index system of enterprise's competence in China Competence index system of Chinese enterprise united federation

Since 1996, Chinese enterprise united federation began to organize strength to do

research and develop national enterprise's competence index system and designed a set of index systems which reflects enterprise's competitive power. It is divided into several parts according to the index contents: economic benefits; financial situation; management level; technology progress; employer's quality; open degree and social benefit. Economic benefits mainly include the sales income, total profits, overall labor productivity, etc; Financial situation mainly includes the net assets, asset-liability ratio, inventory-turnover rate, etc; Management level mainly includes the domestic market share of leading products, comprehensive energy consumption per ten thousand yuan, producing and marketing rate, etc; technological progress mainly includes new degree of apparatus, earning ratio of technological transformation, conversion ratio of scientific findings, etc; Employer's quality mainly includes enterprise's professional title form, education form, expenses on employee's education, etc; open degree includes utilization of foreign capital, foreign exchange earning, etc; Social benefit includes input of environmental protection facilities, employment volume that enterprise provide for local, national tax payment, land tax payment, etc. These comprehensive indexes reflect enterprise sustainable developing ability, profit gaining ability, market sharing ability, sales and product innovation ability, technological development ability, property utilization ability and contribution to society, etc.

CHAPTER 3 ANALYSIS ON DEVELOPMENT OF DOMESTIC AND INTERNATIONAL CHEMICAL SHIPPING MARKET

3.1 Current situation of the market development of overseas chemical shipping

3.1.1 Developing stage of foreign chemical ship

The 1st generation of chemical ship started from 1948, until now it developed into the fourth generation. Fourth generation of chemical ship was born in eighties of the 20th century, and their main characteristics are: Relatively the tonnage is larger than thirty thousand tons, developed controlling system, heating system, detection system, alarming system and inner gas system. The structure and equipment can meet requirement of safety transportation and pollution prevention and have better fitness of different cargoes and better operation performance.

3.1.2 Scale of world chemical fleet

According to monthly report of Britain Drewry shipping consultants Ltd, by the end of December of 2006, there were totally 1813 ships that above 1000dwt and the total dwt were 28649. Among them, the amount and dwt of small-scale chemical ships of 1000-10000dwt increased. Ships of 10,000-20,000dwt got a comparatively quicker increasing. Total amount of ships of 20,000-30,000dwt decreased and general dwt shrunk a little. Quantity of large-scale chemical ships above 30,000dwt didn't change much, only with small rise of general tons. This was mainly caused by the maximization trend in new shipbuilding after old ships breaking. Below figure (3-1) shows details about chemical ships' dwt:

Figure 3-1 Stat. of chemical ships' dwt in 2003~2006

Deadline Tonnage	2003 December		2004 December		2005 December		2006 December	
	Ship quantity	Tonnage (K dwt)	Ship quantity	Tonnage (K dwt)	Ship quantity	Tonnage (K dwt)	Ship quantity	Tonnage (K dwt)
1~5	467	1301	470	1314	511	1407	510	1394

5~10	461	3329	471	3411	493	3565	507	3685
10~20	274	3891	289	4128	337	4940	351	5192
20~30	132	3420	133	3445	128	3322	129	3340
30 以上	316	11975	328	12429	308	12009	316	12358
Statistic	1650	23916	1691	24727	1777	25243	1813	25969

Figure resource: 《The Drewry Monthly》 on 2005 and 2006 reports

From the above figures, on the whole scale of the chemical fleet is expanding constantly, total gross ton in 2006 went up by 2.88% compared with that in 2005, and 2.09%, 3.39% between 2005 and 2004, 2004 and 2003 respectively.

3.1.3 Age of world chemical fleet

According to the statistics from ISL, the average age of 300 tons above vessels were 15.3 in 1998. And the age extended to 17.7 in 2002. Building of chemical ships has 3 peak periods: 1981-1983; 1998-2000; 2003-2005. Due to the huge fall of new ships building up in 2001 and 2002, the renewal speed of ships slow down. In the followed three years, from 2003-2005, a new peak of building ships appeared. Subsequently vessel updating speed has accelerated and the average age of them has been reduced.

3.1.4 Main chemical ship's owner all around the world

The main chemical ship's owners centre in developed countries such as U.S.A., Europe, Japan, etc. Stolt—Nielsen Transportation Group whose headquarter stays in U.S. is biggest chemical cargoes transportation group. By the end of 2006, Stolt group had 78 ships, and operated more than 150 ships which the gross weight was over 2,500,000 mt.

Secondly is Odefjell Asa. They have 76 ships and the general dwt was over 2,200,000mt. The turnover of 2006 is 980 million US dollars.

Jo Tankers lists as the third largest enterprise in the world. Now they operate the most modernized and developed chemical fleet in the world. They have 35 ships, totally dwt are more than 1,000,000mt.

Seachem Tankers engages in association body that composed of 4 companies. At present they have 28 ships which dwt are more than 1,100,000mt.

3.2 Successful experience and enlightenment of the management of overseas chemical shipping enterprise

Not all the success goes the same way. Success only could be draw lesson from but not could be imitated. According to the development courses of several chemical shipping enterprises and successful operation experience of the market, I summarize several key elements in chemical shipping running management:

- a. Correct market orientation;
- b. Reserve of talent resources;
- c. Joint venture.

3.3 Development trend of the market of overseas chemical shipping

The prominent characteristic of chemical shipping market is high profit earning. One of the factors is there exist a permanent silent tactics between the main operators. In order to integrate superior resources, chemical shipping enterprises seized market, improved their service quality and developed their globalization strategy. The cooperation between chemical shipping enterprises became more and more frequent and the trend of annex became more popular.

There are several obvious development trends in chemical shipping enterprises:

1. Integrate the superior resources, supplying logistic services:

Chemical shipping enterprise enlarges its business scope, in terms of quay, on land transportation, storage and etc. Offering comprehensive logistics service for owners. On June in 2004, Odfjell signed a contract with a Chinese company “Jia Sheng”, preparing to build a liquid quay jointly; At the end of 2002, they invested 510 million US dollars building Odfjell Korea, with the aim of turning Ulsan into liquid goods logistic center in Asia - Pacific Ocean area; The Hoyer-Odfjell, a joint venture controlled by both Odfjell and Hoyer GmbH(Germany) is a container transportation company. The door to door service covers whole logistic process, providing intact professional logistics service to many trading companies.

2. Integrate transport capability through lease contract, trusteeship, joint venture and annex.

Through leasing new vessels, Stolt Transportation Group renews a batch of old chemical oil ships coated by stainless steel and optimizes their fleet structure. Utilizing its own advantage to set up vessel manage company to operate ship by trusteeship. Stolt together with sino-chemical trading company set up the first Sino-foreign joint venture shipping manage company in China. Realize two companies' advantage complementation. In 2004, Stolt had more than 60 vessels, meanwhile operated about 140 vessels. Its total dwt is over 2,500,000 tons.

