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On the petroleum security strategy and fleet development of China Shipping Tanker Company

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On the Petroleum Security Strategy and Fleet Development of China Shipping Tanker Company

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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 Research paper**:** **On the Petroleum Security Strategy and the Crude Carrier Fleet Development of China Shipping Tanker Company**

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With the continuous growth of the national economy, China's demand of crude oil increases dramatically. However, China's own production of crude oil cannot meet the increasing demands. Therefore the difference between the huge demand and relatively small self-supply can only be added by turning to import. The transportation of China's imported oil largely relies on ships. Due to the increasingly large import of oil and the implementation of the oil security strategy, there comes a very good opportunity for China's oil importing tanker fleets to develop themselves. On the other hand, the oil transportation corporations should realize the importance of properly planning their ship fleet, enhancing the general power and maintaining competitiveness.

In 1993, China became an oil net import country instead of oil net export. In recent years, with the development of domestic economy, the consumption and importation of crude oil has increased dramatically. The demand of domestic's crude oil is increasing rapidly, but the crude oil transportation of China is very embarrassing.

This also brings a new serious problem, which makes the petroleum security of China be enslaved to others. So once there are wars, diplomatism conflicts or other irresistible conditions, China will be in the danger of oil shortage and stoppage.

Some experts suggested that, China should build up a tanker fleet that can transport at least 50% of import crude oil. But to build such a large tanker fleet will cost great

amount, which also will make China's government and tanker companies have to run a big risk. On the other hand, the purchasing and building of VLCC and ULCC blindly will not only make the countries' and the companies' burden heavier, but also cause the waste of limited resources. So the government and the companies should make a long-term plan for the investment and the construction of China's tanker fleets.

Based on this awareness, it's necessary to have a research on how to develop fleets and how to appropriately construct fleets structure. The aim of this paper is to provide some references for the operation of the development planning of the fleets of China's oil transport corporations in the light of the theoretical researches. I will take China Shipping Tanker Company as the example.

First, this paper will introduce the concept of national security strategy, and will also have a look back at the theoretical and practical outcomes in terms of researches on fleet planning. On the basis of this and by taking into account the development of China's oil transportation enterprises, the author will put forward researching object of the paper, that is, the paths of enlarging China's fleets in the period of development can be purchasing new ships or second-hand ships and renting ships.

Then, I arrange the paper skeleton as follows:

1. Introduction of petroleum security

2. Some theories and concepts of fleet development, and the application of linear programming in fleet layout

3. Current status of global and China's oil shipping market

4. Analysis and demand forecast of China's crude oil import market

5. Based on national petroleum security strategy, China's crude oil import shipping market is facing great pressure, and needs to develop and enlarge crude tanker fleet

6. Introduction of China Shipping Tanker Company, and its crude tanker fleet (scale and structure)

7. Analysis of current configuration of CS Tanker fleet

8. Compare CS Tanker with world-class tanker companies in order to find out the gap between them

9. Layout and programming of tanker fleet of the company

10. SWOT analysis of CS Tanker

11. Some suggestion for the development of CS Tanker fleet

12. Conclusion

Key word: national petroleum security, crude oil transportation, oil tanker fleet, fleet development, China Shipping Tanker Company

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LIST OF ABBREVIATIONS

CS Tanker   China Shipping Tanker Company

GDP   Gross Domestic Production

DWT   Dead Weight Tonnage

SOE   State Owned Enterprise

SWOT   Strength, Weakness, Opportunity and Threat

VLCC   Very Large Crude Carrier

ULCC   Ultra Large Crude Carrier

Chapter 1

Introduction of Petroleum Security

Energy, as a focus question in China, has been attached more importance. Oil, as an important part of energy, also has showed its strategic value. How the oil tankers which is a derivative of oil trade ensure the national energy strategy is a hot subject in current situations. The development strategy of Chinese oil tanker includes establishing oil tanker pool, conventional alliance between oil shipping companies and shipping only by national tankers. The background, the feasible level and the effects about these strategies need to be studied.

As a traditional industry, Chinese oil tanker has a brand affected by national economy, but oil shipping in an international mature field demand China reaches the international level. The contradiction not only bring the power but also pressure to the Chinese oil shipping, so how to solve the questions such as the shipping supply, market property, alliance merits and demerits and the prospect that China is confronting now is very crucial.

The key to petroleum security is stable supply, reasonable price and also safe utilization incompliance with environmental protection requirements. The international factors influencing petroleum security at the present time, and in the future, include US control of the global oil market, resources and technology, contradictions between oil-producing countries and oil consuming countries, competition among oil-consuming countries for petroleum resources, the unstable political situation in major oil-producing countries and the threat of terrorist attacks against energy facilities such as oil pipe lines and tankers. With the present-day move towards economic globalization and market integration, the world is paying attention to China; while China, on the other hand, cannot separate itself

from the world. Petroleum security is a major issue in China, and the settlement of this issue will have an influence on the world petroleum situation.

1.1. Definition of Petroleum Security

Petroleum security belongs to the category of national security. And herein the important status of petroleum in the energy resources, in many countries, energy security is regarded as petroleum security.

The United States of America is one of the most active and influential countries in the research of energy resources of the world. When we talk about the external energy resource supply in many energy reports, energy security usually refers to petroleum security. In its *National Energy Policy* published in 1998, the petroleum security is defined as to freely get foreign oil resources at a reasonable price, or to insure oil price reasonable and circulated freely. For a long time, the White House takes the petroleum security as an important part in its National Security Strategy. For example, in January 1998, President Reagan signed *The National Security Strategy of the United States of America*. It indicated that "energy resources are important basis of our economy, industries and military power, so energy is our national security basis. In Persia Gulf area, we should take action to ensure that we and our alliances can get oil at a reasonable price…" So this paper will define the petroleum security as follows:

To keep the oil import country in such a status:

· get the foreign oil resources
· at a reasonable price
· continuously
· in order to meet the demand of economic and social development

1.2. The Standard of Petroleum Security

There are many factors influencing a nation's oil security, such as embargo of oil producing country, interrupt of oil transit, gambling and so on. When establishing oil security strategy and tactic, the country should consider the factors that will influence the oil security currently and in the near future. Different countries have different channels and accesses to oil resources, and the influencing factors are also different, so oil security strategy should be adjusted in time according to the changes of the factors.

Generally speaking, the important criterion for judging the oil security level is whether or not there is phenomenon or evidence on the interruption of oil supply.

In current studies, we generally define the oil interruption as the supply of oil total stoppage. However, in today's world, the oil resources have not been used up, so the possibility of the oil supply stoppage is almost zero. Therefore, the concepts of petroleum supply interruption will be concluded as follows:

(1) Global shortage on oil supply: such condition is mainly caused by wars and other serious sudden affairs, which results to the great decrease in the world oil supply.

(2) Regional shortage on oil supply: the certain sudden affairs causes the great decrease in the oil import quantity in one or several countries, which results in the domestic shortage in the supply. For example, in 1973, during the 4th Middle-East War, Arabian countries were not satisfied with Middle-East Policies of USA, so they cut down the supply to USA and the Netherlands.

(3) Oil price keeps rising for long time: the oil price increases dramatically in a certain period of time and has great impact on the world economy and society. For example, from 1999-7~2000-12, the oil price increased from $19.39/Barrel on 1999/7/1 to

$37.2/Barrel on 2000/9/20. This great increase is usually called the 4th world oil crisis by some experts. And now, the crude oil price is also changed rapidly.

> "**Crude oil prices** fell to 20-month lows in mid-January as lower demand, due to unusually warm weather and fund repositioning in commodity markets, offset the impact of OPEC cuts. Despite a sharp fall in US crude stocks, high inventories at the NYMEX delivery point of Cushing, Oklahoma, are contributing to the persistence of higher forward prices."
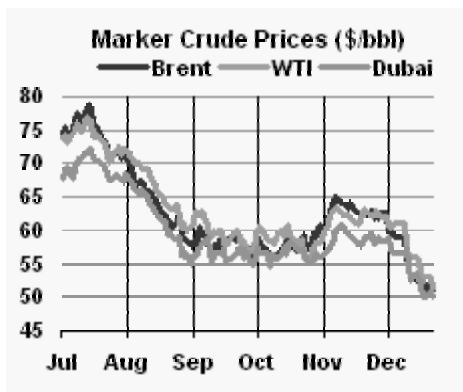
Figure 1-1 Crude Oil Prices
Source: IEA Oil Market Report, dated 18 January 2007
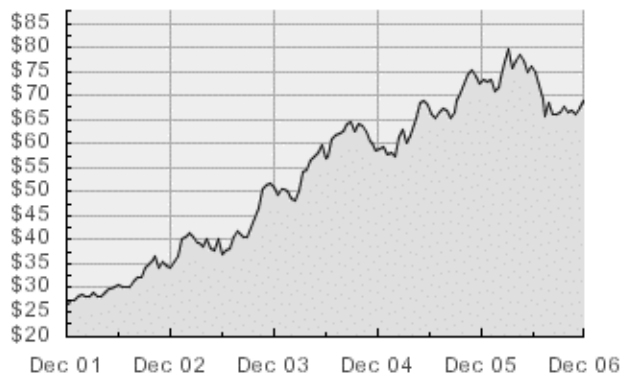
Figure 1-2 Five Year Trend of Crude Oil Price
Source: www.oil-price.net

1.3. The Petroleum Security Strategy

The petroleum security strategy refers to the policies or the measures carried out in order to maintain or pursue the petroleum interest and realize the security objective. For a long period, petroleum security strategy, as the core of energy security strategy, has been the important part of national security strategy in all western countries. On the other hand, the petroleum strategy is not always the same, and the governments should make corresponding adjustments to this strategy according to their own petroleum security problems. For example, on December 1st 1998, the White House of America published *A National Security Strategy for A New Century*, which indicated clearly that:

> "…Conservation and energy research notwithstanding, the United States will continue to have a vital interest in ensuring access to foreign oil sources. We must continue to be mindful of the need for regional stability and security in key producing areas to ensure our access to, and the free flow of, these resources…"

In this report, USA regards the guarantee supply of energy sources as the important measure of fulfilling the target of national security strategy.

