

World Maritime University

The Maritime Commons: Digital Repository of the World Maritime University

World Maritime University Dissertations

Dissertations

8-31-2012

Liner shipping company as the logistics service provider: case study of COSCO Logistics

Tao Zhou

Follow this and additional works at: https://commons.wmu.se/all_dissertations



Part of the [Business Administration, Management, and Operations Commons](#), [Operations and Supply Chain Management Commons](#), and the [Strategic Management Policy Commons](#)

This Dissertation is brought to you courtesy of Maritime Commons. Open Access items may be downloaded for non-commercial, fair use academic purposes. No items may be hosted on another server or web site without express written permission from the World Maritime University. For more information, please contact library@wmu.se.

WORLD MARITIME UNIVERSITY

Shanghai, China



**Liner shipping company as the logistics service
provider: Case Study of COSCO Logistics**

BY

TAO ZHOU

China

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

MASTER OF SCIENCE

(International Transportation and Logistics)

2012

Declaration

I certify that all the material in this research paper that is not my own work has been identified, and that no materials are 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.

(Signature): Zhou Tao

(Date): 2012-06-09

Supervised by

Professor Sha Mei

World Maritime University

Acknowledgements

I would like to take this opportunity to thank Professor Sha Mei for her patient and guidance in my preparation of the dissertation.

My whole-heart gratitude should be expressed to my family, especially to my beloved wife who has given me spirit encouragement and support during this period.

Abstract

Influenced by the uncertainty of global economic and market, the global shipping market experienced a dramatic depression in recent years, especially for the liner shipping companies whose main business heavily depends on the international trades. Through merger and acquisition strategy or internally organic growth strategy and using their existing global logistics networks, liner companies could expand its logistics functions from single ocean shipping to hinterland railroad and truck transportation, even the aero transportation services. Only with such a logistics services integration strategy could liner shipping companies satisfy customers' ever increasing requirement of the lean and "just in time" logistics for their global manufacturing, so that liner companies could recapture competitive capabilities and retain customers' loyalty which may help them to cope with the fluctuating market and mitigate the effects of the economic uncertainty. Through a case study of COSCO logistics, this study will analyze the logistics service efficiency and its contribution to the parent shipping company. By the comparison of the company's financial performance, capacity utilization and the significance of logistics revenue before and after the logistics services launching through three hypotheses of the benefits from the liner shipping companies' comprehensive logistics services, and by using collected data from COSCO annual report or fact books to make simple linear progression analysis, sensitivity analysis and correlation coefficient analysis to test the benefits hypotheses, the objective of this study is to verify the effectiveness of the liner companies' logistics operation and its contribution to the liners overall development. After a case study, a simple comparison of five major ocean carriers' logistics performance will also be presented. Certainly, at the end of the study, the limitation of this study and future research suggestion will also be given.

Table of contents

Declaration	i
Acknowledgement	ii
Abstract	iii
Table of contents	iv
List of Table	vi
List of Figure	vii
List of abbreviation	ix
Chapter 1 Introduction	1
1.1 International market background	1
1.2 The objective and structure	8
1.3 The methodology	8
Chapter 2 Literature Review	13
2.1 What is shipping lines' comprehensive logistics	13
2.2 Relevant research	14
Chapter 3 Case Study of COSCO Logistics	17
3.1 Introduction of COSCO Logistics	17
3.1.1 3PL Service of COSCO Logistics	18
3.1.2 Ship Agent & Freight Forward Services of COSCO Logistics	24
3.2 The performance of COSCO line before Logistics Services Launching	26
3.3 The Hypotheses of the benefits of comprehensive logistics services after COSCO Logistics launching	31
Chapter 4 Data analysis and hypotheses test of benefits of COSCO logistics	33
4.1 Hypothesis 1 test and Performance Comparison: Logistics services benefit the total turnover	33
4.2 Hypothesis 2 test and Performance Comparison: COSCO Logistics services benefit the Liners capacity utilization	39
4.3 Hypothesis 3 test and Performance Comparison: COSCO logistics services become the significant part of liners revenue factor to resist uncertainty	42
4.4 Comparison of COSCO Logistics with Other major carriers	46

Chapter 5	Conclusion	50
5.1	Conclusion of COSCO Logistics study	50
5.2	Limitation and future study	51
References		53
Appendices		57

List of Tables

Table 1	Top 20 leading operators of container ships, 1 January 2011	2
Table 2	Global containership fleet by size range (1 October 2011)	4
Table 3	Output of the linear regression prediction analysis for Turnover and Logistics revenue	35
Table 4	Output of the linear regression prediction analysis for containers handling volume and Logistics revenue	41
Table 5	Result of the simple sensitivity analysis between logistics revenue and total turnover	45

List of Figures

Figure 1	Global container, tanker, and major dry bulk volumes, 1990-2011	1
Figure 2	Global container trade, 1990-2011(TEUs and annual percentage change)	2
Figure 3	Average revenue per TEU of 5 major carriers 2008-2011(US\$ per TEU)	5
Figure 4	Carrier EBIT profit/ loss and operating margins, 1Q08-4Q11	5
Figure 5	Operating margins of selected carriers, 3 rd quarter 2011	6
Figure 6	Strategic partners and customers of COSCO Logistics	18
Figure 7	Household Logistics service of COSCO	19
Figure 8	Automobile Logistics Services of COSCO	20
Figure 9	Retail Logistics services of COSCO	21
Figure 10	Exhibition Logistics services of COSCO	22
Figure 11	Chemical Products Logistics services of COSCO	23
Figure 12	Project Logistics services of COSCO	24
Figure 13	The fleet container capacity of COSCO Line from 1998 to 2003	27
Figure 14	Container capacity and Containers Handling 1 (1998-2003)	28
Figure 15	Container capacity and Containers Handling 2 (1998-2003)	28
Figure 16	Container Revenue of COSCO Line (1998-2003)	29
Figure 17	Growth Rate of Container Revenue, Handling and Capacity 1(percent%)	30
Figure 18	Growth Rate of Container Revenue, Handling and Capacity 2(percent%)	30
Figure 19	The Standard residuals of the estimated Turnover from the linear regression analysis	36
Figure 20	Logistics revenue and Total turnover of COSCO Line 1(Year 2004-2010)	37

Figure 21	Logistics revenue and Total turnover of COSCO Line 2(Year 2004-2010)	37
Figure 22	Total turnover comparison for the two periods before and after logistics launching(Year 1998-2003 and Year 2004-2010)	38
Figure 23	Turnover growth rate comparison between periods of Year 1998-2003 and Year 2004-2010	38
Figure 24	The linear correlation between logistics revenue and containers handling volume	39
Figure 25	The Standard residuals of the estimated containers handling volume from the linear regression analysis	40
Figure 26	Container handling volume comparison for the two periods before and after logistics launching(Year 1998-2003 and Year 2004-2010)	42
Figure 27	The total turnover, container revenue and logistics revenue of COSCO from year 2004 to 2010	43
Figure 28	The respective proportion of container revenue and logistics revenue in total turnover from year 2004-2010(Units:%)	43
Figure 29	The sensitivity changing of Turnover affected by logistics revenue	45
Figure 30	Logistics revenue of major carriers from Year 2005-2010	46
Figure 31	Logistics revenue of major carriers 1 (proportion in turnover) from Year 2005-2010	48
Figure 32	Logistics revenue of major carriers 2 (proportion in turnover) from Year 2005-2010	49