3.4 Analysis on our country's chemical shipping market

3.4.1 Current situation of our country's chemical shipping market

1. Present transportation capacity of chemical ships in our country

According to statistics from Ministry of Transportation And Communications, by the end of 2004, 98 ships were engaged in domestic transportation, 28 ships were engaged in international transportation. The average age of ships reduced dramatically. Due to the absolute quantity of chemical ships is insufficient, nine new chemical ships were built in 2004, therefore the average age declined to 13.9 by the end of 2004. It is estimated the average age of chemical ships will continue reducing in 2005.

2. Situation of chemical products transportation

Over 8 million tons chemical products per year are imported recently. South Korea, Japan and Saudi Arabia are the main source places. According to statistics, volume of domestic transportation is about 2,900,000 tons, increased about 200,000 tons compared with that of last year. Among them the coastal transporting reaches more than 2,500,000 tons, taking up nearly 89% of the total. Transport amount in the Chang Jiang River is more than 300,000 tons, accounting for about 11% of the total.

With the sustainable economic development and people' improving life standards, generally demands for the clean energy increase. Since 1990s, the consumption volume of chemical products in our country increases at the speed of above 10% per year. At the beginning of 1990s, annual consumption of chemical products is about 2,500,000 tons which is even fewer than India. However, by 2003 our country has

already become the third largest consumption country, only inferior to USA and Japan. Consumption volume of this year is 17,100,000 tons. Though the per capita volume is still lower than 15 kilograms of per capita level of consumption in the world, consumer market of our country will still continue growing in the following years. With the constant enhancement of the environmental protection policy in every domestic city and issuing of the national fuel taxation reform policy, quantity of the urban gas car will surge dramatically. Demand for automobile-used chemicals will also be expanded. Chemical consumption of the twelve clean gas car demonstrated city has already exceeded 1 million tons. Therefore, within a longer time in the future, consumer market will present a good growth situation. This will promote the sustainable development of domestic chemical shipping market further.

3. Gradual open of domestic chemical shipping market will break present market pattern

Accompanied by the process of reform in our country, the opening domain is widening constantly, opening degree is strengthened progressively. According to present policies and regulations, developing joint venture fleet and operating coastal transportation belongs to the limited project. On the may in 2004, authorized by the Ministry of Transportation and Communications, five joint ventures were set up to operate domestic transportation. Appropriate opening of transportation market is one of the initiative actions of the Ministry of Communications. This policy helps to import foreign shipping enterprise's advanced management and technology, optimizing the structure of chemical fleet, improving the integral level of chemical shipping industry, promoting the construction process.

Opening policy also has adverse effects. To a certain extent, it has aggravated the competitions between domestic transportation enterprises, producing assaulting to domestic enterprises. This may cause domestic-trade leading right shifting outwards and forming price monopolization. The small chemical shipping enterprises may be eliminated or faced combining in the cruel market competition. Thus form the pattern of the tripartite equilibrium of several large shipping enterprises.

3.4.2 Present main problem of our country's chemical shipping industry

Though our country's chemical shipping industry make a great development these years, still it starts relatively late and also there exists some problems.

1. The technological state of vessel is very good. It is difficult to meet market demand.

In 2005, old chemical ships over 20 years took more than 57% of the total number in China. Though 9 new chemical ships were built in 2006, according to BP's regulation of ship's age, old vessel will lose the important transportation market and their living space will become smaller and smaller. Meanwhile, due to the gradually stricter requirement on sea-water transportation, parts of the old vessels are difficult to meet the security needs. Therefore, seaworthiness area is limited. In addition, present ship's type is multifarious and the structure is unreasonable. Small ships are in the majority, being difficult to meet market development demands.

2. Emergency ability is insufficient.

In recent years, liquid chemical bulk transportation develops very fast in our country. However, each management has greater disparity, spot supervision can not be fully controlled. Public fire controlling strength in some quays and warehouses is weak, the emergency ability is insufficient; in some ports, anti-pollution facilities can not meet production and emergency's needs. At the same time, we our country hasn't involved into the compensation mechanism in this field yet. The marine department doesn't have the ability to allocate the advanced and effective pollution cleaned apparatus. Thus emergency ability is insufficient.

3. Lack appropriate scale of operation, market competitive power is relatively weak

In China, except a few companies have certain economic strength and business scale, most of their capabilities are relatively week, scale of fleets are small; Management level of enterprises, crew's technology, operation benefits and so on is also relatively low. If foreign capital is imported and brought into the domestic market competition, it will be a severe challenge to Chinese shipping enterprises.

4. Fund input is insufficient, industry development is limited.

Now chemicals shipping transportation demands in our country are very prosperous, some old ships will scrap soon. But many shipping enterprises are very prudent to new-built up ships. Reason shows as following: On one hand, present ship's price is in the highest position of history; whatever the new building ships or the second hand ships need large amount of investment, investment payback is very long, risk is big in the market; On the other hand, even some enterprises planned to buy ships recently, but they can't afford the so large amount of investment due to so long time loss. Restricted by various conditions, shipping industry's development speed is slowed down.

3.5 SCP analysis on our country's chemical shipping market

Structure, behavior and performance analysis mode of market is usually called SCP mode. It is a basic tool for market analyzing. In the following, the analysis on our country's chemical shipping market will be given respectively from market structure, market behavior and market performance.

3.5.1 Market structure analysis

Market structure means the key elements of peripheral market such as competition forms, operation styles and so on. Index of the structural state of market mainly includes concentration degree of trade market, concentration degree of regional market, difference intensity, enter or withdraw, macro policy environment these five respects.

1. Concentration degree of trade market

Monopolization intensity and competition intensity are greatly concerned with concentration degree of trade market. This index is mainly reflected by the proportion of the top 4 or top 8 enterprises' total sales amount in the trade. (It is expressed by CR4 and CR8). Presently the popular method in the world is "Bain's Classification". If the trade concentration degree $CR4 < 30$ or $CR8 < 40$, then this trade is a competition type; If $30 \leq CR4$ or $40 \leq CR8$, it is an oligopoly type. While weighing chemical shipping market structure of our country, the transportation capacity of every enterprise is chosen to measure market intensity due to it reflects every enterprise's scale and status perfectly, and also relative figures are easy to collect.

According to the statistics of the Ministry of Transportation, by the end of 2006, total transportation capacities of Chinese chemical ships were 371,045 tons. The sum of the top four enterprise capacity was 223,200 ton. CR4 is 60.1%. This means in China, the chemical shipping industry is an oligopoly type.

2. Concentration degree of regional market

Concentration degree of regional market mainly displays in the geographic layout of every enterprise. Now there are total 23 enterprises that are running the chemical transportation business. Among them, 15 assemble in the Changjiang Delta area. This means they center in the zone with more developed economic and petroleum chemistry industry. Regional market is relatively centralized. However considering vessel's strong fluidity, high concentration degree of regional market does not influence chemistry transportation deeply.