1.4. The Purpose and Meanings of the Paper

Petroleum is usually called *the blood of industry*, because it is not only the important industrial raw material, but also the essential energy resource. Since the 1960s, the petroleum industry has developed rapidly in China, and its exploitation has increased dramatically. At the end of 1997, it has formed three main oil producing bases, east area and west area of mainland and offshore oil fields. Because of the layout of China's industries, the demand of oil in east and north area is very large. On the other hand, since 1993, China has become the petroleum net import country, especially in 1999, the net

import quantity reached 40,000,000 ton, which occupied 20% of domestic petroleum consumption. All these statistics bring a lot of opportunity for China's petroleum maritime transport market. It is reported that the domestic economy is developing steadily and the shipping market is gradually recovering. So, before we optimize the fleet configuration in shipping companies, we should study the demand both in oil consumption and in maritime transport, and also analyze the development trend of China's oil shipping market in the near future.

In 1993, China became an oil net import country instead of an oil net export country. In recent years, with the development of domestic economy, the consumption and importation of petroleum has increased dramatically. Obviously, the annual increase of domestic oil output cannot meet the demand of domestic oil consumption increase. According to the statistics of China's Customs in 2004, China imported 1.2 hundred million ton of crude oil, 34.8% higher than 2003.

The demand of domestic's crude oil is increasing rapidly, but the crude oil transportation of China is very embarrassing. Until now, 80% of China's import crude oil is transported by foreign fleets. Although the total tonnage of China tanker fleet is the No.13 of the world, the fleet structure is not reasonable, and can hardly meet the transport demand.

This also brings a new serious problem, which makes the petroleum security of China be enslaved to others. As is mentioned above, the transportation of import crude oil is completed by foreign fleet companies, so once there are wars, diplomatism conflicts or other irresistible conditions, China will be in the danger of oil shortage and stoppage.

The transportation of import crude oil is not only the business of the companies, but also the business of national petroleum security. So in order to insure China's petroleum strategic security, it is imperative under the situation for Chinese big tanker companies

to build large crude oil tanker fleets.

Some experts suggested that, China should build up a tanker fleet that can transport at least 50% of import crude oil. However, it is estimated that to build such a large tanker fleet will cost great amount, which also means that China's government and tanker companies have to run a big risk. On the other hand, the purchasing and building of VLCC and ULCC blindly will not only make the countries' and the companies' burden heavier, but also cause the waste of limited resources. So the government and the companies should make a long-term plan for the investment and the construction of China's tanker fleets.

In the macroscopical circumstances, for the tanker companies in China facing such a large market with great potential, it is very critical for them to develop their own fleets (including the replacement of vessels, enlarging the fleet scale, adapting to the various kinds of changes, etc.), and at the same time, to keep their capabilities and competitive advantages.

A well-performing tanker company will consider two things for the management of fleet; one is the long-term strategic objective, the other is the short-term operating performance. The long-term strategic objective refers to the consideration of the fleet scale (type, number and ship-age) and the strategy of development in the next few years. The short-term operating performance refers to how to maximize the profit of existing fleets, and minimize the cost. This paper will focus on development and layout of a tanker company.

At present, only a few Chinese tanker companies own ULCCs and VLCCs. If these companies want to complete the transport task relating to the national petroleum security and competing with foreign companies in global market, they have to enlarge the fleet

scale especially the scale of ocean tanker fleet. In the study of fleet programming before, the research models mostly took the large tanker companies as the object which is very limited and cannot directly used by China's tanker companies.

The tanker fleet scale of China is relatively small, and the proportion of the import crude oil carried by China's tanker fleet is very low. In order to keep national petroleum security and complete the tasks of strategic storage of petroleum, China's ocean tanker fleets need to enlarge their scales through various channels. The research fruits of fleet programming mentioned above are mostly about the fleet carrying large amounts of cargo, such as bulk carrier fleets and the tanker fleets, but these fruits don't totally fit the situation of China. We should aim at the current status of China's tanker companies, and set up the fleet programming models that are suitable for them by the combination of theory and practice.

Chapter 2

Fleet Development

2.1 Fleet Scale

The scale of a fleet commonly refers to the total tonnage or the total deadweight of the fleet. For the shipping companies, a reasonable programming of the fleets is relative to not only the cargo sources, but also the financial status, technical levels and managerial levels. The company should firstly consider its cargo sources, and secondly, its financial and technical strength.

The scale of the fleet depends on the potential scale of cargo sources, and only when the market share (that the company could probably occupy) is estimated correctly can the company fix on the fleet tonnage that it should have. In addition, the financial and managerial capabilities of the company are also the important factors.

There are five main forms of fleet scale according to the share of cargo sources:

a. **Extroversive fleet scale** --- In a certain period of time, the total tonnage can meet the demands of its own company, and the rest tonnage capacity can be rented by others in the global market.

b. **Self-sufficient fleet scale** --- In a certain period of time, the company is equipped with appropriate tonnage according to the estimation of maximum demands, in order to make the fleet meet the demands at any time to complete the company's tasks.

c. **Basic fleet scale** --- In a certain period of time, the company is equipped with appropriate tonnage according to the estimation of minimum demands, in order to

make sure that the fleet can be fully used.

d. **Economical fleet scale** --- This is the scale form between self-sufficient scale and basic scale. In a certain period of time, the company is equipped with appropriate tonnage according to the estimation of average demands.

e. **Growing fleet scale** --- The company decides the total tonnage according its limited finance, technology, managerial strength, and the scale is much smaller than is required and has great potentials.

The shipping companies with relatively better financial, managerial and technical level should consider expanding its fleets to pursue the profit brought by scale economy.

2.2. Reasonable Fleet Structure

The fleet scale of a shipping company reflects the supply capacity of its total tonnage, but can hardly reflect some special relationships between supply and demand. We cannot say the market is balanced if total supply equals to total demand, and we also cannot guarantee that the supply of different ship types can meet all the demands.

Fleet structure refers to the composing status and basic characteristics of operating vessels in a company which include ship kinds, types, tonnage, ages and technical equipments and so on. We usually consider three factors when judging a fleet structure.

a. Whether the ship kinds and types are suitable for the international shipping market or not

The shipping companies should substitute old ship type with new type. For examples, with the development of tanker, the single-hull tankers are gradually replaced by

double-hull tankers in order to ensure the security and prevent the ocean from oil pollution; for the ocean transportation of crude oil, the shipping companies should try to use VLCCs in order to reduce the freight rate and costs so as to keep the competitive advantages.

b. The vessel number of different kinds

In a fleet, the proportion of different kinds of vessel should be reasonable and appropriate. The company should try to avoid the conditions that the capacity of one kind is left unused, while the other kind is out of supply.

c. The advance technology and ship age layout

The life-span of a vessel can be as long as several decades, which makes the technologies and equipments used different greatly in a certain period of time. Some new ships are equipped with advanced technologies and more secure, while some old ships are relatively outdated in some technologies because of the building levels at that time.

A fleet with many old ships has other disadvantages such as long-time repairing, low operating performances, high repairing cost and operating cost, etc. However, considering the fluctuation of the market, to keep an appropriate number of old ships with low maintenance costs can reduce the operating risks when the market is not very good.

The study on the fleet scale and structure can not only focus on the macroscopical research of the world merchant fleet, but also focus on the microcosmic review of a company or a fleet.

2.3. Approaches to Enlarge Fleet Scale

a. Enlarge Fleet Scale by Chartering Vessels

Chartering vessels to supplement fleet tonnage is a kind of provisional measure to solve the short-term shortage of capacity. The merits are: (1) have the access to the vessel in time with little capital; (2) only pay for the hire rate according to the charter party; (3) comparing with purchasing a vessel, it can reduce the risks when the market is down. There are also some disadvantages: (1) the profit of the vessel chartered is less than the vessel owned by self; (2) the technical and operating capabilities cannot totally meet the demands.

b. Enlarge Fleet Scale by Purchasing Second-hand Ships

The outstanding merits of purchasing old ships are: (1) lower prices; (2) quickly put into operation, and quickly produce profit; (3) lower maintenance costs; (4) lower loss when the vessels are left unused. Because the vessels are old and outdated, the capabilities and performance will be affected more or less.

When the market is at the bottom, some relatively new vessels will be sold at low prices, which is an important approach for those companies who need capacities urgently and expanding their company scale. Many big shipping companies nowadays grew up by purchasing second-hand vessels. However, when the shipping companies are striving to invest to enlarge fleet, the price of old vessels will be higher and the shipowners are always not willing to sell their new ships. It is not a wise choice to purchase old vessels at this time. So, only when the price is relatively low in the second-hand market is the right time for the shipping companies to enlarge fleet scale by purchasing not-very-old vessels.

c. Enlarge Fleet Scale by Booking New Ships

The advantages and disadvantages of making orders for new vessels is just the opposite to those of purchasing second-hand vessels. The advantages of new vessels are: (1) good capabilities; (2) low consumption of bunker, low repairing cost; (3) high efficiency; etc. The disadvantages are: (1) costly; (2) long waiting time until the vessel is put into service; (2) sink capital; (3) high maintenance cost; (4) higher loss when the vessel is left unused; etc.