List of abbreviation

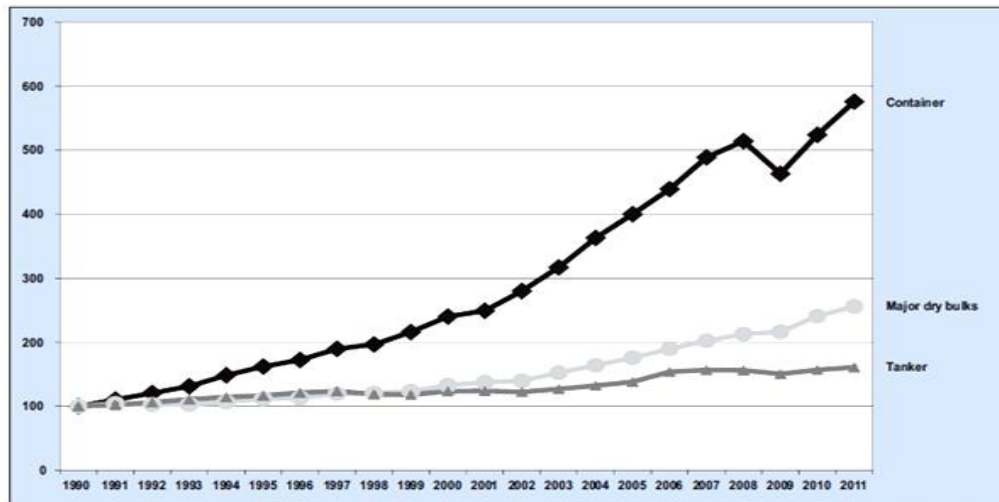
UNCTAD	United Nations Conference on Trade and Development
TEU	Twenty feet Equivalent Units
GPN	Global Production Network
CLM	Council of logistics management
SCM	Supply Chain Management
COSCO	China Ocean Shipping Company
3PL	3 rd Party Logistics
APL	AMERICAN PRESIDENT LINES
OOCL	Orient Overseas Container Line
NYK	NIPPON YUSEN KABUSHIKI KAISHA
RDC	Regional Distribution Center
GSLP	Global shipping carrier-based logistics service providers
GSCs	Global shipping carriers
CV	Customer Value
LSRM	Liner shipping revenue management
ROA	Return on Assets
ROE	Return on Equity
ROS	Return on Sales
IT	Information Technology

Chapter 1 Introduction

1.1 International market background

After entering the 21st century, the global liner shipping market has experienced a historical prosperity because of the fast economic development of the developing countries, especially those countries in Asia area like China and India, which led to a huge demand for the shipping transportation. As showed in UNCTAD(2011) report, during this prosperous time, demand for seaborne transportation almost had a double digits growth annually until 2008, and the container shipping sector has the biggest growth for years compared with the Tanker and Dry Bulk volume(see Figure 1&2).

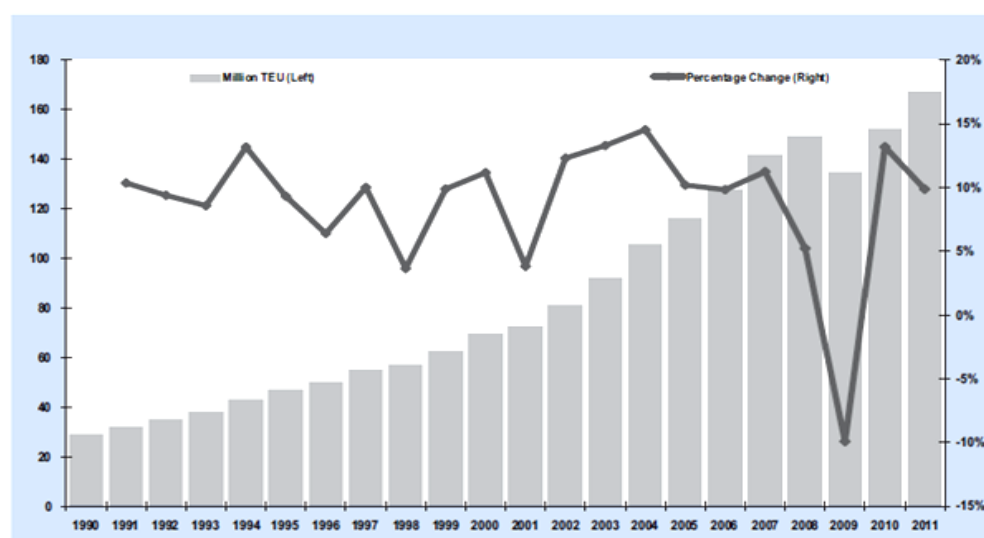
Figure 1. Global container, tanker, and major dry bulk volumes, 1990-2011



Source: UNCTAD secretariat, based on *Review of Maritime Transport*, various issues; and on Clarkson Research Services, *Shipping Review and Outlook*, Spring 2011.

Regarding to the container shipping industry, it has become increasingly consolidated during recent years. Liner companies have tailored their business strategies under the premises of strong growth of container trade fuelled by the production globalization process and the large-scale adoption of the container, and liners merger and acquisition is forecast to continue (Notteboom 2011). Until 1 January 2011, the largest 20 lines controlled almost 11 million TEUs of shipboard capacity, which at that time was equivalent to about 70% of all cellular capacity worldwide (see Table 1).

Figure 2. Global container trade, 1990-2011 (TEUs and annual percentage change)



Source: Drewry Shipping Consultants, *Container Market Review and Forecast 2008/09*; and Clarkson Research Services, *Container Intelligence Monthly*, May 2011.

Note: The data for 2011 were obtained by applying growth rates forecasted by Clarkson Research Services in *Container Intelligence Monthly*, May 2011.