3. Difference intensity

The difference between different companies is really very large displaying in fleet scale, operation management level and products sort. Referring to the fleet scale, the largest chemical enterprise has 15 ships, more than 100,000tons while those smaller ones only have less than 1,000tons capacity; from the management level aspects, several Chinese large-scale chemical shipping companies have built new relationship with those international ones which grasp strong leadership in the world. They set up joint-venture transportation companies, absorb advanced management experiences from outside. Compared with those small companies which still stay in the simple operation style of running single ship and single cargo transportation, the differences is very huge.

4. Enter or withdraw

The requirement for enter or withdraw shipping industry is relatively high. Due to characteristics of chemistry cargo, the requirement to shipping safety and environment protection is very strict. This need shipping enterprises do not only have perfect vessels but also the advanced fleet management. At present, CDI inspection is widely accepted in the world which is the standard index of ship's technique and management situation. CDI inspection refers to all respects related to fleet technical

management. Mainly displaying in the following aspects: Requirements for vessel, requirements for crew, requirements for operator, requirements for safe operation.

5. Macro policy environment

From 2001, Ministry of Communications has strengthened and developed chemistry transportation management. They issued several relevant regulations from then on. Generally speaking, macro policy environment is favor to the development of chemistry shipping industry.

3.5.2 Market conduct analysis

Market conduct means in order to obtain greater risk resisting ability, more profit earning ability, stronger competition ability, etc, every enterprise takes series of behaviors. Chinese enterprise's market behavior mainly includes following parts:

1. Service optimization

Service level improving, fleet scale enlarging, large owner seizing and market share scrambling are the main competition strategy for chemistry shipping enterprises. For example, Hainan Sino-Chemical Shipping Co.Ltd was granted to buy 7 chemical shipping ships with 2,000-5,000tons each on Oct 22nd, 2004; On Nov, they decided to invest 450,000,000RMB to build six new stainless steel ships; On Dec, they signed a new COA contract with Secco, preparing to carry 80% Secco's cargos in 2005. From crew training side, they not only participate in the authentication training of maritime affairs department but also set up examination mechanisms to strengthen crew's management. These measures are for getting larger market.

2. Joint venture

In 2004, approved by Ministry of Communications, the five Chinese-foreign cooperative enterprises are: Hainan sinochem international corporation company and Stolt transportation Co Ltd company; Shanghai Dong-zhan transport company and Odfjell group; Cosco Dalian and Asean company; China north industries Corp and Wanbang shipping company; Nanjing Yangyang chemical transportation company and Tokyo Marine company. These joint ventures mainly adopt "foreign capitals add famous native enterprise" operation style

3. Price competition

In the last several years, ships number is relatively high while cargo amount is comparatively low in the shipping market. Competition becomes fiercer due to the freight rate reduction. This leads the whole shipping price dropped by a wide margin. Decrease of the average freight rate exceeds 40%. However, fuel price is soaring constantly during this period. Whole chemical shipping industry suffers a great loss and its development has been seriously restricted. In recent few years, government takes strict measure to control the increase of transportation capacity, making demand and supply of transportation prone to the equilibrium. Freight rate is resumed by a certain degree. However, because of the particularity of chemical transportation, owners pay more attention to the safe and superior transport service, the impact of price competition on market will be diminished gradually.

3.5.3 Market Performance

Market performance means under the present market structure, the development level and profit level that they have. In the following, analysis on enterprise's scale, profit earning rate and technology progress will be given to instruct market performance.

1. Chemical shipping enterprise's scale

After the dramatic rectification and recombination of chemical shipping enterprises from 2000 to 2002, the quantity of chemical shipping enterprise has already been reduced from 43 to 22. By the end of 2006, ships amount increased by 30 compared with 2005, total dwt was 51,386. In a situation that the number of enterprise reduced, increase of the total tonnage instructed that enterprise's scale have been enlarged.

2. Profit earning rate

In 2005, the net assets profit rate of Transportation Industry is 6.45%, rank the first place in every industry. The rate to Medicine, Steel, Electronics and machinery is 5.96%、5.04%、5.04%和4.9% respectively. They have a good earning capacity. The net assets profit rate of coal industry is 2.57%, rank the end.

By the end of 2004, registered capital for Hainan sino-chem is 244 million yuan, the total assets is 400 million yuan, realized earning the net profit of 11.8 million yuan. Net assets profit rate is 2.95%.

By the end of 2004, registered capital for Shanghai Jinhai shipping company is 60 million yuan, total assets is 109 million yuan, the net profit is 6.46 million yuan, net assets profit rate is 0.59%.

Though 2.95% and 0.59% can't represent the assets income level of whole chemical shipping industry, they can partly reflect that the net asset profit rate of chemical shipping industry is a little bit low compared with other industries.

3. Technology progress

With the further opening of chemical transportation market, some more joint venture will enter into our domestic market. The aggravation of competition and advanced management will promote the improvement of technological progress and enterprise's management level. The technological progress advantage brought by combination of the strong ones has already appeared gradually.

CHAPTER 4 APPRAISAL MODEL OF THE COMPETENCE OF CHINA'S CHEMICAL SHIPPING ENTERPRISES

The definition to enterprise's competence has already been given in chapter one. Referring to chemical enterprise's competence, it means on the present and future chemical shipping market, enterprises fully utilize their own resources and ability to supply better transportation service, bring more benefits and promote the sustainable development.

4.1 The factor influencing China's enterprise's competence in chemical shipping market

This article will proceed from several internal and external influence factors of enterprise's competence, setting up enterprise's competence level model, as the theoretical foundation of the index assessing. The hierarchical structure of competence is shown as: The first level is behavior level. It is mainly weighed by the index related to market controlling; the second level is critical factors that influence enterprise internal management; the third level is the determination level. It is source and soul of enterprise's competence, is the final goal and supreme level to study enterprise's competence. In the following, analysis will be given on market controlling ability, management and administration ability and sustainable development ability.

4.1.1 Market controlling ability

The factors that influence market controlling ability include enterprise's scale, market share and market performance. To chemical shipping enterprises, the market controlling ability is the most basic kind of competence. As the competition is being aggravated constantly, keep a proper scale is the guarantee and support to strengthen enterprise's competence. Meanwhile, only in a certain transportation scale, an effective marketing could be launched and could contend with their rivals on the market coverage. In a word, if there is not enough market controlling ability, it's impossible for a enterprise to compete with others.

4.1.2 Management and administration ability

Management and administration ability means compared with their rivals, enterprises have better management performance. If we want to appraisal one enterprise competence ability, safe management level, corporate culture, capital operation ability and business performance are important indicators.

4.1.3 Sustainable development ability

Sustainable development ability is another important indicator to evaluate an enterprise's competence. In chemical shipping company, human resource, ship's renewing speed and management innovation are three critical indicators reflecting sustainable development ability.