Because of its outstanding merits of building new vessels, some shipping companies with rich capital and some far-sighted shipowners are willing to enlarge their fleets by booking new vessels.

2.4. Mathematical Techniques Used in Fleet Development

One important task of fleet scale and structure optimization is the analysis of technical and economic performances. Using the economic standards or index to fix on the appropriate time of fleet renewal is not an easy work, because it involves some unpredictable factors, such as building costs, operating costs, freight rates and so on.

Linear Programming

As an important embranchment of operational research, linear programming has become more and more mature in its theory. It is widely applied in our real life because it is easy to understand, and its model is easy to establish. With the help of computer processing hundreds and thousands of constraint terms and decision variables, linear programming can be used in a much wider field. Linear programming has been widely used in the research of fleet programming.

In 1969, John L. Everett and some other scholars made systematic study in his paper *Optimization of a fleet of large tanker and bulkers — A Linear Programming Approach*. At that time, the American government prepared to give some allowance to those who build and operate tankers and bulk carriers, and was ready to set aside the particular fund for the ship building in large number. And the government also required that the total tonnage of the vessels built in the next ten years can bear 15% of annual America's export. The scholars started from the points of system theory, and formed a fleet programming model that can meet the demand of cargo transportation with minimum operating cost in the future. In this model, some main factors that would influence the operation were considered, such as cargo flows, number of voyages, sailing time, parameters of ship type, constraints of ports, rates of investment return, and so on. This model worked as guidance for the investment decisions of the fleet.

At the end of 1970s, Ir. M. A. Wijsmuller with his assistants researched and developed a decision optimization model, which would help the shipping companies renew their fleet and make loans according to the forecast of the future market. This model deals with the dynamic relationships between fleet renewal and investment during a certain period of time by considering some main factors influencing the fleet development, such as loans, chartering-in vessels, chartering-out vessels and so on. But the form of this model is very complicated, and didn't consider the forecast of cargo flows in different lines, and the vessel collocation.

In China, some experts and scholars are trying their best to do some contribution for the research of fleet programming. At the end of 1980s, Professor Xie Xinlian set up a linear model for fleet programming. On the base of this model, some scholars turned the fleet programming into linear programming by using the operating model in a single line.

Linear programming is widely used in the fleet programming research, and is relatively

more mature, but there is a defect in linear programming models. The number of vessels that should add into the fleet every year is commonly not an integer. Although the number can be turned into an integer artificially, this will make us doubt whether the solution with integers is still optimal or not. And sometimes we can only get a partial optimal solution from the linear programming.

I decide to study the development of CS Tanker fleet based on the classic models, such as linear regression model to forecast the volume in short-term. The research fruits of fleet programming mentioned above are mostly about the fleet carrying large amounts of cargo, such as bulk carrier fleets and the tanker fleets, but these fruits don't totally fit the situation of China. We should aim at the current status of China's tanker companies, and set up the fleet programming models that are suitable for them by the combination of theory and practice.

Chapter 3

Market Analysis and Forecast of Crude Oil Market and Its Shipping Market

For a shipping company, the first thing should do is to study the demand situation from the market before the company starts to plan its short-term or long-term developing strategy and its fleet configuration. Every shipping company should start from the study of the market, and know the demand changes in this market and the potential demand, and then forecast the developing trends, only which can help the company work out a correct managing decision. For tanker shipping companies, the layout of the tanker fleets is the study of fleet scale and structure for a certain period of time in the future, so they should know clearly the trends of the market. They should first study the demand and supply of this market, and then analysis and forecast in order to fix on a reasonable and optimal structure and scale.

3.1 Current Status of World Tanker Fleet

Tanker fleet is the largest fleet of the world, which occupies about 39.5% (Clarkson) of the total tonnage of the world merchant fleet. By April, 2007, the number of tankers (crude and product tankers only) in the world had been 2776 with 324.6 million DWT, and the total number of tanker orders in 2007 is 217 with 22 million DWT. (Drewry Shipping Insight, May 2007)

3.1.1 Developing Trends of World Tanker Fleet

Table 3-1 World Tanker Fleet Capacity（By the end of 2007/5）

Tanker Size　（'000 DWT)	No.	Million DWT
10-50	825	28.2
50-80	386	25.6
80-120	718	73.1
120-200	355	53.6
200-320	486	141.7
320+	6	2.4
Total	2776	324.6

Source: Drewry Shipping Insight, May 2007

Table 3-2 Tanker Orderbook in 2007

Tanker Size　（'000 DWT)	No.	'000 DWT
10-50	69	2833
50-80	63	4154
80-120	43	4736
120-200	17	2741
200-320	23	6985
320+	2	640
Total	217	22089

(Crude and product tankers only)

Source: Drewry Shipping Insight, May 2007

a. Let's see the existing fleet scale and the ship building orders in Table 3-1 and Table 3-2, and we can find that the VLCC with more than 200,000 DWT is the main force in the fleet, which also shows that the developing trend of world tanker fleet.

b. The world tanker fleet will become younger and younger, and the old single-hull tanker will be totally out of commission. According to the regulations established by BIMCO, all the single-hull tankers with about 78 million DWT will be scrapped around 2010.

c. World tanker fleets will grow stably and continuously, and the prosperity of crude oil market in recent years will make this trend last until the end of 2007.

3.1.2 World Famous Tanker Companies

With the development of tanker market, the scale of the fleets owned by petroleum companies is getting smaller and smaller. According to the statistics of INTERTANKO, at the beginning of 2004, the independent ship-owners had about 82% of world tanker capacity while the fleet owned by petroleum companies had only 10%.

The world-class tanker companies are: Frontline, Teekay, OSG, GMC, Heidmar, TORM, Stelmar and so on. Frontline has 35 VLCC and 31 SUEZMAX with 1.681 million DWT in total; Teekay owns the world largest AFRAMAX fleet with 8.89 million DWT; OSG has 18 VLCC and 14 AFRAMAX with 7.32 million DWT in total.

The main characteristics of these companies are:

(1) Segmentation market and centralized target: mainly develop the main ship type of the fleet in order to have higher market share in the corresponding segment market;

(2) Tanker pool: take the advantage of scale economy, and use the tanker pool to reduce the risks;

(3) Agility management: these companies sign the contract of COA combining with time / voyage chartering, in order to ensure the stable profit and reduce the market

risks;

(4) Pay attention to the adjustment of fleet structure: the companies adjust the structure by replacing the old tankers or charter in new vessels;

(5) Pay attention to the construction and application of information system: to set up the close relationship with the brokers, ship-owners and charterers, and can get the latest information and market trends in order to strengthen the quick react ability.

3.2 Current Status of China's Ocean Tanker Fleet

In recent years, the import of China's crude oil is growing continuously at a very high speed. We can see that from the Table 3-3, in 2002 the VLCC is also the main force for China in the import transportation of crude oil and its proportion will increase. Table 3-4 is the demand forecast of China's VLCC tankers in the next few years.

Table 3-3 Transportation Volumes of Different Ship Types in 2002

Ship Type	Transportation Volume (ten thousand tons)	Proportion (%)
VLCC	3752	57.6
SUEZMAX	978	15.6
AFRAMAX	961	14.7
PANAMAX	738	11.3
MR SIZE	91	0.8
Total	6520	100

Source: Analysis of Chinese Carrying Capacity

Table 3-4 Demand Forecast of VLCC

Year	2005	2010	2020
Import of Crude Oil (hundred million tons)	0.9-1.0	1.1-1.3	2.0-2.2
Proportion of VLCC's Transport Volume	60%	65%	70%
Transport Volume of VLCC (hundred million tons)	0.6	0.78	0.97
Number of VLCC Required	30	39	58.5

Source: Analysis of Chinese Carrying Capacity

3.2.1 China's Tanker Companies

HONG KONG MING WAH Shipping Co., LTD

Founded in 1980, HONG KONG MING WAH Shipping Co., LTD is wholly owned by China Merchants Group. It presently runs and operates a large commercial fleet made up of oil tankers and bulk carriers, of which the carrying capacity amounts to 3.2 million DWT and the VLCC fleet is among the largest of its kind in the Far East. Ming Wah has an oil tanker fleet consisting of 6 VLCC, 1 SUEZMAX, and 7 AFRAMAX under the management and operation by Associated Maritime Company (Hong Kong) Limited ("AMCL").

CS Tanker Company

Affiliated to China Shipping (Group) Company, China Shipping Development Co., Ltd. Tanker Company (abbrev. China Shipping Tanker or CS Tanker) is a joint-stock company listed on both Hong Kong and Shanghai Stock Exchanges. As the largest oil transportation carrier in China, CS Tanker specializes in the domestic and international

transportation of crude oil and product oil with total assets of about RMB 7.8 billion and an annual transport volume more than 60 million tons. VLCC, Aframax, Panamax, and Handy-size, as the company's key tanker types, comprise a modern fleet with an average service year of thirteen.

COSCO Dalian

COSCO Dalian is a large scale State-owned shipping company affiliated to China Ocean Shipping (Group) Company. COSCO Dalian stresses the development of specialized fleet for liquid bulk cargo transportation and attaches importance to the tanker fleet in accordance with the policies of COSCO and the State. The company currently owns and operates 29 tankers, liquefied gas carriers and chemical tanker, with over 2 million total deadweight tons.

CSC Nanjing Tanker Corporation

CSC Nanjing Tanker Corporation, a subsidiary under "China Chang Jiang National Shipping (Group) Corporation" of more than one hundred years history, is a shipping enterprise specialized in the shipping of oil and oil products.