Table1. Top 20 leading operators of container ships, 1 January 2011

Ranking	Operator	Country/territory	Number of vessels	Average vessel size	TEU	Share of world total, TEU	Cumulated share, TEU	Percentage of growth in TEU over 2010
1	Maersk Line	Denmark	414	4 398	1 820 816	11.2%	11.2%	4.2%
2	MSC	Switzerland	422	4 176	1 762 169	10.8%	22.0%	16.9%
3	CMA CGM Group	France	288	3 715	1 069 847	6.6%	28.6%	13.2%
4	Evergreen Line	China, Taiwan Province of	162	3 666	593 829	3.7%	32.3%	0.2%
5	APL	Singapore	141	4 197	591 736	3.6%	35.9%	12.8%
6	COSCON	China	147	3 848	565 728	3.5%	39.4%	14.1%
7	Hapag-Lloyd Group	Germany	126	4 446	560 197	3.4%	42.8%	19.1%
8	CSCL	China	120	3 841	460 906	2.8%	45.7%	0.8%
9	Hanjin	Republic of Korea	98	4 565	447 332	2.8%	48.4%	11.8%
10	CSAV	Chile	119	3 217	382 786	2.4%	50.8%	95.4%
11	OOCL	China, Hong Kong SAR	85	4 408	374 714	2.3%	53.1%	29.1%
12	MOL	Japan	91	3 989	362 998	2.2%	55.3%	4.2%
13	NYK	Japan	85	4 152	352 915	2.2%	57.5%	-1.9%
14	K Line	Japan	84	4 143	347 989	2.1%	59.6%	7.0%
15	Hamburg Sud	Germany	98	3 423	335 449	2.1%	61.7%	18.2%
16	Yang Ming	China, Taiwan Province of	78	4 137	322 723	2.0%	63.7%	1.7%
17	HMM	Republic of Korea	60	4 753	285 183	1.8%	65.4%	9.7%
18	Zim	Israel	73	3 857	281 532	1.7%	67.2%	30.5%
19	PIL	Singapore	111	2 146	238 241	1.5%	68.6%	36.9%
20	UASC	Kuwait	47	3 800	178 599	1.1%	69.7%	1.1%
Total top 20 carriers			2 849	3 979	11 335 689	69.7%	69.7%	12.4%
Others			6 839	719	4 918 299	30.3%	30.3%	1.1%
World containership fleet			9 688	1 678	16 253 988	100.0%	100.0%	8.7%

Source: UNCTAD secretariat, based on Containerisation International Online, Fleet Statistics. Available at www.ci-online.co.uk.

Note: Includes all container-carrying ships. Not fully comparable to tables 2.2. and 2.3 above, which only cover the specialized fully cellular container ships.

However, the unpredictable economic crisis which began in United States due to the severe sub-credit problem of the real estate market caused fierce deterioration of the global economic since 2008 which directly led to the dramatic fluctuation of the international trade and global production. This economic crisis has affected the global liner shipping industry in a deep decline. Data from the Drewry Shipping consultant (2011) showed that against a background of deteriorating economic conditions, the whole liner shipping industry strives to savage itself from the bog of depressed market with overcapacity, low demand and freight rates.

As data of October 2011, the global liner fleet numbered 5,083 vessels, with a nominal capacity of 15.11 million TEUs (see Table 2). But at the end of the third quarter of 2011, about 980,000 TEUs capacity had been added to the global fleet since the beginning of the year, this 8.6% fleet growth is running a couple of percentage points above global demand growth for this year. On the contrary, in the scrapping market, only about 30,000 TEUs capacity were demolished in the full to the end of September of 2011, this figure is considerably lower than in the past two years and will lead to virtually no modification of the global fleet. In addition, the number of the older ships (more than 25 years age) could be scrapped in early October 2011 estimated by Drewry approximately 300,000 TEUs capacity, this total only equates to around 2% of global capacity which could do nothing to help the supply/demand balance in the trades that are experiencing real difficulties.

This situation directly affected the freight rates level negatively, the average revenue of per TEU experienced a significant decline (see Figure 3). For example, With Drewry's 2011 all-in weighted average East-West freight rate set to reach as low as \$1,294 per TEU, many carriers are likely to be operating at a loss on these trades. This decline proves the inability of carriers to deal with the market overcapacity and align their rates with rising costs, especially for the high bunker costs. As showed in the Figure 4, after the short recovery in profitability recorded in 2010, the even worse condition has thrown most carriers deep into the red. As Drewry estimated, Carrier

losses worsened in the third quarter of 2011, the liner industry operating loss for 2011 is almost as bad as it was in 2009, that the industry made a loss of \$2.3 billion in third quarter, the operating margin fell to -4.9% as unit revenue, which is already below costs.

Table 2. Global containership fleet by size range (1 October 2011)

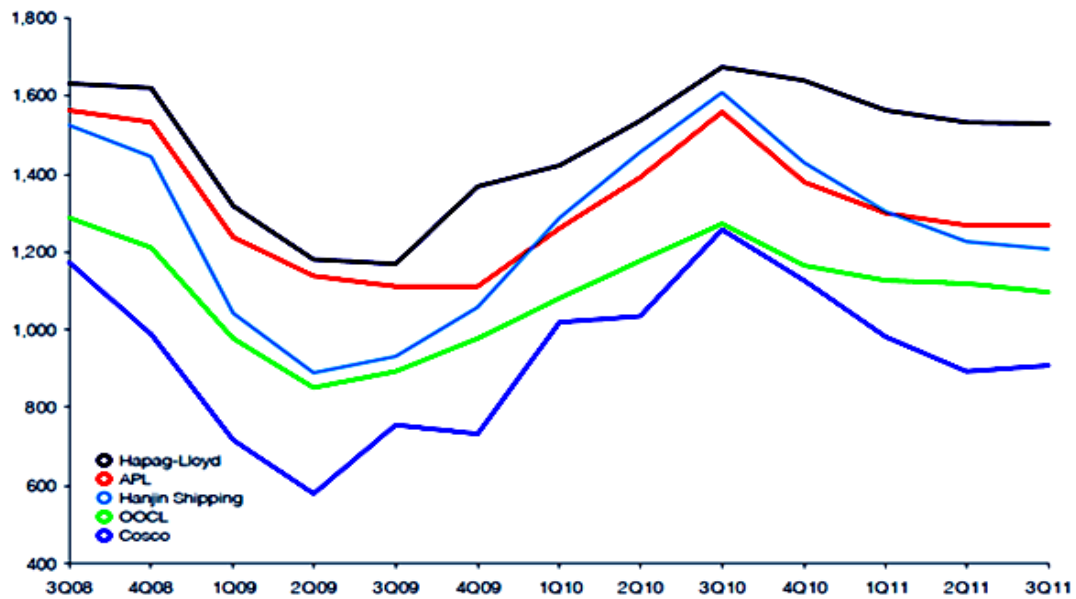
Size Range (Teu)	No. of Vessels	%	Total Capacity (Teu)	%	Average Speed (Knots)	Average Age (Years)
<500	389	7.7%	120,749	0.8%	13.8	23.4
500-999	828	16.3%	614,685	4.1%	17.0	11.8
1,000-1,499	706	13.9%	833,964	5.5%	18.6	11.3
1,500-1,999	575	11.3%	979,914	6.5%	19.9	10.5
2,000-2,499	304	6.0%	701,577	4.6%	20.9	12.8
2,500-2,999	411	8.1%	1,113,463	7.4%	22.1	9.0
3,000-3,999	334	6.6%	1,139,101	7.5%	22.6	12.4
4,000-4,999	604	11.9%	2,656,693	17.6%	24.2	7.4
5,000-5,999	309	6.1%	1,670,858	11.1%	25.1	7.4
6,000-6,999	203	4.0%	1,323,911	8.8%	25.2	5.6
7,000-7,999	43	0.8%	315,058	2.1%	24.8	5.5
8,000-8,999	206	4.1%	1,715,293	11.3%	25.0	4.5
9,000-9,999	70	1.4%	652,063	4.3%	24.6	4.2
10,000+	101	2.0%	1,277,318	8.5%	24.5	1.5
Grand Total	5,083	100%	15,114,847	100%	20.6	10.6