All the three ability are the most important elements in enterprise's competence. But the proportion that they take is different. The below graph may give a clear view on their relationships. (

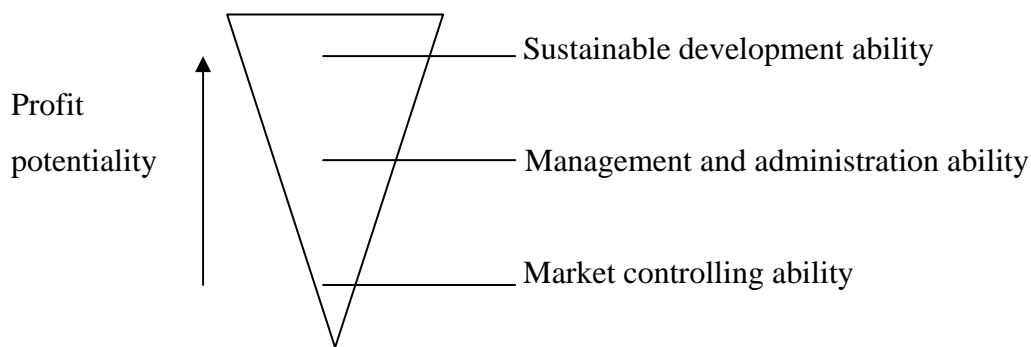


Figure 4-1 key elements in competence and profit potentiality chart

Only the competence is possessed in every aspect, a company could own certain market share and profit potentiality continuously and compete with its rivals.

4.2 Establishment of competence index system and China's chemical shipping enterprises system structure

4.2.1 The Principle of Index System of Core Competence

1. Systematic principle

The evaluation of core competence cannot just be based on one factor influencing; However, it should lie on overall analysis with systematic plan and measurement.

2. Feasibility principle

For the sake of increasing the feasibility, the definition of index and the reliability of data should be taken into account for avoiding misunderstanding and different meanings; moreover, it is necessary to consider the suitable index numbers to escape overlap index.

3. Comparability principle

The core competence index should apply in most corporations. The economy contents, special scale, time limit, calculation caliber and calculation methods shall have comparability for both the horizontal and vertical comparison.

4. Graduation principle

Before planning index system, it is crucial to summarize every important factor influencing core competence and conduct profound analysis to set up the measuring system with some graduation for scientific judgment.

4.2.2 Intact index system

Through consulting a large number of materials, writer has do some spot survey and study on several chemical shipping enterprise in Shanghai and Ningbo. And set up competence index system according to the above four principles. Totally this index system has 40 indicators. All the indicators are divided into two kinds: quantitative index and qualitative index. Among them, 29 belong to quantitative one and 11 belong to qualitative one. Details of this index system are listed as the below table:

Table 4-2 Intact index system of China's chemical shipping enterprise

First class index	Second class	Third class	Explanation and calculation method
Market controlling ability	Transport capacity	Fleet scale	Deadweight tonnage
		Ships quantity	
		Average ton	Average ton = DWT/Quantity
	Market coverage	Quantity of shipment	Quantity within a certain period (usually one year)
		Routine network	
		Market share (%)	Proportion of single enterprise shipment quantity
	Market operation	Satisfaction of customer service	Higher scores, more satisfaction

	ability	Self-owned ships proportion (%)	Self-owned capacity of transportation / total capacity	
		Custom stability (%)	COA quantity / total quantity	
		Enterprise's brand	High score, high satisfaction	
		Freight rate level	Evaluate by owners and forwarders	
Management and administration ability	Safety management	Completion of the system	Whether there are a set of intact security quality control certificates.	
		Emergency ability	Ability of offering ships under emergency any necessary guidance	
		Personnel's technological ability	Knowledge and skill of safety management which safe relevant personnel possess	
	Ship operation management	Operation rate (%)	Operation time/Registered time	
		Utilization ratio of loading capacity	Rotation volume /Ships ton mile	
		Productivity rate	Transportation amount/DWT	
	Capital operation management	Net return rate on capital (%)	Net profit/Total value	
		Sale return rate (%)	Profit/Income	
		Turnover rate of the current assets (%)	Sales income/Average remaining sum of current assets	
		Turnover rate of total assets (%)	Sales income /Average remaining sum of total assets	
	Enterprise culture	Liability rate (%)	Total value in debt /total assets	
		Adaptability of corporate culture	Appraised by the staff on the middle and senior level	
		Enterprise sincerity degree	Evaluate by owners and forwarders	
			Leader's quality	High score, high quality they have
	Sustainable development ability	Human resource	Total amount of staff	Including crew, on bank personnel
Staff's schooling degree (%)			Proportion of the university-educational personnel	
Proportion of educational training expense (%)			Educational training expenses/Total expenditure expenses	
Human resource performance			Net profit/ Staff's total number	
Technology innovation		Proportion of under ten-year old ship's transportation capacity (%)	Under ten-year old ship's transportation capacity /General capacity	

		Ships renewing speed (%)	New ships/Total ships
		Investment	
		Proportion of technological investment (%)	Technological investment /Total investment
	Management innovation	Enterprise transforming frequency	Times of huge adjustment of enterprise on its structure and management style
		Imitation ability	
		International cooperative partner quantity	
		Proportion of research investment (%)	Research investment /Total incomes
	Supporting ability of extended industry	Logistic synthesis ability	High score, high degree of this ability
		Port amounts concerning the operation	Including the port of participating equity, holding share and leasing.
		Throughput of self-operation quay	

4.2.3 Recommended index system

Though intact index system can reflect the competence situation of chemical shipping company in an all-round way, there is always some difficulty in obtaining them indexes while we actually need them. For data easily collection, a convenience system should be introduced which possess following conditions:

1. Easy to get in collection;
2. Certain coverage rate exists in intact index system that with three-floor structure.
3. Having important function in intact index system.

According to this, such below system is recommended:

Figure 4-3 Recommended index system

First class index	Second class	Explanation and calculation method
Market	Fleet scale	Deadweight tonnage

controlling ability	Average ton	Average ton = DWT/Quantity
	Quantity of shipment	Quantity within a certain period (usually one year)
	Market share (%)	Proportion of single enterprise shipment quantity
	Enterprise's brand	High score, high satisfaction
	Self-owned ships proportion (%)	Self-owned capacity of transportation / total capacity
	Custom stability (%)	COA quantity / total quantity
Management and administration ability	Completion of the system	Whether there are a set of intact security quality control certificates.
	Leader's quality	High score, high quality they have
	Productivity rate	Transportation amount/DWT
	Sale return rate (%)	Profit/Income
	Net return rate on capital (%)	Net profit/Total value
	Liability rate (%)	Total value in debt /total assets
Sustainable development ability	Human resource performance	Net profit/ Staff's total number
	Proportion of under ten-year old ship's transportation capacity (%)	Under ten-year old ship's transportation capacity /General capacity
	Ships renewing speed (%)	New ships/Total ships
	International cooperative partner quantity	
	Logistic synthesis ability	High score, high degree of this ability
	Port amounts concerning the operation	Including the port of participating equity, holding share and leasing.