Table 3-5 Tanker Fleets of Chinese Tanker Companies   Ten Thousand Tons

	VLCC	SUEZMAX	AFRAMAX	PANAMAX
HONG KONG MING WAH	6	1	7	--
CS Tanker	3	--	6	16
COSCO Dalian	3	5	--	7
CSC Nanjing Tanker	1		2	9

Source: http://www.hkmw.com.hk/webappen/index.asp#
http://www.cnshipping.com/youlun/default.asp
http://www.coscodl.com/english/index.jsp
http://www.njtc.com.cn/njyy/col256/index.htm1?id=256

3.2.2 The Characteristics of Chinese Tanker Fleets

1. Targeting Domestic Market

At present, China crude oil transportation have covered many routes all over the world, from Cuba in North America to Venezuela in South America, from Iraq, Iran, Saudi Arabia in Middle East to Sudan in Africa, and from Singapore to Indonesia in Southeast Asia. Although there are many other oil companies operating on these lines, China's tanker companies mainly work for the domestic oil companies, and have little businesses with foreign clients.

2. China's Tanker Companies are owned by the Country

China Shipping Tanker, COSCO Tanker, CMG Tanker and CSC Tanker are all SOEs (State Owned Enterprises). In some condition especially for emergency, SOE tanker companies can disregard the cost in order to ensure the energy resource supply for the country, so the SOEs should complete the tasks given by the government to maintain the national energy security strategy. On the other hand, such sacrifice of SOE tanker companies can be compensated by the government in some way, such as allowance in shipbuilding, priority in taxation and policies, and so on.

3. The development of tanker industry is restrained by national energy security strategy.

Looking back into the history, we can find that the development of China's tanker industry is always enslaved by national petroleum security strategy. As mentioned above, most import crude oil is transported by foreign fleet companies, so once there are wars, diplomatism conflicts or other irresistible conditions, China will be in the danger of oil shortage and stoppage.

The transportation of import crude oil is not only the business of the companies, but also the business of national petroleum security. So in order to insure China's petroleum strategic security, it is imperative under the situation for Chinese big tanker companies to build large crude oil tanker fleets.

4. China's tanker industry cannot get rid of the control of Chinese planned economy system.

China is establishing and improving its market economy system, but influenced by the long-term planned economy system, the governmental direct intervention to some key industries is very frequent. This also affects the development of tanker companies and its competition in the global market.

3.2.3 The existing problems of China's Tanker Fleet

China has already had many tanker companies, and also has the certain transport capacity. However, compared with world tanker companies and tanker fleets, China's ocean tanker fleets have some main problems as follows:

a. The defect in the fleet structure: compared with liner shipping and bulk shipping, the scale of tanker fleets is relatively small with too many single-hull tankers in small size and old age, which made China's tanker companies lie in the bad situation when competing with other countries in the global market.

b. Small quantity of import crude oil is transported by China's tanker fleet. There are two main reasons for this situation. One is that China's tanker fleet developed late than other countries. The other reason is caused by the cooperation between oil companies and tanker companies. They don't have a long-term strategic fellowship.

c. Too much capacity is put in the wrong place. For example, when the 90% of China's crude oil was transported by foreign tanker fleets, some China tanker fleet devote itself into the international market.

d. The operational system is not very perfect, and the managerial level needs to be improved. In other words, the operational experiences are relatively insufficient. Compared China's tanker companies, especially some companies in mainland of China with those world famous companies, there are many advanced managerial concepts and corporation system for us to learn.

However, all these problems existed in China's tanker companies have been corrected or improved in recent years. Some companies purchased new or second-hand tankers to enlarge the scale of ocean tanker fleets, and they also actively sign strategic agreements with Chinese petroleum and oil companies in the process of fulfilling the target of national petroleum security strategy. Inside the companies, they try to adjust the operation system to improve the fleet efficiency and strengthen their competition power. All these measures show that Chinese government and its corporations have attached great importance to the industry of crude oil transportation industry. On the other hand, it also shows the great profits and its unlimited potential market in China.

3.3 The Analysis and Forecast of China's Crude Oil Shipping Market

As is mentioned in Chapter 1, in 1993, China became an oil net import country instead

of an oil net export country. The import volume of crude oil continues to increase every year, so the burden for China's tanker companies will be even heavier.

Then, to forecast the future trends of China's crude oil import market can help the shipping companies make a better plan in order to respond to the changes and fluctuations of the market. For the tanker companies, when they are programming their tanker fleets, the first thing they should do is to have a clear and correct understanding of the current market. They should study the changes between demand and supply, know about the potential demand in the market, and forecast the developing trend in the future. So the tanker companies should make a forecast for the import crude oil market first, then they can decide the scale of their tanker fleets according to the market development in the next few years.

3.3.1 Forecast of China's Crude Oil Import

The import quantity of crude oil is influenced by many factors, such as the political situation, policies, currency, domestic economy and so on. I find that when GDP (Gross Domestic Product) increases, the import of crude oil will also increase. So I assume that there is some relationship between GDP and the import of crude oil. Next, to prove my assumption. I raised a mathematics model to forecast the future trends of China's crude oil import.

From Table 3-6, except the decrease of crude oil import quantity in two years, the import quantity of crude oil was always increasing while GDP increased (Gross Domestic Product), so there should be some relationship between them. A mathematics model is settled hereafter based on such relationship in order to forecast the future trends of China's crude oil import.

Table 3-6 China's GDP and Crude Oil Import Volume

Year	GDP		Crude Oil Import	
	Annual (A hundred million RMB)	Increase Rate (%)	Total (Ten Thousand Tons)	Increase Rate (%)
1993	34634.4	13.5	920	----
1994	46759.4	12.6	1230	33.7
1995	58478.1	10.5	1710	39.0
1996	67884.6	9.6	2260	32.2
1997	74462.6	8.8	3550	57.1
1998	78345.2	7.8	2732	-23.1
1999	82067.5	7.1	3661	34.1
2000	89468.1	8.0	7026	92.1
2001	97314.8	7.5	6025	-16.6
2002	105172.3	8.3	6941	15.1
2003	117251.9	9.4	9112	31.3
2004	136515.0	9.5	12272	34.6
2005	182321.0	9.8	13600	40.7
2006	209407.0	8.7	n/a	n/a

Source：www.infobank.com

In the forecast models of energy demand, the elasticity coefficient model is widely used as follows:

$$E = kG^e \quad \text{or} \quad \ln E = \ln k + e \ln G$$

E — Indigenous Variable, the demand of energy resources;

G — External Variable, Macroeconomic Index such as GDP or GNP

If $\ln E = y, \ln G = x, \ln k = a$, the model will be changed into:

$$y = a + ex$$

Then, we can use the linear regression forecast model, and calculate the corresponding data of (x_t, y_t), and put the data into the following formula:

$$\hat{e} = \frac{n \sum_{i=1}^{n} x_t y_t - \sum_{i=1}^{n} x_t \sum_{i=1}^{n} y_t}{n \sum_{i=1}^{n} x_t^2 - \left(\sum_{i=1}^{n} x_t \right)^2}$$

$$\hat{a} = \frac{1}{n} \sum_{i=1}^{n} y_t - \hat{e} \cdot \frac{1}{n} \sum_{i=1}^{n} x_t$$

The last step is to check this regression formula. The simplest way is to calculate the correlative coefficient r :

$$r = \frac{\sum\limits_{i=1}^{n} x_t y_t - \dfrac{1}{n} \sum\limits_{i=1}^{n} x_t \sum\limits_{i=1}^{n} y_t}{\sqrt{\sum\limits_{i=1}^{n} x_t^2 - \dfrac{1}{n}\left(\sum\limits_{i=1}^{n} x_t\right)^2} \cdot \sqrt{\sum\limits_{i=1}^{n} y_t^2 - \dfrac{1}{n}\left(\sum\limits_{i=1}^{n} y_t\right)^2}}$$

If $|r|$ is close to 1, it shows that there is linear relationship between x and y.

According to the history data by using the formula based on linear regression theory, and with the help the spreadsheet of EXCEL, we can easily get the import volume of crude oil in the next few years, and the forecast is showed in Table 3-7.

The final detailed forecast model is:

$$y = 0.5595 \cdot x^{2.0111}$$

And $|r| \approx 0.9810$, which shows that there are strong relationship between them, so this model can be used.

Table 3-7 shows the short-term developing trends of China's crude oil import from 2007 to 2010.

Table 3-7 Forecast of Crude Oil Import   Ten Thousand Tons

Year	2007	2008	2009	2010
Import Volume	14228.33	15096.26	16077.52	17112.56

(The increase rate of GDP is supposed to be about 8 %.)

Preconditions and hypothesis:

(1) According the forecast of some organizations and experts, the annual increase rate of China's GDP will be 7.9% ~ 8.3% in the next few years. In this paper, I take 8.0% as the increase rate of GDP since 2007;

(2) In order to improve the reliability of this linear model, the writer eliminated the extraordinary data so as to keep the accuracy of the forecast;

(3) Although the correlative coefficient $|r| = 0.9810$ shows the close relationship between GDP and import volume, there are other factors which may influence the crude oil import volume, so the forecast results in this model are a little conservative;

(4) Because of the limitation of the method and the data used in the forecast, the forecast figures cannot totally match with the actual figure in the future. However, this model shows the general trend of China's crude oil import volume in the next few years, which is the key parameter in the decision making of tanker fleet scale.