Source: Drewry Maritime Research

Source: Drewry Maritime research

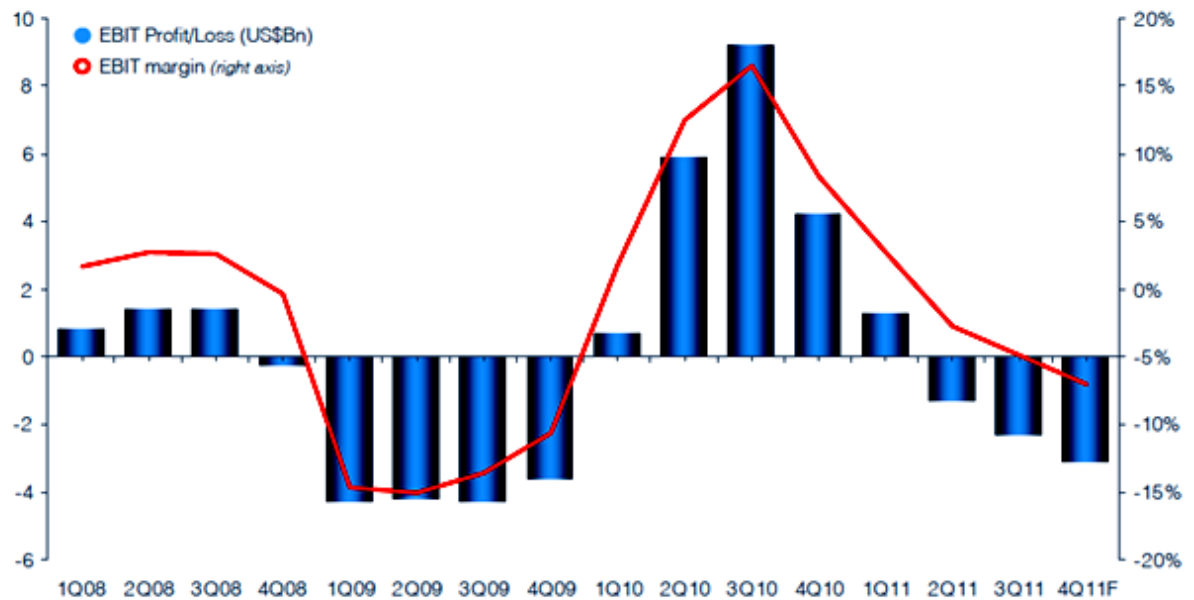
According to the Top 20 carriers published financials, Hapag-Lloyd was the only carrier to turn a profit (\$46 million) in the third quarter 2011, while other two carriers, Wan Hai and RCL, also made small profits as their primary intra-Asia trade remained relatively strong(see Figure 5). Compared with 2010 revenue and profit, the top 20 liner carriers are really experiencing a difficult times(see appendix 1). Shipping lines may have not gone far enough to combat the bad economic situation, but it is the exactly right time for the liner companies to reconsider their development strategy.

Figure 3. Average revenue per TEU of 5 major carriers 2008-2011(US\$ per TEU)



Source: Drewry Maritime research

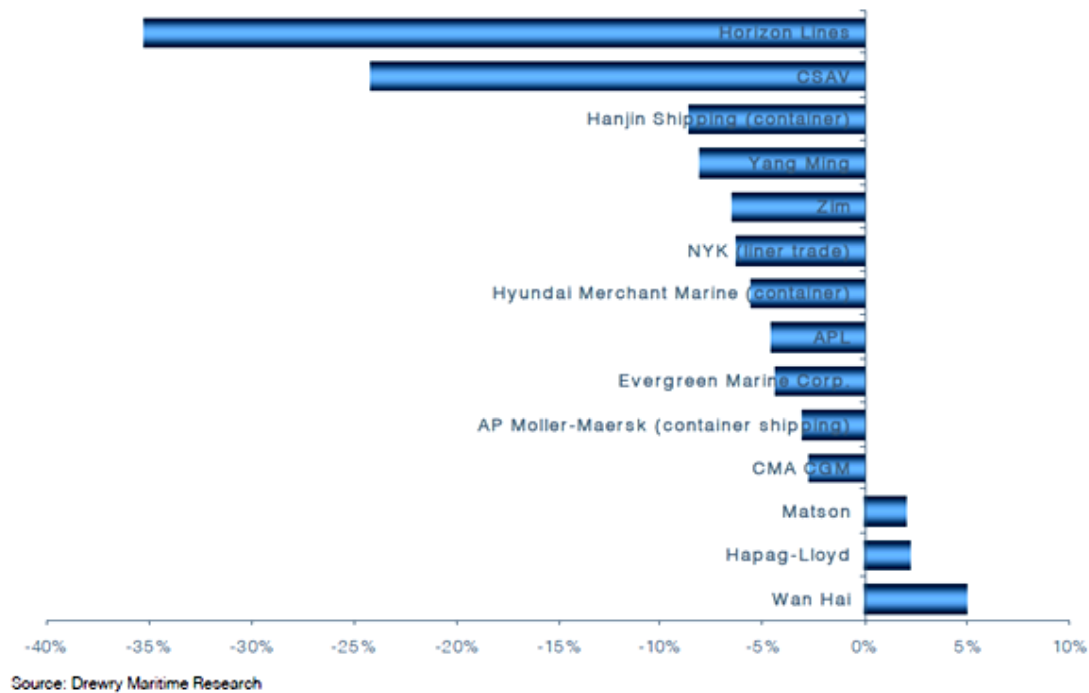
Figure 4. Carrier EBIT profit/ loss and operating margins, 1Q08-4Q11



Note: EBIT margins based on average of sample carriers after currency conversion to US dollars when necessary.
Sample consists of AP Moller-Maersk (container shipping); APL; CMA CGM; CSAV; Hanjin Shipping (container); Hapag-Lloyd; HMM (container); NYK (liner, calendar year basis); Wan Hai; Yang Ming and Zim.

Source: Drewry Maritime Research

Figure 5. operating margins of selected carriers, 3rd quarter 2011



With the fast technological development and intensity, one of the key pressures encouraging global integration, the Global Production Network (GPN) has been established. Nowadays, International firms pursuing a global strategy will search for competitive advantage by locating activities in the best (and in the optimum number of) locations worldwide, and it will seek to manage those activities as interdependent members of a single system, not as a portfolio of independent businesses (Hout, Porter & Rudden, 1982; Porter, 1986 Cited in Notteboom &Podrigue 2008,pp 152–174,). This means that firms are increasingly adopting a supply chain approach as a new way to integrate their own operations and to extend this integration to their supply chain partners. In this phase, gaining competitive advantage no longer depends exclusively on the level of integration within the firm itself, but rather on exploiting the advantages derived from integrating suppliers (of goods and services) and continuous improvements in quality, cost and delivery. Therefore, the Global Supply chain integration has become an emergent issue for those multinational companies.