4.3 Fuzzy synthetic appraisal of competence of China's chemical shipping enterprises

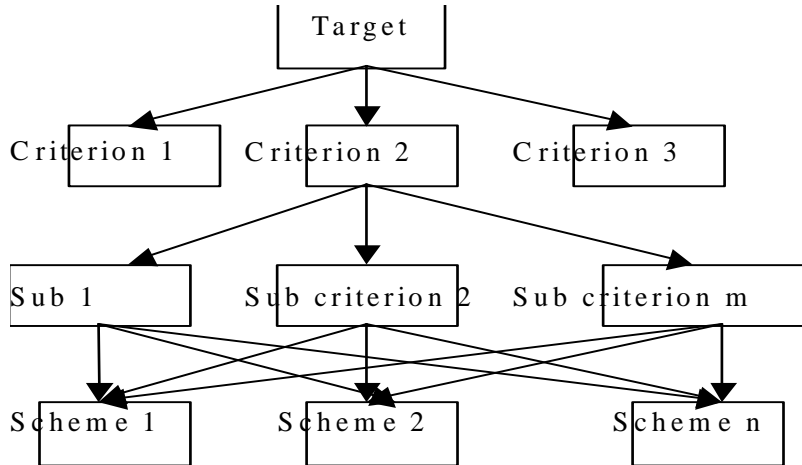
4.3.1 Analytical Hierarchy Process (AHP)

AHP was put forward in the middle period of the seventies by T.L.Satty. It is a kind of systematic analytical method. It developed from analysis of policy making and combined quantitative index and qualitative index together. It is a method of combining data, expert opinion and analytical people's judgment with the characteristic of clearly thinking, simple method, wide adaptability and strong systematicness, etc. The general step of using AHP is as follows:

1. Question defining:

While using AHP method, first task is to have a clear understanding about the question. Especially in question range, factor included and relationship between each factor.

2. Hierarchical model setting up:



3. Matrix judgment:

$$A = (a_{ij})_{n \times n}, (i, j=1, 2, \dots, n), a_{ij} = \frac{W_i}{W_j}, (i, j=1, 2, \dots, n) \quad \text{Obviously: } a_{ij} = \frac{1}{a_{ji}},$$

$a_{ii} = 1, (i, j=1, 2, \dots, n)$, as the below chart:

Table 4-5 Definition Table

Judgment criterion	Definition
1	Comparing two factors, they have the same importance.
3	Comparing two factors, a factor is slightly more important than the other.
5	Comparing two factors, a factor is obviously more important than the other.
7	Comparing two factors, a factor is intensely more important than the other
9	Comparing two factors, a factor is extremely more important than the other.

2, 4, 6, 8	Situated between above two neighboring judgments criterion.
Reciprocal	One factor is less important than the other, expressed with above reciprocal

4. Level list arrangement

The main calculation methods include Power Law Method, Asymptotic Normalization Coefficient and Root Law Method. The step of Root Law is as below:

Calculates each line of elements the product M_i in the matrix:

$$M_i = \prod_{j=1}^n b_{ij}, \quad i=1, 2, 3, \dots, n$$

Calculate the n root of M_i : \bar{W}_i

$$\bar{W}_i = \sqrt[n]{M_i}$$

Standardize vendor $\bar{W} = [\bar{W}_1 \quad \bar{W}_2 \quad \dots \quad \bar{W}_n]^T$:

$$W_i = \frac{\bar{W}_i}{\sum_{j=1}^n \bar{W}_j}$$

$W = [W_1, W_2, \dots, W_i, \dots, W_n]^T$ Is the weight which as we need.

5. Uniform examination

Calculate and compare the Maximum characteristic value of matrix.

$$\lambda_{\max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i}, \quad \lambda_{\max} \cong n$$

Calculate uniform target: $CI = \frac{\lambda_{\max} - n}{n - 1}$

Calculates the stochastic uniform ratio: $CR = \frac{CI}{RI}$, when $CR < 0.1$, The matrix has satisfactory uniform ratio, see below table:

Table 4-6 RI Coefficient table:

Matrix step number n	2	3	4	5	6	7	8	9	10
RI	0.00	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.52

4.3.2 Weight determination

At first, set up the judgment matrix. The form is as follows:

Table 4-7 Comparison between first class index

↗	Market controlling ability	Management and administration ability	Sustainable development ability
Market controlling ability	1		
Management and administration ability	—	1	
Sustainable development ability	—	—	1

Then use Root Law Method to calculate every judgment matrix.

1. Calculate the product of elements in every line

$$M_1=1*1*1/2=0.5$$

$$M_2=1*1*1/2=0.5$$

$$M_3=2*2*1=4$$

2. Calculate the n root of M_i : \bar{W}_i

$$\bar{W}_1 = \sqrt[3]{M_1} = \sqrt[3]{0.5} = 0.7937$$

$$\bar{W}_2 = \sqrt[3]{M_2} = \sqrt[3]{0.5} = 0.7937$$

$$\bar{W}_3 = \sqrt[3]{M_3} = \sqrt[3]{4} = 1.5874$$

3. Standardize vendor $\bar{W} = [\bar{W}_1 \quad \bar{W}_2 \quad \dots \quad \bar{W}_n]^T = [0.7937, 0.7937, 1.5874]^T$

$$\sum_{j=1}^n \bar{W}_j = 0.7937 + 0.7937 + 1.5874 = 3.1748$$

$$W_1 = \frac{\bar{W}_1}{\sum_{j=1}^n \bar{W}_j} = 0.7937 / 3.1748 = 0.25$$

$$W_2 = \frac{\overline{W}_2}{\sum_{j=1}^n \overline{W}_j} = 0.7937/3.1748 = 0.25$$

$$W_3 = \frac{\overline{W}_3}{\sum_{j=1}^n \overline{W}_j} = 1.5874/3.1748 = 0.5$$

So the characteristic vector $W = [0.25, 0.25, 0.50]^T$

4. Calculate the Maximum characteristic value of matrix

$$AW = \begin{bmatrix} 1 & 1 & \frac{1}{2} \\ 1 & 1 & \frac{1}{2} \\ 2 & 2 & 1 \end{bmatrix} \begin{bmatrix} 0.25 \\ 0.25 \\ 0.5 \end{bmatrix}$$

$$(AW)_1 = 1 * 0.25 + 1 * 0.25 + \frac{1}{2} * 0.5 = 0.75$$

$$(AW)_2 = 1 * 0.25 + 1 * 0.25 + \frac{1}{2} * 0.5 = 0.75$$

$$(AW)_3 = 2 * 0.25 + 2 * 0.25 + 1 * 0.5 = 1.5$$

$$\begin{aligned} \lambda_{\max} &= \sum_{i=1}^n \frac{(AW)_i}{nW_i} = \frac{(AW)_1}{3W_1} + \frac{(AW)_2}{3W_2} + \frac{(AW)_3}{3W_3} \\ &= \frac{0.75}{3 * 0.25} + \frac{0.75}{3 * 0.25} + \frac{1.5}{3 * 0.5} = 3 \end{aligned}$$

$$CI = \frac{\lambda_{\max} - n}{n - 1} = (3 - 3)/2 = 0$$

$$CR = \frac{CI}{RI} = 0/0.52 = 0$$

This proves that the judgment matrix has fully consistency.