3.3.2 Trade-Off Analysis

Great Gap between Demand & Supply

As the transport tool of crude oil import trade, the scale of China's tanker fleet and its capacity cannot meet the demands of national crude oil trade. Let's take the crude oil import as the example. Since 1992, the import volume has been over 12 million tons and 35 million tons at most. In 2002, the volume even reached more than 70 million tons. After joining WTO, China should import at least 45 million tons of product oil according to the WTO agreements. And at the same time, the transport volume of crude

oil along the Chinese coast should be kept between 35 million and 45 million tons. However, the tanker fleets owned by COSCO, China Shipping and CSC have totally about 4 million tons DWT, which have only met 10%-20% transportation demand in China. From the opposite aspect, such a huge gap between demand and supply also brings a god-given opportunity for the development of China's tanker fleets.

Very Important For National Oil Security

Ocean crude oil transportation not only plays an important role in the development of world and national economy, but also has great influence on the political and military affairs for an independent country. In the new century, Chinese government should solve the energy resources problems carefully as a whole, and firmly carries out the petroleum security strategy. In November 2002, the State Department decided to establish the national strategic oil reserves. The benefits of establishing national strategic oil reserves are: (1) guarantee the national security; (2) guarantee the oil demand caused by the stead economic growth; (3) avoid the risks caused by the prices fluctuation, buy in when the price is low, buy less or stop buying when the price is high, and even use the strategic reserves when the price is too high; (4) reduce the influences caused by the block of transportation channel (during the war).

According to the precedent of USA and Japan, crude oil is the main strategic reserves and the oil products are the supplementary reserves. The proportion of crude oil and oil products is 9:1. The European strategic oil reserves can last for 90 days, and that of China is demanded to last for at least 60 days. In 2010, the Chinese strategic oil reserves are expected to be lasted for 60 days, so the strategic oil reserves will increase the crude oil import at some extent in recent years.

China Has the Power to Develop National Tanker Fleet

Since 1970s, China has already had a certain scale of crude oil ocean transportation, which has several SOEs (State Owned Enterprises) such as COSCO, China Shipping and so on. On the other hand, with the development of China's economic power and its sufficient foreign exchange reserve, China has good circumstances and conditions to enlarge its crude oil tanker fleet.

All in all, China's crude oil import by sea, the national strategic oil reserves and the transport capability of crude oil import, these three main factors give the crude oil import market great developing space. However, this doesn't mean to blindly build or purchase large-size tankers, because the fast growing carrier capacity will cause the vicious competition in the market, the tanker freight index will go down, and finally cause the low benefit of the corporations. So it is of great importance for Chinese tanker companies to consider how to take the advantages of such good chance to develop their own fleets.

Chapter4

China Shipping Tanker Company and Its Tanker Fleet

4.1 Introduction of China Shipping Tanker Company

Affiliated to China Shipping (Group) Company, China Shipping Development Co., Ltd. Tanker Company (abbrev. China Shipping Tanker or CS Tanker) is a joint-stock company listed on both Hong Kong and Shanghai Stock Exchanges. As the largest oil transportation carrier in China, CS Tanker specializes in the domestic and international transportation of crude oil and product oil with total assets of about RMB 7.8 billion and an annual transport volume more than 60 million tons. CS Tanker, with its headquarters in Shanghai and a subsidiary in Guangzhou, has owned and operated more than 78 oil tankers with a total carrying capacity of about 3.78 million DWT. As the company's key tanker types, VLCC, AFRAMAX, PANAMAX, and Handy-size, comprise a modern fleet with an average service year of thirteen. (See Table 4-1)

Table 4-1 Current Situation of CS Tanker Fleet

	Number	Average DWT	Average Service Year
VLCC	3	292,083	3.25
AFRAMAX	6	105,732	8.71
PANAMAX	16	66,861	13.95
HANDYSIZE（MR）	34	9,933	19.26

Source: http://www.cnshipping.com/youlun/ship_1.asp

CS Tanker has expanded its customer size following the strong development of its fleets. At present, CS Tanker has more than 220 customers, including 80 domestic customers

and 130 foreign customers, such as SINOPEC, SINOCHEM CORPORATION, Morgan Stanley, Exxon Mobile, BP, Shell and so on.

Company Performance

According with the rapid growth of the domestic economy and the requirement of national strategic oil reserves system, CS Tanker is devoted to building up a world-class oil tanker fleet with the aim of becoming a truly global oil carrier. The company has made remarkable achievements with its expansion program. In 2005, the company carried 62.3 million tons of oil with a turnover exceeding 84.16 billion ton nautical miles, an increase of 6.3% and 53.6% respectively as compared with the same period of 2004. The revenue arising from oil transportation was RMB 5 billion, an increase of 28.6% as compared with the same period of 2004.

Tanker Fleet Developing Plan

By 2010, CS Tanker will have built up a world-class oil fleet of over 110 vessels with a total carrying capacity of 7.5 – 8.5 DWT, which combines foreign and domestic trade, has a sound fleet structure, and features advanced ship technology. CS Tanker will further optimize its fleet structure and reduce its average service year in the process of becoming a large-size, modern and professional shipping company. The company endeavors to maintain the leading position in domestic coastal shipping market and to reach advanced levels in all aspects by 2010.

Market Prospect

1. To consolidate the development of coastal transportation with controlling over 60% of domestic-trade oil market in China.

2. To expand ocean transportation with taking approximately 20%share in imported oil shipping market.

3. To explore the third country shipping market by increasing its proportion of total fleet carrying capacities from 16% currently to 30%- 40% eventually.

4. To promote the strategic cooperation with oil-related enterprises and customers, and to ensure the steady resources supply.

5. To increase annual oil transport volumes to 100 million tons by 2010

Development Strategy

To shift market focus from coastal transportation to ocean-going transportation

To adjust fleet structure from a small-to-medium scale into a medium-to-large scale

4.2 Analysis of Current Configuration of CS Tanker Fleet

Table 4-2 Current Configuration of CS Tanker Fleet

		0～5	6～10	11～15	16～20	21～25	25～	Total	%
VLCC	Number	3	0	0	0	0	0	3	5.08%
	DWT	876248	0	0	0	0	0	876248	30.03%
AFRAMAX	Number	4	0	0	1	1	0	6	10.17%
	DWT	433834	0	0	110296	90261		634391	21.74%
PANAMAX	Number	4	0	6	4	0	2	16	27.12%
	DWT	301984	0	388641	268530		110620	1069775	36.66%
HANDYSIZE	Number	0	2	10	8	7	7	34	57.63%

	DWT	0	9980	108257	42308	34119	143062	337726	11.57%
Total	Number	11	2	16	13	8	9	59	100.00%
	DWT	1612066	9980	496898	421134	124380	253682	2918140	100.00%
%	Number	18.64%	3.39%	27.12%	22.03%	13.56%	15.25%	100.00%	---
	DWT	55.24%	0.34%	17.03%	14.43%	4.26%	8.69%	100.00%	---

Source: http://www.cnshipping.com/youlun/default.asp

By the end of December, 2006, CS Tanker has owned and operated more than 78 oil tankers with a total carrying capacity of about 3.78 million DWT. In the existing tanker fleet, all the vessels are owned by CS Tanker itself.

In Table 4-1 & 4-2, as for the DWT, we can see that the VLCC only occupy the 5% in number of the fleet, but they covers 30% of the total carrying capacity, whereas the handy-size tankers only cover 11.57% of total carrying capacity. As for the average service year, the VLCC and the AFRAMAX are relatively much younger than PANAMAX and HANDYSIZE.

In the official announcements, CS Tanker is trying to sign the building contracts which contain 14 tankers with 1.08 million DWT in 2007. On the other hand, CS Tanker is busy with the disposition of old vessels. It plans to scrap 4 tankers with 131,000 DWT which are going to out of service. 5 small-size product oil tankers are on sale, and the other 9 tankers are waiting for disposition on appropriate time.

According to the statistics of April, 2007 (Table 4-3), disregarding the second-hand vessels and time-chartering vessels, CS Tanker will have 17 new tankers by the end of 2010, and the expected increasing carrying capacity will achieve 3.10 million DWT. Among these newly-built tankers, 9 of them are VLCCs, which means the VLCC fleet of

CS Tanker will have 12 vessels till 2010.

Table 4-3 CS Tanker under Construction   DWT: Ten Thousand Ton

Name	Contract Date	Date Keel Laid	Date Launched	Date Delivered	DWT
#1	2004.12.30	2006.03	2007.01	2007.05	5.2
#2	2004.12.30	2006.07	2007.05	2007.08	5.2
#3	2004.12.30	2006.11	2007.08	2007.11	5.2
#4	2004.12.30	2007.02	2007.11	2008.02	5.2
#5VLCC	2004.12.15	2004.12	---	2007.11	30
#6VLCC	2006.03.31	2007.12	2008.11	2009.06	29.8
#7VLCC	2006.03.31	2008.05	2009.04	2009.09	29.8
#8VLCC	2006.03.31	2008.06	2009.04	2009.11	29.8
#9VLCC	2006.03.31	2008.09	2009.07	2009.12	29.8
#10	2006.03.31	2006.07	2007.04	2007.10	4.2
#11	2006.03.31	2008.01	2008.08	2008.12	4.2
#12	2006.03.31	2008.04	2009.03	2009.08	4.2
#13	2006.03.31	2008.07	2009.06	2009.11	4.2
#14VLCC	2008.10.28	---	---	2009～2010	30.8
#15VLCC	2008.10.28	---	---	2009～2010	30.8
#16VLCC	2008.10.28	---	---	2009～2010	30.8
#17VLCC	2008.10.28	---	---	2009～2010	30.8

4.3 The Gap between CS Tanker and World-class Tanker Companies

To carry out a suitable and correct market strategy is not enough for CS Tanker to build a world-class oil fleet. It should make some adjustments to the existing tanker fleet, because the fleet is the basic resource and platform for the company to implement its strategy goals. But how could CS Tanker adjusts its oil fleet? First, we should compare with those world-famous tanker companies, and find out the gap between them. The second step is to confirm the developing direction for the fleet. We should decide the developing target based on the market strategy. The third stage is to use all the strategies to implement the adjustment plan.