As Containerization of Liner service can improve the competitive playing field for global manufacturing in the transport chain by providing new value-added services in an integrated package, through freight integration along the supply chain. So nowadays most Manufacturers who previously had limited access to the global market because of remote locations and lack of transport infrastructures realized that the universal widespread of the container as a global transport product provide them a new set of opportunities for their multinational business operation (Notteboom & Rodrigue 2008, pp152–174). And furthermore, the worldwide networks of liner shipping companies could also help manufacturers to have an easy connection with their partners all around the world for close cooperation and collaboration, the global supply chain efficiency has become a reality through liner shipping's integrated logistics services package.

1.2 The Objective and Structure

The objective of this study is to verify the efficiency of the liner companies' comprehensive logistics operation and its contribution to the liners overall performance development. To exemplify the new strategy of the integrated logistics services providing of Liner companies and test the efficiency of this comprehensive logistics services, this article will use an empirical case study of COSCO logistics to analyze the logistics service efficiency and its contribution to its liner shipping company. By the comparison of the company's financial performance, capability utilization efficiency and market performance before and after the logistics services launching, three hypotheses of the benefits from the liner shipping companies' comprehensive logistics will be tested and verified. Begin with the introduction of COSCO's logistics; three hypotheses of the benefits will be described in detail. Then, by using collected data from COSCO annual report or fact books, an analysis of COSCO's performance before logistics services launching will be presented. Following the preliminary analysis, significant data analysis of COSCO's performance after logistics services providing will be made. In addition, a comparison between the different strategy periods will also be carried out so as to verify the hypotheses of the logistics efficiency. Regarding with the data analysis, simple linear progression analysis, sensitivity analysis and correlation coefficient analysis will be applied during the testing process for the benefits hypotheses. After the case study, a simple comparison of five major ocean carriers' logistics performance will also be presented. At the end of the study, after a necessary study conclusion, the limitation of this study and future research suggestion will also be given.

1.3 The Methodology

This paper will use data from the biggest Chinese shipping line company of COSCO and its logistics division to carry out a case study to verify the efficiency of the logistics services of Liner Company. As Leonard (1990, pp 248-266) pointed out that

as case study is a history of a past or current phenomenon, draw from multiple sources of evidence, it can include data from direct observation as well as public and private archives, any fact relevant to the stream of events describing the phenomenon is a potential datum in a case study since context is important. So to meet the quality requirements of the current research and the methodological criteria of good scientific practice, this case study will retrieve the secondary data from official data archives of annual reports and fact books of COSCO available via Internet and Organizational data files as well as some internal unpublished financial data, so as to ensure the quality of the data in precise and relevant, hence data applied in the study analysis could be pragmatic and reliable. In similar, after the case study , the comparison part of major liner companies' logistics services efficiency, secondary data will also be collected from earlier resources of relevant companies such as official statistics, administrative records or other accounts kept routinely by organizations(Hox & Boeijs, 2005).

To test the efficiency of logistics services and its contribution to liner companies' whole performance, three hypotheses will be produced as follows:

- 1) Hypothesis 1: Liner companies' comprehensive logistics services benefit the major revenue results of shipping lines
- 2) Hypothesis 2: Liner companies' comprehensive logistics services benefit the Liners capacity utilization
- 3) Hypothesis 3: Liner companies' comprehensive logistics services become the significant factor to resist the uncertainty of liner industry

To carry out the data analysis for the hypotheses verification, different practical data of COSCO will be employed for each hypothesis test. For Hypothesis 1, the logistics revenue and major business sectors' total revenue of the COSCO line will be collected as two indicators for study. The major revenue data of two periods that of before and after the logistics services launching will have a comparison, this comparison will try to present a clear picture that if the logistics revenue has contribute to the liner companies' major revenue and influence the major revenue in a significant growth. In

addition to the major revenue comparison, the simple linear regression analysis and sensitivity analysis between the logistics revenue and major revenue will also be made, as well as the correlation coefficient analysis between the two revenues, so as to clarify the relationship between these two indicators and the validity of the comparison. For Hypothesis 2, to test the influence of the logistics services on the liner's carrying capacity utilization efficiency, history data of COSCO's transported TEUs and overall TEUs capacity will be collected to make a comparison between two different strategy periods, and to find out its relationship with logistics services. For the last Hypothesis, the logistics services revenue growth rate will be used to compare with that of the major revenue of COSCO, and its proportion in the overall turnover of the liner company will also be depicted, so as to clarify the business position of the logistics services in the liner company. Certainly, the relationship validity of these indicators will also be analyzed through simple liner regression analysis, correlation coefficient test , and sensitivity analysis as well.

Regarding to the data analysis approaches that to be applied in testing the relationship of relevant indicators in each hypothesis, the detail methodological application of three approaches (simple linear regression analysis, correlation coefficient analysis and sensitivity analysis) are as follows:

The linear regression model provides a powerful device for organizing data analysis. Sensitivity analysis can be used as an aid in identifying the important uncertainties for the purpose of prioritizing additional data collection or research (Cullen and Frey, 1999). In simple linear regression analysis, if the significance F (same as p value) is within the scope as $0.05 \geq p > 0.01$, it means this linear regression model is a valid statistics study, and there is significant linear regression relationship between X and Y. The another indicator of R square measures the Goodness of fit of the linear regression equation, the bigger the values of R square, the better of the fitness of the equation, so there is stronger linear relation between these two variables. In addition, if the absolute values of the Standard residuals are scattered within the scope between

(-2, 2), this means the confidence degree is reliable, it also proved the ideal situation of Goodness of fit between the equation and the observation value, which means there is an obvious linear relationship between the variables of X and Y. Most commonly the modeling is aimed at describing how the mean of the dependent variable $E(Y)$ changes with changing conditions; the variance of the dependent variable is assumed to be affected by the changing conditions. The simplest linear model involves only one independent variable and states Model that the true mean of the dependent variable changes at a constant rate as the value of the independent variable increases or decreases. Thus, the functional relationship between the true mean of Y_i , denoted by $E(Y_i)$, and X_i is the equation of a straight line:

$$E(Y_i) = \beta_0 + \beta_1 X_i.$$

β_0 is the intercept, the value of $E(Y_i)$ when $X = 0$, and β_1 is the slope of the line, the rate of change in $E(Y_i)$ per unit change in X (Zhu 2009).

Different from regression coefficient which shows the quantitative rise and full relationship between variables, the correlation coefficient is for the measurement of the relevance degree and direction of variables. In probability theory and Statistics study, Correlation Coefficient shows the strength and direction of two variables linear relationship. The meaning of correlation is to measure the independent distance of two variables. (Pearson 1900)

The value of Correlation coefficient(r) is between -1 and $+1$, that is $-1 \leq r \leq +1$, in detail:

- If $r > 0$, variables are positively related; if $r < 0$, then variables are negatively related.
- If $|r| = 1$, variable have complete linear correlation, that is function related.
- If $r = 0$, variables have no linear correlation.
- If $0 < |r| < 1$, variables have linear correlation in some extent, the closer of $|r|$ to 1, the stronger linear correlation between variables; the closer of $|r|$ to 0, the weaker linear correlation between variables.