Through Analytical Hierarchy Process, writer calculated all indexes investigated, and average the corresponding weight to get the below data:

Table 4-8 Weight of recommended indexes

First class index	Weight to previous class index	Second class	Weight to previous class index	Weight to total index
u ₁ Market Controlling	0.321	u ₁₁ Fleet Scale	0.206	0.066
		u ₁₂ Average Ton	0.122	0.039
		u ₁₃ Quantity Of Shipment	0.136	0.044

ability		u ₁₄ Market Share (%)	0.198	0.063
		u ₁₅ Enterprise's Brand	0.168	0.054
		u ₁₆ Self-owned ships proportion (%)	0.086	0.028
		u ₁₇ Customer Stability (%)	0.084	0.027
u ₂ Management and administration ability	0.324	u ₂₁ Completion of the system	0.190	0.062
		u ₂₂ Leader's quantity	0.151	0.049
		u ₂₃ Productivity rate	0.142	0.046
		u ₂₄ Sales return rate (%)	0.144	0.047
		u ₂₅ Net return rate on capital (%)	0.261	0.084
		u ₂₆ Liability rate (%)	0.112	0.036
u ₃ Sustainable development ability	0.355	u ₃₁ Human resource performance	0.182	0.065
		u ₃₂ Proportion of under ten-year old ship's transportation capacity (%)	0.139	0.049
		u ₃₃ Ships renewing speed (%)	0.136	0.049
		u ₃₄ International cooperative partner quantity	0.175	0.062
		u ₃₅ Logistic synthesis ability	0.196	0.061
		u ₃₆ Port amounts concerning the operation	0.172	0.069

4.3.3 Fuzzy synthesis appraisal model

1. Establish the factor collection and the weight collection

Appraisal factor collection:

$U = \{\text{market controlling ability } u_1, \text{ management and administration ability } u_2, \text{ sustainable development ability } u_3\}$.

Weight collection:

$$\tilde{A} = (0.321, 0.324, 0.355)$$

Among them, three sub factor collections are:

(1). Market controlling ability u_1 :

$u_1 = \{u_{11} \text{ Fleet Scale, } u_{12} \text{ Average Ton, } u_{13} \text{ Quantity Of Shipment, } u_{14} \text{ Market Share, } u_{15} \text{ Enterprise's Brand, } u_{16} \text{ Self-owned ships proportion, } u_{17} \text{ Customer Stability}\}$

Weight $\tilde{A}_1 = (0.206, 0.122, 0.136, 0.198, 0.168, 0.086, 0.084)$

(2). Management and administration ability u_2 :

$u_2 = \{u_{21} \text{ Completion of the system, } u_{22} \text{ Leader's quantity, } u_{23} \text{ Productivity rate,}$

u_{24} Sales return rate, u_{25} Net return rate on capital, u_{26} Liability rate }

Weight $\tilde{A}_2 = (0.190, 0.151, 0.142, 0.144, 0.261, 0.112)$

(3). Sustainable development ability u_3 :

$u_3 = \{ u_{31}$ Human resource performance, u_{32} Proportion of under ten-year old ship's transportation capacity, u_{33} Ships renewing speed, u_{34} International cooperative partner quantity, u_{35} Logistic synthesis ability, u_{36} Port amounts concerning the operation }

Weight $\tilde{A}_3 = (0.182, 0.139, 0.136, 0.175, 0.196, 0.172)$

2. Set up appraisal collection:

While confirming the grade of appraisal collection, writer defines it as four grades according to characteristic of this thesis and the commonly used division method:

$$V = \{ v_1, v_2, v_3, v_4 \} = \{ \text{excellent, good, middle, pool} \}$$

3. Confirmation of the evaluation index

There mainly two kinds index in this article: 1. Indexes that could be quantified directly. Most of the evaluation indicators in this article belong to this; 2. Quantitative indexes with fuzzy nature. That is to say they are hardly to express by specific figures. For example, enterprise's brand, completion of the system, leader's quantity and logistic synthesis ability, etc.

To the first kind indexes, writer has divided the range of the index, and designed the "Vector investigation table". The following two examples will give a better instruction about this:

Table 4-9 Total transportation capacity

Total transportation capacity	Excellent	Good	Middle	Pool
50000~100000	0.75	0.15	0.10	0
10000~50000	0.10	0.60	0.30	0
5000~10000	0	0.35	0.65	0
2000~5000	0	0	0.55	0.45
0~2000	0	0	0	1

Table 4-10 Customer's stability

Customer's stability	Excellent	Good	Middle	Pool
Above 85	0.10	0.40	0.40	0.10
70~85	0.10	0.70	0.20	0
50~70	0.80	0.10	0.10	0
25~50	0.20	0.50	0.20	0.10
0~25	0	0	0	1

To the second kind indexes, according to estimator's appraisal results to every evaluation index, writer has calculated proportion that every index accounts for. Then gets the vector \tilde{R}_i ,

$$\tilde{R}_i = (r_{i1}, r_{i2}, \dots, r_{im})$$

Then form multifactor and synthesis fuzzy matrix by using all vectors \tilde{R}_i ,

$$\tilde{R} = \begin{pmatrix} R_1 \\ R_2 \\ \vdots \\ R_n \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{pmatrix}$$

Among them, $r_{ij} = \mu_k(u_i, v_j)$, $0 \leq r_{ij} \leq 1$. It means during the consideration of u_i , the extend of judging result v_j .

4. Fuzzy operator

According to the appraisal result of single index, we calculate the proportion of every index and get \tilde{R} .

$$\tilde{R} = \begin{pmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{pmatrix}$$

Among them, $\sum_{j=1}^4 r_{ij} = 1$ ($i = 1, 2, 3, \dots, n$).

It means the calculation method of judging value by index of lower floor compounding into upper strata index. The confirmation of fuzzy operator equals to

confirmation of fuzzy formation.

The key on fuzzy appraisal is the fuzzy judging operator. The Commonly used fuzzy operator includes: main factor stressing type, main factor determine type and average mean type. Depending on characteristic of this article, writer chooses average mean $M(\cdot+)$.

$$M(\cdot+), b_j = \sum_{i=1}^n a_i r_{ij}, \quad j = 1, 2, \dots, m \quad (4-1)$$

This algorithm has considered all factors influence depending on the proportion of the weight. Compared with the other two types, average mean has more excellent natures.