4.3.1 Comparison of the Scale of Tanker Fleet

According to the statistics of INTERTANKO 2003, Frontline is the No. 1 in the scale of tanker fleets of 29 VLCCs, 30 SUEZMAXs with 13.24 million DWT. The No. 2 and No. 3 belong to Teekay and MOL, with 11.35 million DWT and 10.72 DWT. However, CS Tanker only has 3.78 million DWT.

If we compare the tanker type, it is clear that the tanker scale of CS Tanker is relatively smaller than that of world-class tanker fleets. Including the VLCCs built, the average vessel tonnage is about 49,500 DWT. However, the average tonnages of Frontline, Teekay, MOL may have reached 224,400 DWT, 112,400 DWT and 188,100 DWT, which shows that the main force of world-class tanker fleets is VLCC/ULCC, SUEZMAX, and their target market is focused on the global market of long lines.

Therefore, it is essential for CS Tanker to enlarge its tanker scale and optimize the fleet configuration.

4.3.2 Comparison of Technical Status

The average service year of world famous tanker fleet is very short, and the technologies equipped on the tankers are very advanced, and the level of modernization is very high. As is shown in the Table 4-4, the average service year of world tanker fleets doesn't exceed 10 years, while the average service year of CS Tanker fleet is about 16 years. It shows that the fleet of CS Tanker is relatively old and its equipment condition is not very good. Compared with other world-class tanker fleets, we can find that VLCCs of CS Tanker are relatively young, while the tankers with less than 60,000 DWT are too outdated. In the next 10 years, PANAMAX and Handy-size tankers of CS Tanker need to be replaced.

Table 4-4 Average Service Year of Existing World Tanker Fleets

	VLCC	SUEZMAX	AFRAMAX	PANAMAX	≤60,000 DWT	Total
Frontline	40	21	---	---	---	9.6
MOL Tanker	6	11	10	12	6	6.9
BW Tanker	21	---	---	3	---	8.2
Teekay	1	13	44	25	---	6.6
Maersk Tanker	5	---	14	1	39	5.2
CS Tanker	3.2	---	8.7	14	20	16

Source:
http://www.frontline.bm/fleetlist/index.php
http://www.mol.co.jp/tanker.shtml
http://www.bergesenworldwide.com
http://www.teekay.com/?page=fleet_list
http://www.maersktankers.com/main.asp?id=4

4.3.3 Comparison of Developing Strategy

Combining the manufacturing management with capital management is the most popular method of operating for the world-class tanker carriers. Especially for the scale enlargement, they usually achieve frog-leaping development by merger and acquisition. For example, Frontline not only builds and purchases vessels to increase its carrying capacity, but also annexes other companies. In1997, Frontline also purchased the Sweden company ICB which owned 4 VLCCs. In 2000, Frontline acquired Golden Ocean which owned 13 VLCCs and 10 bulk carriers.

Based on their own tanker fleets, the world-famous tanker carriers have their controlling tankers (chartered tankers) at a certain proportion. Like Teekay, the proportion of its own vessels and the vessels it chartered is about 58% to 42% in 2004. Such combining modes

of fleet development can increase the flexibility to coping with the changing market conditions, and also can reduce the investment risks and financing pressure efficiently.

4.4 Fleet Adjustments Strategy

4.4.1 The Direction of Fleet Adjustments

By 2010, the company's total carrying capacity will reach to 7.5-8.5 million DWT. CS Tanker is dedicated to the commitments to be an international, large-sized, and professional shipping company. As is mentioned in Chapter 2, the domestic oil import market is very prosperous. And the most urgent task for CS Tanker is to enlarge its carrying capacity and scale, when meeting the precondition of ensuring the cargo resources.

At present, the main force of international oil transportation belongs to VLCC and ULCC, and SUEZMAX and PANAMAX are usually used on some short lines. Nowadays, 90% of China's oil import volume is carried by foreign carriers. One disadvantage of CS Tanker is the lack of VLCC and SUEZMAX, so the company cannot compete with the world-class companies in the international market. Therefore, CS Tanker should develop its VLCC, AFRAMAX fleets to cope with the changes of international market. The other disadvantage of CS Tanker in the fleet structure is the problem of vessel aging, which should be improved in order to realize its fleet developing plan.

4.4.2 Analysis of Fleet Adjustments Strategy

As is mentioned above, the popular developing mode of tanker fleet is the combination of own vessel and controlling vessel, which is widely used in world-class tanker companies. The advantages of such mode are flexibility and low-risks. So I think CS

Tanker can learn something from this kind way of fleet management, i.e., the fleet can be developed by building, purchasing and chartering. Keeping the chartered vessels at an appropriate proportion can increase the elasticity of the whole fleet which is more flexible to the market changes and helpful to reduce the investment risks and financing stress.

Risks and opportunity coexist in this prosperous market. Many tanker companies are all trying to enlarge its tanker fleets, so the world tanker carrying capacity is increasing rapidly these years. According to the statistics of Clarkson, the total DWT of new vessel orders reached 108 million which includes 49 million DWT of tankers and covers 46% of total world fleet DWT. Although the evidence of surplus carrying capacity does not show up now, it is believed that competition of the future oil transportation market will become much fiercer. It is very risky for CS Tanker to invest large amount of money to build new ships blindly.

So CS Tanker should increase the controlling vessels when enlarging its fleet scale. There are many ways for the company to develop its fleet, such as time chartering, bareboat chartering, financial leasing, joint venture, pooling, merger and acquisition of other companies, and so on.

As for the problem of vessel aging, CS Tanker can not only add new vessels to reduce the average service year, but also disposition the old and outdated vessels. The company can consider selling those product oil tankers with small DWT because of its low performance and negative profits. According to the international regulations, all the single-deck tankers should be out of service at the end of 2015. CS Tanker can sell those old, single-deck tankers at relatively higher prices when the vessel market is good.

Chapter 5

The Study and Analysis of Programming Model in the Fleet Layout

5.1 Linear Programming Model of the Tanker Fleet

In Figure. 5-1, the transport net has K_1 loading ports and K_2 discharging ports. Every loading port has more than one line connecting with the discharging ports, which means the vessels are operating on these routes. The vessel loads the cargo at the loading port and voyages to the discharging port. After discharging all the cargo, it returns to the loading port and gets ready for reloading. Such cycle is usually called one voyage, and the time spent in one voyage is called the voyage time.
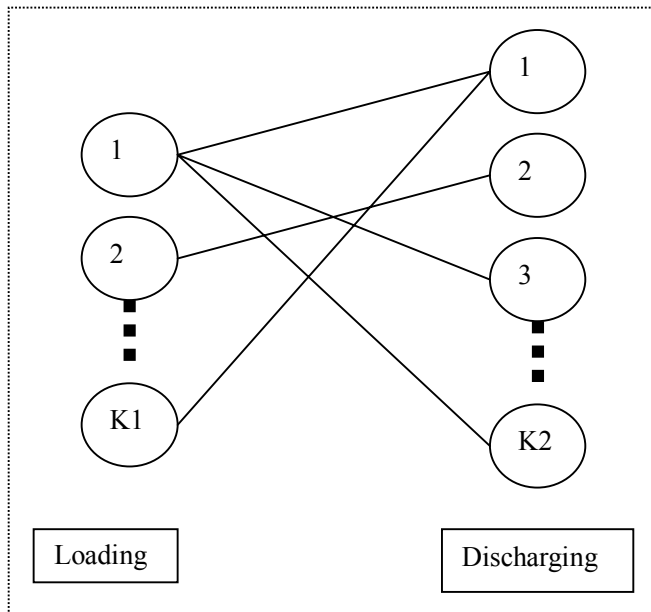
Figure 5-1 Net of loading and discharging ports

Hypotheses:

1. There are G lines in this transport net which is going to be studied;

2. There are K vessel types to choose which is going to be used on these G lines;

3. The research period is N years, and one year is the time unit of fund balancing;

4. The payout of vessel purchasing and operation cost is happened at the beginning of every year;

5. The new-added carrying capacity is put into service at the beginning of every year;

6. Considering the factors such as capital interest, time value, brokerage and so on, the vessel purchasing price is 3% higher than building cost;

7. The transport volume should be completed on every line every year.

The model is required the following capabilities of decision-making:

- to allocate the vessels according to the lines

- to purchase the new vessels

- to leave some vessels unused

- to limit some type vessels not to be purchased

- to scrap the old vessels as the schedule

In order to get the solution more easily, we should first confirm the average annual voyage time of every type of vessel which operates on every route. And then, we can calculate the corresponding annual operating cost and carrying volume based on the voyage time. In other words, the annual operating cost and carrying volume of the fleet have the linear relationship with the vessel number. In such conditions, I will introduce the following continuum variable linear programming model.