-
- There are three divided value level of within $0 < |r| < 1$: $|r| < 0.4$ means low linear correlation; $0.4 \leq |r| < 0.7$ means obvious linear correlation; $0.7 \leq |r| < 1$ means high linear correlation.

Through above simplest linear model and correlation coefficient to analyze the relationship between indicators in each of the three hypotheses, the validity of the analysis between the indicators could be verified and ensure the study to be kept in practical and meaningful.

Furthermore, sensitivity analysis can play an important role in model verification and validation throughout the course of model development and refinement (Fraedrich and Goldberg, 2000, pp.55-62). Sensitivity analysis also can be used to provide insight into the robustness of model results when making decisions. Sensitivity analysis methods have been applied in various fields including complex engineering systems, economics, physics, social sciences, medical decision making, and others. Therefore sensitivity analysis as an instrument for the assessment of the input parameters with respect to their impact on model output is useful not only for model development, but also for model validation and reduction of uncertainty. Sensitivity analyses are then can be preformed to evaluate the gradients of the error functions with respect to the model parameters used in the hypotheses analysis (Saltelli, Chan & Scottet 2000). In the hypothesis test, through sensitivity analysis, the significance extent of the major impact by the logistics services on variable efficiency indicators (such as major revenues, turnover) can be find out and be estimated as well, and then to determine if the risk of the logistics services investment project is tolerated or not. In this study, a relatively simple sensitivity test will be carried out through the adjustment of the logistics revenue to see its impact on the related indicators, then to determine the sensitivity degree between these indicators so as to verify the significance extent of the comprehensive logistics services. Therefore, to verify the validation of the benefits hypothesis about the logistics services strategy.

Chapter 2 Literature Review

2.1 What is shipping lines' comprehensive logistics

According to Christopher and Towill (2000, pp 206-213) "leading edge companies of Global Production Network (GPN) have realized that the real competition is not company against company, but rather supply chain against supply chain". This means that firms are increasingly adopting a supply chain approach as a new way to integrate their own operations and to extend this integration to their supply chain partners. In this phase, gaining competitive advantage no longer depends exclusively on the level of integration within the firm itself, but rather on exploiting the advantages derived from integrating suppliers (of goods and services) and continuous improvements in quality, cost and delivery. Therefore, the Global Supply chain integration has become an emergent issue for those multinational companies.

While GPN have made many manufacturers contemplate global logistics strategies rather than simply relying on conventional shipping or forwarding activities, to have a deep understanding of global efficient logistics activities is a must for Liner services companies which is the backbone of international trade in manufactured goods, because liner shipping moves vast quantities of consumer, industry and military goods such as electric appliances, clothes and milling machines etc. (Helmick 2001, pg. 20). As the council of logistics management (CLM 2004 cited in Stank, Davis & Fugate 2005, pp. 27-46) defined, comprehensive Logistics management is that part of SCM that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements. Under this requirement, Containerization of Liner service can level the competitive playing field for global manufacturing in the transport chain by providing new comprehensive value-added logistics services in an integrated package, through freight integration along the supply chain. Most actors Manufacturers who previously had limited access

to the global market because of remote locations and lack of transport infrastructures realized that the ubiquity of the container as a global transport product is linked to a whole new set of opportunities (Notteboom & Podrigue 2008, pp.152–174). And the worldwide networks of liner shipping companies could also help manufacturers to have an easy connection with their partners all around the world for close cooperation and collaboration, the global supply chain efficiency has become a reality through comprehensive logistics services of liner shipping's integrated package of the combine ocean shipping, hinterland railroad and truck transportation, and aero transportation service together.

2.2 Relevant research

According to Wong's (2002) research study, Ocean carriers are now under the risk of becoming ocean transport contractors for freight forwarder and third party logistics operators. There would be a total shift of power, both in terms of cargo volumes and market intelligence. To face this challenge, ocean carriers have no choice but to offer a range of value-added service to attract direct accounts. Carriers will find themselves being forced to provide more sophisticated logistics system to satisfy customers' highly accurate supply chain management demand and coordinated actions among supply chain partners. So that, Ocean carriers once get involved in the supply chain process and being invited as a strategic partner, they have to be prepared to provide a cost-effective and tailor-made shipping service to their customers. (Brooks, 2000). In response to this risk, many ocean carriers have either set up a separate logistics firms to expand their business scope or add more value added activities to their core shipping services to increase the attractiveness of their services. For example, Maersk Sealand, APL, OOCL, K-Line, etc. have already established a separate third party logistics firms. Basically, these logistics firms primarily serve the carriers' own loyal customers' logistics needs. Meanwhile, these firms can help diversify the business activities of the parent companies. For the latter case, carriers like Evergreen, Zim Line, try to incorporate more different value added activities such as web-based

service offerings, specialized cargo handling, etc. Furthermore, according to Ding (2010, pp. 1299-1307), the global shipping carrier-based logistics service providers (GSLPs) are emerged due to the acute competitions and many changes among global shipping carriers (GSCs) focusing on business logistics. Total solutions of many logistics services are integrated by these GSCs, and as a result, the goals of customer satisfaction and customer value (CV) in the shipping market are striving toward by GSCs. Ding also (2010, pp. 1299-1307) had evaluated the critical factors influencing Customer Value for GSLPs based on the shippers' perspective in Taiwan in the empirical survey via fuzzy AHP approach.

Although there is few study about the benefits of comprehensive logistics services of liner shipping, there are a lot of literature has examined a variety of measures to measure general or specific performance of logistics service providers regarding transport activities, timeliness and accuracy, delivery performance (Stewart, 1995, pp. 38–44), personnel scheduling and safety measures (Crum and Morrow, 2002, pp. 20-41). Mentzer and Konrad (1991) define performance measures in five sub-areas of logistics: transportation, warehousing, inventory control, and order processing and logistics administration. Logistics service providers can also be distinguished based on characteristics of customer relationships, customer satisfaction and loyalty (Stank et al., 2005). A conceptual model for liner shipping revenue management (LSRM) is proposed by Ting & Tzeng (2004, pp. 199-211) and a slot allocation model is formulated through mathematical programming to maximize freight contribution. They illustrate this slot allocation model with a case study of a Taiwan liner shipping company and the results show the model's applicability and excellent performances in practice. Liner shipping revenue management (LSRM) is an excellent research area with a high potential for developing new models and procedures to improve revenue, and provide decision support to liner shipping companies, and according to their discussions, cargo weight is the crucial factor to achieve better capacity utilization.