After the confirmation of weight collection \tilde{A} and judging matrix \tilde{R} , writer carried on matrix multiply and got the synthesis collection \tilde{B} ,

$$\tilde{B} = \tilde{A} \circ \tilde{R} = (a_1, a_2, \dots, a_n) \circ \begin{pmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{pmatrix} = (b_1, b_2, \dots, b_m) \quad (4-2)$$

Then, regard this result as the vector of next layer and get the comprehensive appraisal result of next level. So until obtain final appraisal result.

5. Defuzzification

While confirming target's grade, we need to defuzzify it.

The defuzzification methods include: Maximum Membership Principle and Centre of Gravity Method.

Maximum Membership Principle is an often used defuzzification method. We use this method on the final collection \tilde{B} ,

$$b_0 = \max(b_1, b_2, \dots, b_m)$$

This method is relative simple but can't defuzzify result meticulous. However, Centre of Gravity Method can dispel the shortcoming described above. Its calculation formula is as follows:

$$M = \frac{\sum_{i=1}^n b(u_i) \times u_i}{\sum_{i=1}^n b(u_i)} \quad (4-3)$$

Among them, u_i is corresponding score of each index. In order to get a meticulous result, writer has designed the grade range of the variable value {Excellent ,Good ,Middle ,Pool}={100~90,89~75,74~60,59~0}. If calculate value in its group, it is {95,82 ,67 ,30}:

Table 4-11

Evaluate Grade	Synthesis Appraisal Value	Result
Excellent	$100 \geq u_i \geq 90$	95
Good	$90 > u_i \geq 75$	82
Middle	$75 > u_i \geq 60$	67
Pool	$60 > u_i \geq 0$	30

Centre of Gravity Method can reflect whole information amount. Therefore, we get a synthesis value M . Then according to its numerical value, we will find its evaluation grade according Table 4-11. And this grade is the final appraisal result of one shipping enterprise.

CHAPTER 5 POSITIVE RESEARCH OF COMPETENCE OF CHINA'S CHEMICAL SHIPPING ENTERPRISES

In charter four, in term of operating feasibility, writer has designed a recommended index system and evaluation model. On the condition of collecting all index data, we can evaluate the competence of a specific enterprise. Confirm its advantage, find out its disparity. Therefore enterprise could improve its competence effectively.

In this charter, writer will regard China oil field service company marine transportation operation department as the appraising target, carrying on positive research on it.

5.1 Introduction about China oil field service company marine transportation operation department

5.1.1 Current situation of China oil field service company marine transportation operation department

He was set up in 2001, registered capital is 244 million yuan. By the end of 2005, his total capital had rise to 400 million yuan. Net assets were 369 million yuan. It is mainly engaged in liquid chemicals transportation, ships administration and safe management system offering and is one of the biggest chemical shipping enterprises in China. Now he possess 14 IMO II / III type liquid bulk chemical vessels which the deadweight is between 1000-14000 tons. His transported goods include liquid chemical, vegetable oil, fuel oil, diesel oil, petrol and edible oil, etc. Water areas of shipping involve domestic, coastal international airline, north-India course, American course, Mediterranean course, Middle East course and European course. The good sources are steady to them, total quantity reach to 2 million tons in recent each year.

5.2 Positive research of competence of China oil field service company marine transportation operation department

5.2.1. Data acquisition:

Table 5-1 Vector \tilde{R} to Every evaluation index

Second class level index	Enterprise data	Vector \tilde{R}
u_{11} Fleet Scale	100,000	(0.75, 0.15, 0.10, 0)
u_{12} Average Ton	6858	(0.80, 0.20, 0, 0)
u_{13} Quantity Of Shipment	200	(0.75, 0.25, 0, 0)
u_{14} Market Share (%)	26.9	(0.50, 0.40, 0.10, 0)
u_{15} Enterprise's Brand	—	(0.55, 0.45, 0, 0)
u_{16} Self-owned ships proportion (%)	74	(0.75, 0.25, 0, 0)
u_{17} Customer Stability (%)	60	(0.80, 0.10, 0.10, 0)
Weight $\tilde{A}_1 = (0.206, 0.122, 0.136, 0.198, 0.168, 0.086, 0.084)$		
u_{21} Completion of the system	—	(0.70, 0.20, 0.10, 0)
u_{22} Leader's quantity	—	(0.75, 0.15, 0.10, 0)
u_{23} Productivity rate	20	(0.25, 0.65, 0.10, 0)
u_{24} Sales return rate (%)	10.3	(0, 0.35, 0.65, 0)
u_{25} Net return rate on capital (%)	2.95	(0, 0.30, 0.70, 0)
u_{26} Liability rate (%)	7.7	(0.80, 0.20, 0, 0)
Weight $\tilde{A}_2 = (0.190, 0.151, 0.142, 0.144, 0.261, 0.112)$		
u_{31} Human resource performance	54.3	(0.80, 0.20, 0, 0)
u_{32} Proportion of under ten-year old ship's transportation capacity (%)	16	(0, 0, 0.20, 0.80)
u_{33} Ships renewing speed (%)	17.3	(0.20, 0.70, 0.10, 0)
u_{34} International cooperative partner quantity	2	(0.60, 0.40, 0, 0)
u_{35} Logistic synthesis ability	—	(0, 0, 0.55, 0.45)
u_{36} Port amounts concerning the operation	0	(0, 0, 0.40, 0.60)
Weight $\tilde{A}_3 = (0.182, 0.139, 0.136, 0.175, 0.196, 0.172)$		

Data resource: Annual report of China oil field service company, spot survey and study.

5.2.2. Evaluation of competence

In term of the above table, set up the appraising matrix by using the method in Charter four. Make operation with MATLAB software. Getting the result of the first class level as below:

Market controlling ability $\tilde{R}_1 = (0.6772, 0.2740, 0.0488, 0)$; $M_1 = 90.1$, the grade

is "excellent ".

Management and administration ability $\tilde{R}_2 = (0.3713, 0.3041, 0.3246, 0)$;

$M_2 = 82.3$, the grade is "good ".

Sustainable development ability $\tilde{R}_3 = (0.2778, 0.2016, 0.2180, 0.3026)$; $M_3 = 66.6$, the grade is "middle ".

Then the second class level is carried on, we can get the final judgement indicator $\tilde{B} = (0.4363, 0.2581, 0.1982, 0.1074)$, use the formula of (4-3) to defuzzificate it, $M = 79.1$, final grade to this company is "good ".

5.2.3 Comparison with large-scale chemical shipping enterprises in the world

It is also necessary to investigate our country's chemical shipping enterprise in whole world scope. So let's take a look at the comparison between China oil field service company marine transportation operation department and Stolt Group.