5.2 Objective Function:

$$\min Z = \sum_{t=0}^{N-1} (1+i_0)^{-t} \left\{ \sum_{j=1}^{K} \left[\sum_{h=1}^{G} X_{jht} \cdot R_{jht} + 1.03 \cdot S_{jt} \cdot \sum_{h=1}^{G} \left(X_{jht} - X_{jht-1} \right) \right] \right\}$$

Constraint Terms:

Group 1: Constraint of Transport Volume

$$\sum_{j=1}^{K} X_{jht} \cdot V_{jht} \geq W_{ht} \qquad h=1, 2, ..., G; t=0, 1, ..., N-1$$

Group 2: Constraint of Fleet Continuity Development

$$\sum_{h=1}^{G} \left(X_{jht} - X_{jht-1} \right) + WT_{jt} \geq 0 \quad j=1, 2, ..., K; t=0, 1, ..., N-1$$

The meanings of the notations in the model:

Z — Objective function, which means the total discount payout expenses relating with all the decision variables in the certain period;

j — Vessel type (VLCC, AFRAMAX, PANAMAX, HANDYSIZE)

h — Voyage route

t — Year (from 2007 to 2010)

X_{jht} — Decision variable, which means the number of j-type vessel used on the h line in t year;

R_{jht} — Means the annual operation cost of each j-type vessel used on the h line in t year;

S_{jt} — Means the building cost or the selling price of each j-type vessel launched into service at the beginning of t year;

V_{jht} — Means the annual carrying volume of each j-type vessel used on the h line in t year;

W_{ht} — Means the forecasted carrying volume on the h line in t year;

WT_{jt} — Means the number of j-type vessel scrapped in t year;

i_0 — Discount rate

In this model, there are $K \times G \times N$ variables, and $(G+K) \times N$ constraints. After the calculation, we can get the optimal solution for the vessel configuration on every line every year. At the same time, we can also get the vessel number of each type that need

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to be added at the beginning of every year from the second group of the constraint term. So we can work out the optimal developing layout for the whole fleet in the certain period of time.

5.3 Supposition and Calculation of Parameters

5.3.1. Time Period of Layout

The layout period is from 2007 to 2010.

5.3.2. Vessel Type and Vessel Number

VLCC, AFRAMAX, PANAMAX and HANDY-SIZE are the key tanker types of CS Tanker. The deadweight of each type will be 300,000 DWT, 100,000 DWT, 50,000 - 70,000 DWT and 30,000 - 40,000 DWT.

5.3.3. Voyage Routing

In order to make the model easier, the voyage lines of CS Tanker will be simplified into four main lines: Middle East – China, Red Sea – China, Western Africa – China, South America – China, and East Southern Asia – China.

According to the statistics of past years, the import crude oil of China is mainly from the Middle East (Persian Gulf, Red Sea and the east of Mediterranean), Western Africa, East-Southern Asia, and South America. In recent years, the export of crude oil in East-Southern Asia region is decreasing, so the import oil of China is shifting to the Meddle East area. At present, the four main region occupies the 97% of Chinese import crude oil: the Middle East region – 47.2%; Western Africa: 30.3%; East-Southern Asia: 7.6%; South America and other areas: 14.9%.

The voyage line from Middle East to China should pass through the Malacca Strait, the voyage distance is about 6,000 nautical miles, and the facilities of loading ports are very good for large size of tankers such as ULCC, VLCC and SUEZMAX. The voyage line from Western Africa to China belongs to long-distance line, which is more than 10,000 nautical miles. In additional, the port facilities are relatively outdated which restrict the entrance of large-size tankers (VLCC). The voyage distance from East-Southern Asia (Indonesia) is about 2,000 nautical miles, which belongs to short-distance line, and also limit the operation of large-size tankers (VLCC, SUEZMAX).

Table 5-1 Forecast Volume of Four Routes

	Middle East –China	Red Sea –China	Western Africa –China	Southern Asia – China
2007	8296900	3975500	5050600	2153100
2008	9105500	4325200	5587200	2282100
2009	9782600	4518600	6043200	2426800
2010	10547400	4816200	6553000	2561000

5.3.4. Annual Carrying Volume

In the layout period, the annual carrying volume is calculated on the basis of forecast volume for every year. And the carrying volume will increase at a certain percent every year.

The annual carrying volume for each vessel sailing on each line is determined by the voyages completed in a year. In every voyage from China to the loading port, the vessel is empty loaded. On the backhaul, the vessel is fully loaded.

Table 5-2 Annual Carrying Volume Forecast   Tons

	Middle East –China	Red Sea –China	Western Africa –China	Southern Asia – China
VLCC	2170000	2030000	1820000	---
AFRAMAX	800000	750000	630000	1230000
PANAMAX	550000	493000	450000	850000
HANDYSIZE	---	380000	---	450000

5.3.5. Ship-building Cost

The building cost of new vessel always changes with the relationship between demand and supply. In order to objectively reflect the average price of new-building vessels, this paper will take the records of building prices from 2000 to 2006, and forecast the average building prices in the next few years. The forecast has also considered some uncertain factors, such as the fluctuation of freight rate, steel prices, oil supply and demand, and so on. So the building prices of tankers in the next few years will be assumed as follows:

Table 5-3 Forecast Prices for Each Type of Tanker   Million RMB

	2007	2008	2009	2010
VLCC	630.1	649.3	614.8	616.1
AFRAMAX	334.5	357.1	341.9	351.9
PANAMAX	294.8	315.6	307.5	318.7
HANDYSIZE	253.0	260.6	244.9	254.8

5.3.6. The annual operation cost

Operation cost is the total amount of capital cost (depreciation and loan interest), voyage cost (variable cost) and management cost (the cost exclude capital cost and voyage cost).

In this paper, the operation cost of the tankers includes the capital cost, the voyage cost and the management cost. The capital cost includes the depreciation cost and the loan interest; the voyage cost includes the bunker cost and the port fee; the management cost includes the salary of seafarers, surcharges, repair cost, maintenance cost, insurance and so on. It also presumed that the operation cost does not change during the layout period.

Table 5-4 Annual Operation Cost of Each Type of Tanker   Million RMB

	Middle East –China	Red Sea –China	Western Africa –China	Southern Asia – China
VLCC	73.1	75.2	78.4	---
AFRAMAX	46.7	48.9	61.5	42.0
PANAMAX	35.7	37.9	51.0	31.0
HANDYSIZE	---	26.0	---	22.0

5.4 Layout Result

1. There are 4 lines in this transport net which is going to be studied;

2. There are 4 vessel types to choose which is going to be used on these 4 lines;

3. The research period is 4 years, and one year is the time unit of fund balancing;

So, in this model, there are 64 variables, and 32 constraints. After the calculation, we can get the optimal solution for the vessel configuration on every line every year. At the

same time, we can also get the vessel number of each type that need to be added at the beginning of every year from the second group of the constraint term. So we can work out the optimal developing layout for the whole fleet from 2007 to 2010.

Table 5-5 Layout Results of CS Tanker from 2007 to 2010

Year		Middle East –China	Red Sea –China	Western Africa –China	Southern Asia – China	Scrapped Vessels
2007	VLCC	0	1	3	0	0
	AFRAMAX	6	0	0	0	0
	PANAMAX	6	0	0	10	0
	HANDYSIZE	0	4	0	28	3
2008	VLCC	0	1	3	0	0
	AFRAMAX	6	0	0	0	0
	PANAMAX	8	0	0	10	2
	HANDYSIZE	0	6	0	28	2
2009	VLCC	2	2	3	0	0
	AFRAMAX	6	0	0	0	0
	PANAMAX	0	0	0	21	3
	HANDYSIZE	0	0	0	38	4
2010	VLCC	6	2	4	0	0
	AFRAMAX	0	0	0	6	0
	PANAMAX	0	0	0	22	1
	HANDYSIZE	0	0	0	41	3

From the layout result in Table 5-4, we will find that the large-size tankers like VLCC and AFRAMAX are operating on the long-distance routes, and small-size tankers like PANAMAX and HANDYSIZE are working for the short-distance transportation. Many old, single-hull tankers will be scrapped or sold, and new tankers will be constructed and put into service. This will make the total average service year reach about 10.6 years. On other hand, the average carrying capacity of single tanker will be get higher which will increase the competitive power and profitability.

In the next three years, CS Tanker will have at least 9 VLCCs to enlarge its ocean tanker fleet. Then, here comes a new problem. When the scale and carrying capacity of CS tanker fleet is enlarged, will the cargo resources be still sufficient and stable? According to the layout result, in 2010, the total carrying capacities of 12 VLCCs will much more than the transport demands of import crude oil from Middle East, Red Sea area and Western Africa area. So the canvassion tasks will be under great pressure. For CS Tanker, in spite of completing the missions of national oil security strategy, it should join in the world tanker market in order to increase the operating days of large-size tankers, because the idle time for VLCC will be a great loss for the tanker company.

Chapter 6

Develop the Tanker Fleet of CS Tanker Based on National Condition

6.1 Disadvantages that Affect the Fleet Development

We should not just notice the advantages that will drive Chinese tanker fleets to develop. Sometimes the study of disadvantages is more important for the layout of tanker fleet.

In the previous chapters, we have got the conclusion that although the supply in the world tanker market is more than the demand, there is still wide developing space for Chinese tanker industry. China's import oil, national oil strategic reserves and import oil transportation, such three factors determine the potential development of this industry.

However, there are still some disadvantages existing in the world oil transport market:

(1) the competition of global market is fierce, and it's risky for Chinese companies to enter;

(2) the current prosperous shipbuilding market makes the tanker new-building price relatively too high;

(3) in the import oil market, the state policies can only determine the cargo resources, and the freight rate is still decided by the whole market. So this will bring CS Tanker great risks if it enlarges its tanker fleets cosmically.