In addition, researches relating to the measurement of performance in shipping have approached the measurement of performance from different perspectives and most studies have sought to analyze determinants or predictors of high performance rather than develop a systematic approach to the measurement of performance. Randoy, Down and Jenssen (2003, pp. 40-54) examine the effect of corporate governance mechanisms on the financial performance of 32 publicly traded maritime firms from Norway and Sweden during the period 1996-1998. Using Return on Assets (ROA), Return on Equity (ROE) and Return on Sales (ROS) as the measure of firm performance, they find (through regression analysis) that maritime firms with a founding family CEO have better financial performance than maritime firms with a non-founding family CEO; a high level of board independence enhances profitability in maritime firms; but there is no significant relation between the level of board ownership and firm profitability in maritime firms. Panayides (2003, pp. 123–1400) examines the relationship between competitive strategy and performance in the context of ship management companies. Recognizing performance as a multi-dimensional construct, performance is measured using seven items of self-reported measures constructed from questionnaires. The study finds that companies that apply competitive strategies are more likely to be high performers. The strongest influences on performance seem to be achieving economies of scale, differentiation (in particular through a wider range of services offered), and market-focus and competitor-analysis. It is suggested that high performers are more likely to pursue a combination of the generic strategies rather than pursue one of the generic strategies in isolation. Jenssen and Randoy (2006, pp. 327–343) investigate how innovation contributes to company performance in Norwegian shipping. They hypothesize that organizational and inter-organizational variables influence innovation and innovation in turn influences performance in the shipping firms. Performance is said to be measured by financial results, market position and bargaining power, although it is not clear from the paper how these are actually computed and why they are considered appropriate.

Furthermore, the paper of Lun, Pang and Panayides(2010, pp.203-226) examines how the factor and product markets are related to organizational capacity and firm performance in the container shipping industry. The findings revealed Expansion can be a strategy for firms to achieve performance gains. This study used a simple linear regression equation model and objective data to empirically test the relationship between organizational capacity and firm performance, shedding light on the profitability of ocean carriers.

On the basis of the preceding discussion, it may be also appropriate to assess shipping lines comprehensive logistics performance using a number of key performance measures depending on the scope of the analysis consist of capacity utilization performance measures, financial performance measures and market-based performance measures, and regression equation model and objective data can also be adopted for empirically test.

Chapter 3 Case Study of COSCO Logistics^①

3.1 Introduction of COSCO Logistics

After entering the 21st century, consolidating the leading status in shipping and logistics industry has become the most significant part of COSCO's strategies and mission. To this end, COSCO Logistics was established by the China COSCO Holding company in January 2002, this logistics branch of COSCO aims to integrate the internal logistics resources, rationalize the management of global supply chains and provide comprehensives and seamless logistics services for the customers. Now, COSCO Logistics has become one of the largest logistics companies in China and has over 300 service providers across the country. COSCO has positioned itself around the three key business areas: 3PL modern logistics(Third Party Logistics), ship agency, freight forwarding based on its marketing conditions and brand strategies, so as to consolidate even improve its competitive edge in house electric appliances, automobile, electricity and chemical industries. COSCO Logistics will go beyond the

^①All the data and figures of COSCO in this case study were collected from COSCO website and its annual report

traditional shipping businesses to provide customers with comprehensive value-added logistics services. Within a considerably short time, COSCO Logistics has integrated and consummated its service resources to establish a comprehensive transportation network, which includes variable services such as aero transportation, inter-city express, railway transportation ,barge and feeders, etc.,

Figure 6. Strategic partners and customers of COSCO Logistics

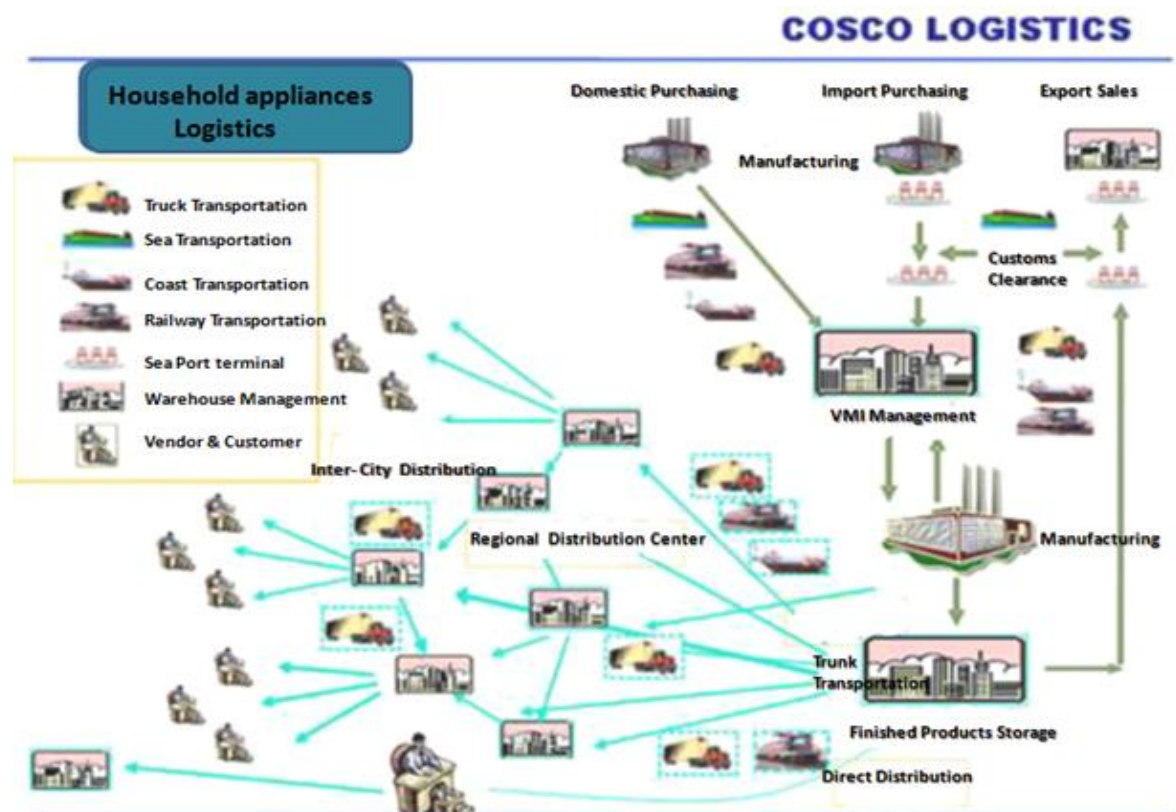


3.1.1 3PL Service of COSO Logistics

There are mainly two kinds of logistics services provided by COSCO 3PL services: Products Logistics and Project Logistics. The Products logistics service focuses on the manufacture customers or those customers who sell the manufactured products (the big retailers). The services include Household Appliances Logistics, Automobile Logistics, Chemical Products Logistics, Retail Logistics and Exhibition Logistics. For the Project Logistics, Electric power Project Logistics and Petrochemical Project Logistics are two major services types. Till now COSCO Logistics has already established strong strategic partnerships with those manufacturers in variable industry

field to provide them customized 3PL services. Within those partners, there are many famous companies who are the great giants in their own industry field (see Figure 6). For example, Haier and Sharp (Household Appliances Logistics), Audi and Volkswagen (Automobile Logistics), Auchan (Retail Logistics), Shell (Chemical Products Logistics), National Grid of China (Electric power Project Logistics) and Sinopec (Petrochemical Project Logistics).