Table 5-2 Comparison table

	Recommended index	Stolt Group	China oil shipping
1	Fleet scale	250,000,000 dwt	10,000,000 dwt
2	Vessel quantity	140	18
3	Average tons	17857dwt	7143dwt
4	Total transportation capacity	2,700,000,000 tons	200,000,000 tons
5	Operational network coverage	Course among Pacific Ocean, Atlantic Ocean, Indian Ocean, Rhine River and various countries in Europe, Asia, Caribbean.	Coastal course of Europe, America, Middle East, Indian Ocean and our country.
6	Sales returning rate	21.6% (163 million \$ /7.55million \$)	10.3% (11.8 million ¥/114.7 million ¥)
7	Relative operational port	10	0

Data resource: compilation of relevant enterprise's website data.

From the above, readers can understand the discrepancy between our country and foreign country clearly.

5.3 Development strategy and suggestion to China oil field service company

This article will propose the development strategy and suggestion from three

respects.

1. Accurately find market orientation, expand fleet's scale, strengthen the market controlling power.

The specialized chemical shipping has already developed for nearly 60 years, market has already been very ripe and competition is fierce. But Chinese chemical shipping enterprise started relatively late, and there scale is also small. If they want successful management, they must find their market orientation accurately. As China's economy is developing very fast, the demand for chemical products increases dramatically. On one aspect, the world-famous petrochemical industry group such as BASF、Shell、BP will set up joint-venture with Chinese enterprise to product styrene monomer in very near future; On the other aspect, Exxon Mobile Group and Dow Chemical Group will expand their business in 2008. Therefore, demand will increase continually. However, Chinese chemical fleet is insufficient in total amount, can not meet the transportation requirement. In this case, China oil field service company should rely on its domestic advantage, expand domestic market and expand fleet scale, focus on advanced customer, improve his service level to occupy the share of more advanced markets.

2. Strengthen safety management, optimize business procedure

Service quality and management level of the security are closely linked with each other, safety management is very important to chemical shipping enterprise. China oil field service company have already set up high-standard security quality management system. Through setting up, perfecting and carrying out every relevant rules and regulations, they strengthen safe consciousness, make safe transportation being in the state of in advance controlling. In term of their internal management, they should further optimize management structure, operation decision system and business procedure. Meanwhile control the market risk well to guarantee management quality. Also they should continue strengthening human resources management and training work, pursue ISO service quality system authentication in an all-round way, lead their staffs to step advance constantly.

3. Develop synthesis logistics, build up sustainable development capacity

After the seventies, international shipping industry began to pay attention to logistics business, large-scale chemical transport enterprise set up logistics enterprises. However, if China oil field service company marine transportation operation department wants to open up the synthesis logistics service alone depend on his present scale and capacity, they will face a huge problem in term of both capital and technology. Therefore, the feasible way for his exploring is cooperate with some other large foreign companies. This is an effective way to reduce operation risk and increase profit space. So fantastic it is.

CHAPTER 6 SUGGESTION ON COMPETENCE PROMOTION METHOD TO CHINA'S CHEMICAL SHIPPING ENTERPRISES

The competence of whole chemical shipping industry is an industrial organization question. Forming effective market structure and institutional framework is the basic route and decisive condition to strengthen China's chemical shipping enterprise's competence. Government should make great efforts to build a suitable external environment condition and take positive measure to accelerate the construction of legal system for fair competition in the market. Meanwhile, they should also devote to making relevant policies, setting up international current rule gradually. Like this, fair external environment and condition could be thereupon created.

6.1 Make and issue technical supervision inspecting standard as soon as possible.

At present, the ship testing procedure CDI (chemistry distribution institution) is a kind of technical supervision inspecting standard which is widely accepted by every large transnational chemical group in the world. In recent years, the jointly chemical projects setting up by our country's large-scale chemical enterprise and international transnational chemical group have not merely introduced internationally advanced production technology but also accelerated the process of integrating with international management standard for chemistry warehousing and transportation. Our Ministry of Communications has accumulated certain experience in so many years supervision practice. Therefore, writer suggests that technical supervision inspecting standard should be made and issued as soon as possible. At the same time, authorized unit could be regarded as technological advisory organization to offer the overall and objective risk assessing service to our customers.

6.2 Set up crew's training and examination system

This kind of system should be set up urgently. The mission of improving crew's

quality and technological ability to guarantee shipping service high quality is very urgent. By this, possibility of pollution accident caused artificially could be reduced greatly. Meanwhile, government should continue to strengthen the management and supervision of crews to weight them whether they are competent for their jobs in order to promote constructions of our country's crew team.

6.3 Improve regulation of water transport of liquid chemical, strengthen the efforts of Rectifying and supervising to the market

On the existing foundation related to chemical water transport laws and regulations, writer suggests that our Ministry of Communications further improve the laws and regulations by combining development trend after chemical water transportation market opening to the whole world. At the same time, they should strengthen the efforts of Rectifying and supervising to the market to ensure the security of water transportation. Offer good market environment to operator, promote sustainable, fast and healthy development.

6.4 Encourage and support strong chemical shipping enterprises and ports especially

Keep appropriate concentration degree and enterprise scale is the guarantee and support to strengthen the competence of chemical shipping enterprise. From a certain meaning, the quantity of large-scale shipping enterprises has become the important sign of weighing industry's competence between country and country. According to the request of economics of scale, our country should develop some capital-intensive, technology-intensive company, implementing the "fewer but better" policy, making these enterprises become the leading strength of chemical shipping industry to optimize institutional framework and to drive industry upgrading.

Chapter 7 Conclusion

The chemical shipping industry of our country is still at the primary stage. Compared with foreign countries, obvious disparity exists. Seizing opportunity, developing market in a more cost-effective manner and improving enterprise's competence is undoubtedly important task in the circle of shipping.

This article starts from the intension of enterprise's competence, analysis the present market environment that chemical shipping enterprises are staying in. Then writer launches study on chemical shipping enterprise. This article was finished on the basic of reading lots of documents and materials and doing many spot surveys in different chemical shipping enterprises. I have obtained my own view in several following respects:

1. Through an all-round way analysis on chemical shipping market, writer thinks the market in our country is in a backward state, and also is an oligopoly market. The present demands increase very fast, and government opens the market more and more. All of this has offered very large market space for enterprise's development.

2. Writer proceeds from three main factors which are market controlling ability, management and administration ability and sustainable development ability, set up an intact index system to appraise competence. For the convenience of data collection and practical operation, this article offered a set of more simple and more convenient recommendation index systems, and set up fuzzy synthetic appraising model for China's chemical shipping enterprise. And have confirmed index weight on this basis.

3. Writer has analyzed competence of China oil field service company marine transportation operation department and has offered suggestions of improving its competence. Then rising from single enterprise to the whole industry, puts forward some industry's policy recommendations.

However, due to the limitation of research time, condition, source of data and personal own knowledge, there are some works that I want to do but fail to accomplish. Such as not arranging the competence of our country's chemical shipping enterprise in an order, not carrying on more overall comparison between each

enterprise, etc. Though there will be deficiency in the article unavoidably, I hope this article can offer a beneficial thinking for different shipping companies and can offer certain reference for enterprise's making management strategy and improving competence.

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