Despite the influential factors above, the external changes also bring high risks to the development of CS Tanker. One important change is the transformation of energy consumption structure. Although the crude oil is still the main energy resource in the

world, its total reserve is decreasing gradually. On the other hand, many developed countries are trying to find the substituted energy and have made some progresses. So it is believed that the dependency on crude oil will reduce in the future.

The second change is the development of oil transport mode. As we all know, tankers have occupied most of the oil transport volume. However, the pipelines and railways of oil transportation are developing rapidly these years in China. Although oil import volume transported by tankers is increasing every year, its proportion in the total import oil of China is getting smaller and smaller. Further more, the construction of pipeline will shorten the distance of ocean transport distance, which will affect the utility of large-size tankers.

6.2 Intervention of Chinese Government to the Tanker Industry

In the past several years, some experts of Chinese government have paid great attention to the development of China's energy transportation issue. They have studied the development of Chinese tanker fleets at the level of national energy security strategy. Then they met an important problem which was how could the government support China's oil transportation industry, how to ensure the security of oil supply chain by the development of tanker fleets, and what kind of role should the government play?

If we look at the tanker fleets of foreign countries, the concepts of national fleet is not very clear. In additional to several oil export countries in Middle East, like Iran and Saudi Arabia, we can hardly find a national tanker fleet which monopolies the whole oil transportation of the country. Even for the national oil strategic reserves, they are usually accomplished under the commercial contracts between tanker companies and the government authorities. So I think we can choose the China's flag in the coastal and offshore transportation, and choose the convenient flag for the ocean shipping. On the

other hand, the companyies cannot simply invest huge amount of money to build new ships which will cause the shipbuilding price higher and break the balance of supply and demand. So the tanker companies should use various approaches to strengthen their fleet capacity by purchasing new ships and second-hand ships, or annexing and chartering other fleets.

1. The government should encourage the tanker companies to keep a close strategic partnership with domestic oil companies (SINOPEC, SINOCHEM), and to sign long-term contract of affreightment (COA) in order to guarantee the carrying capacity supply for those oil companies.

2. The government should encourage the tanker companies to build new ships in domestic ship yards. For those tanker companies that complete the national oil strategic tasks, the government can give them some priorities and favorable policies such as low-interest loan and some subsidies when building new tankers.

6.3 SWOT Analysis for CS Tanker

SWOT analysis is a very popular tool used in the strategy research for the enterprises. It is widely used in the corporation strategic management, market analysis, competitor analysis and so on. SWOT can tell the companies how to make use of advantages, how to eliminate the weakness, how to grasp the opportunities, and how to evade threats.

SWOT is the abbreviation of Strength, Weakness, Opportunities and Threats. With the help of SWOT analysis, the company can find ways to strengthen its advantages, make use of opportunities, alleviate the weakness, and avoid threats. Here is the SWOT analysis for CS Tanker.

Table 6-1 SWOT Analysis for CS Tanker

	Factors	Hints
Strength	the scale and power of tanker fleet	make good use of the scale effect
	advantage of financing	increase the investment to pursue greater development
	good reputation and brand	strengthen the marketing, improve the company image
	strong capability of gaining profit	keep developing the existing business and try to maximize the profit
	superiority of human resource(professional managerial level and seafarers)	make good use of human resources to improve company's performance
Weakness	lack of large-size tankers	low competitive power in world market
	aging of tanker fleet	build, charter or purchase new tankers
	lack of experiences of operating large-size tankers	give business personnel chances to visit world famous tanker companies, and cooperate with these companies
	disadvantages of SOE(i.e. bureaucracy and low efficiency)	innovation, reform, and enhance management
Opportunity	the growth of world economy and crude oil trade	great opportunity for rapid development
	great developing potential in this industrial	going-up trend redueces the invenstment risks on the tanker fleet
	imbalance of world oil resource	develop the ocean transport business
	policy of China's energy resources strategic reserves	enlarge fleet scales and develop business of import oil
	all China's import oil will be carried by Chinese tanker carriers	great opportunity to increase the domestic market share, and enjoy preferential policy given by the government
	the construction of port facilities for large tankers	especially good for large-size tankers (VLCC, SUEZMAX)
Threat	oil pipeline among Shanghai, Nanjing and Ningbo	try to explore new market
	oil pollution	control the performance and operation strictly
	new substitute of oil energy	great challenge to the traditional industries

	increasing of building cost of new vessels	purchasing or chartering second hand vessels will be a good choice, or the government can give some priorities or preferential policies
	fluctuation of world market	make some adjustments to the strategy in order to avoid risks

From Table 6-1, we can easily find out that the opportunity for CS Tanker is excellent, and its strength and advantages are obvious. However, there are still some threats and challenges existing in the market, especially the threats from the pipeline transportation and the rate fluctuation in the world freight market. These factors will more or less bring the risks and stress to CS Tanker in the development of its tanker fleet. No matter how fierce the competition will be in this market, I still believe the fact that the strong will be stronger, and the weaker will be weaker. And CS Tanker should be the strong if he takes the effective market strategy.

6.4 Development Suggestions

From all the discussion and analysis mentioned above in the paper, we can have a clear recognition and understanding of the opportunities, challenges, advantages and disadvantages. Now I will try to state my suggestions as follows:

a. The strategic goal: by the end of 2010, to build up a world-class oil tanker fleet. This target, I think, has neglected a very important factor, which is the benefit. The scale of a tanker fleet is very crucial, but we should not enlarge the scale blindly, and the key is how to take advantage of large scale to create good benefit. Certainly, the enlargement of tanker fleet is essential because it is the basic resource of benefit, but we should enlarge the scale based on the analysis of the market in order to maximize the capital efficiency.

b. The development strategy of CS Tanker comes from the opportunities of market

environment and the advantages itself. It is confident for CS Tanker to realize its goal in 2010, although there are many threats and challenges from the external market, such as threats from pipelines, fluctuation of freight rate and so on. The first thing that CS Tanker should do is to adjust its fleet structure and improve its management ability in order to cooperate its market strategy.

c. As a SOE, CS Tanker has the responsibility to complete the tasks given by the government. National oil security reserves require CS Tanker to supply stable carrying capacity in order to keep Chinese oil reserves at a safe and sufficient level. No matter how the world freight market fluctuates, CS Tanker should try to complete this task disregarding the cost. When the operating cost is too high and CS Tanker suffers great loss to fulfill the tasks, Chinese government should consider some allowance and compensation for CS Tanker in other aspects.

d. CS Tanker should tries to make its tanker fleet scale larger, its average age younger, and its performance more competitive. As is mentioned in the previous chapters, building new tankers is not the only way. Purchasing or chartering second-hand tankers is also considerable. As for those tankers with small DWT and old age, CS Tanker should deal with them without any hesitation because they are not competitive in this market now.

Conclusion

Firstly, in Chapter One and Two, the paper introduces the concept of national oil security strategy and the study fruits in the field of fleet development.

Secondly, in Chapter Three, the paper introduces the current status of word tanker market, and compares them with domestic tanker companies in order to find out problems existing in Chinese tanker industry. Then, by using a reasonable model, the paper forecast the developing trend of Chinese import crude oil market in the next few years.

Thirdly, the paper takes China Shipping Tanker Company as the example, and compares it with world famous tanker companies. After finding out the differences and gaps between world-class tanker fleets and CS Tanker fleet, the paper gives some fleet adjustment strategies.

Fourthly, in Chapter 5, the paper works out a layout solution of CS Tanker from 2007 to 2010 with the help of linear programming and EXCEL.

Finally, the SWOT analysis helps the author to have a clear understanding of CS Tanker. According to its strengths, weaknesses, opportunities and threats, the author provides some development suggestions.

In accordance with above research, the author has got the following conclusions:

1. The developing trend forecast in Section 3.3 shows that the import crude oil volume of China will continue to grow in the next few years. This gives the Chinese tanker companies a good environment and opportunity to develop.

2. Comparing with world-class tanker companies and their tanker fleets, CS Tanker should enlarge its tanker fleet scale, increase its carrying capacity, and reduce its fleet's average service years. The developing methods will be building new vessels, purchasing second-hand vessels, and chartering vessels to supplement its existing fleet.

3. Although the world market is prosperous, CS Tanker should not develop its tanker fleet blindly. Building new large-size tankers will cost a lot of company's resources and will be very risky when the market fluctuates.

4. The enlargement of tanker fleet is essential because the tankers are the basic resource and tool that create benefits. However, we should enlarge the scale based on the analysis of the market in order to maximize the capital efficiency.

Because of the limitation of some knowledge, the linear programming model in Chapter Five does not discuss many other factors and conditions. For example, there are only four main routes mentioned in the model, however, in real practice, there are several other routes like South America — China, Europe — China. The model also does not consider the influence from the pipeline transportation. So the data is not very accurate, and should have some differences with real practice. Therefore, this topic still has much space for discussion and improvement.

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The following websites of tanker companies give further information on courses:

HONG KONG MING WAH Shipping Co., LTD
(http://www.hkmw.com.hk/webappen/index.asp#)

China Shipping Development Co., Ltd. Tanker Company
(http://www.cnshipping.com/youlun/default.asp)

Dalian Ocean Shipping Company
(http://www.coscodl.com/english/index.jsp)

CSC Nanjing Tanker Corporation
(http://www.njtc.com.cn/njyy/col256/index.html?id=256)

Frontline Tanker Company
(http://www.frontline.bm/fleetlist/index.php)

MOL Tanker
(http://www.mol.co.jp/tanker.shtml)

Bergensen Worldwide Tanker
(http://www.bergesenworldwide.com)

Teekay Shipping Company
(http://www.teekay.com/?page=fleet_list)

Maersk Tanker
(http://www.maersktankers.com/main.asp?id=4)