Figure 7. Household Logistics service of COSCO

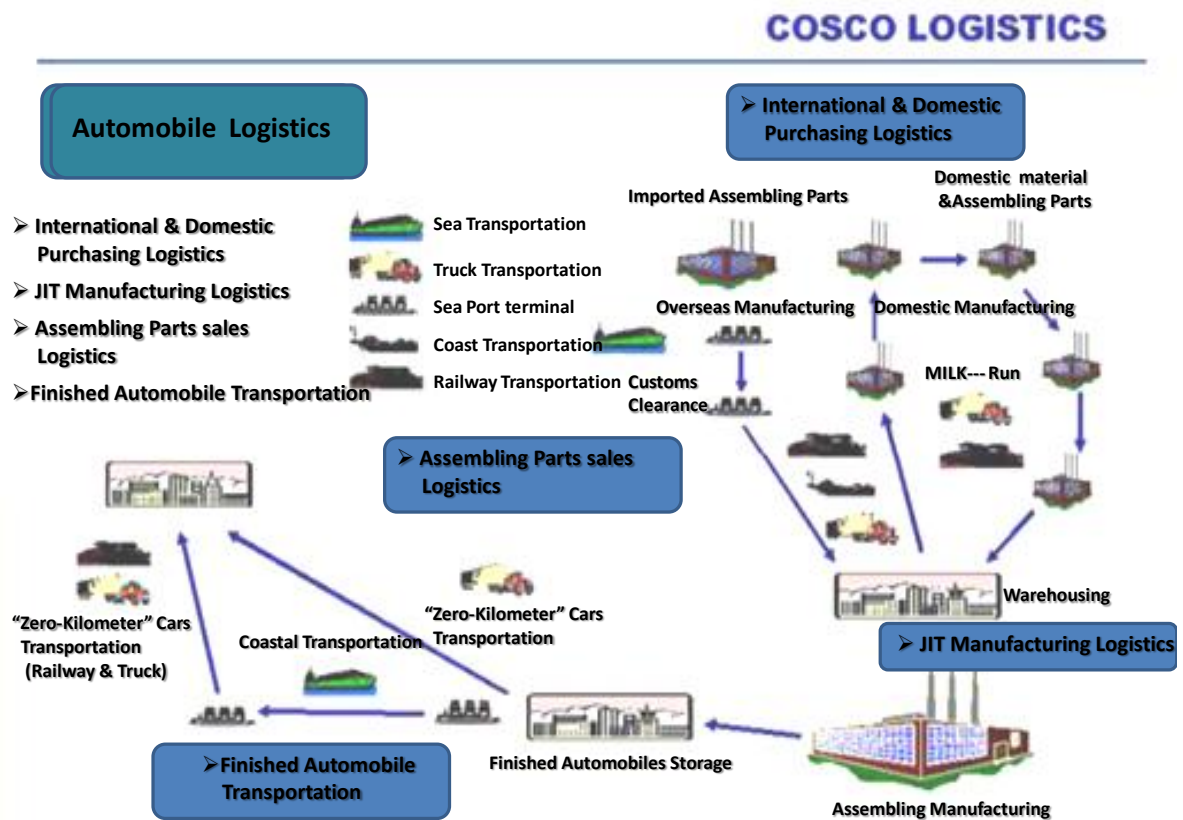


For the Household appliances logistics, COSCO designed a comprehensive solution which begins from the storage planning for the fresh products that are just taken off the assembly line to the regional distribution for retailers and ending customers (see Figure 7). The simple description of the Household appliances logistics solution is as follows:

1. Off Assembly line: COSCO receive the final products from the end of the assembly line and move to the final products warehouse in factory.
2. Warehouse management: Factory warehouse and Central warehouse management.

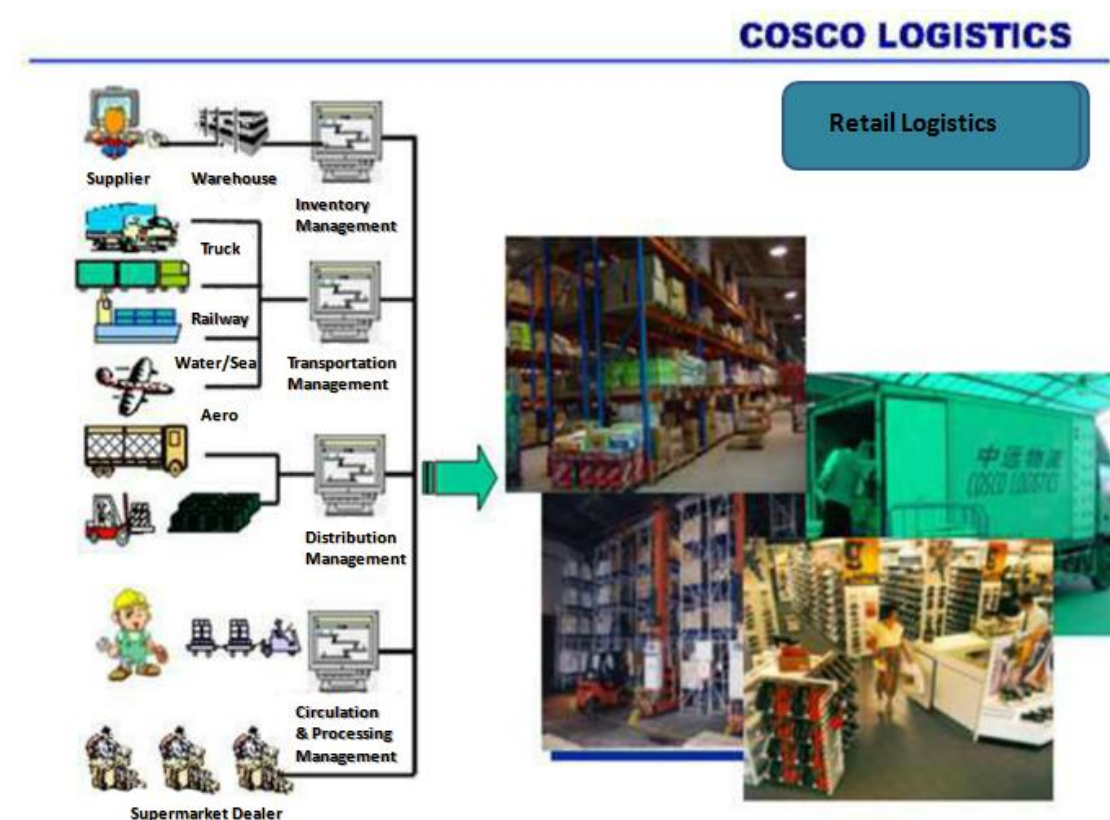
3. Inter –Warehouse allocation: To allocate products reasonably between factory warehouse and Central warehouse, so as to improve the efficiency of the distribution preparation works.
4. Inter –Warehouse transportation: To manage the products transportation between factory warehouse and Central warehouse in the most effective way.
5. Trunk transportation: To manage the products transportation from warehouse to sales center or Regional Distribution Center (RDC) including truck, aero , sea and Railway transportation.

Figure 8. Automobile Logistics Services of COSCO



6. Horizontal allocation: To manage the transportation between RDC or from RDC to Warehouse.
7. Retrieve transportation: To manage the transportation from sales center to RDC or warehouse and from RDC to central warehouse.
8. Barcode management: To scan then the barcode of the final products and feedback the barcode information to manufactures.

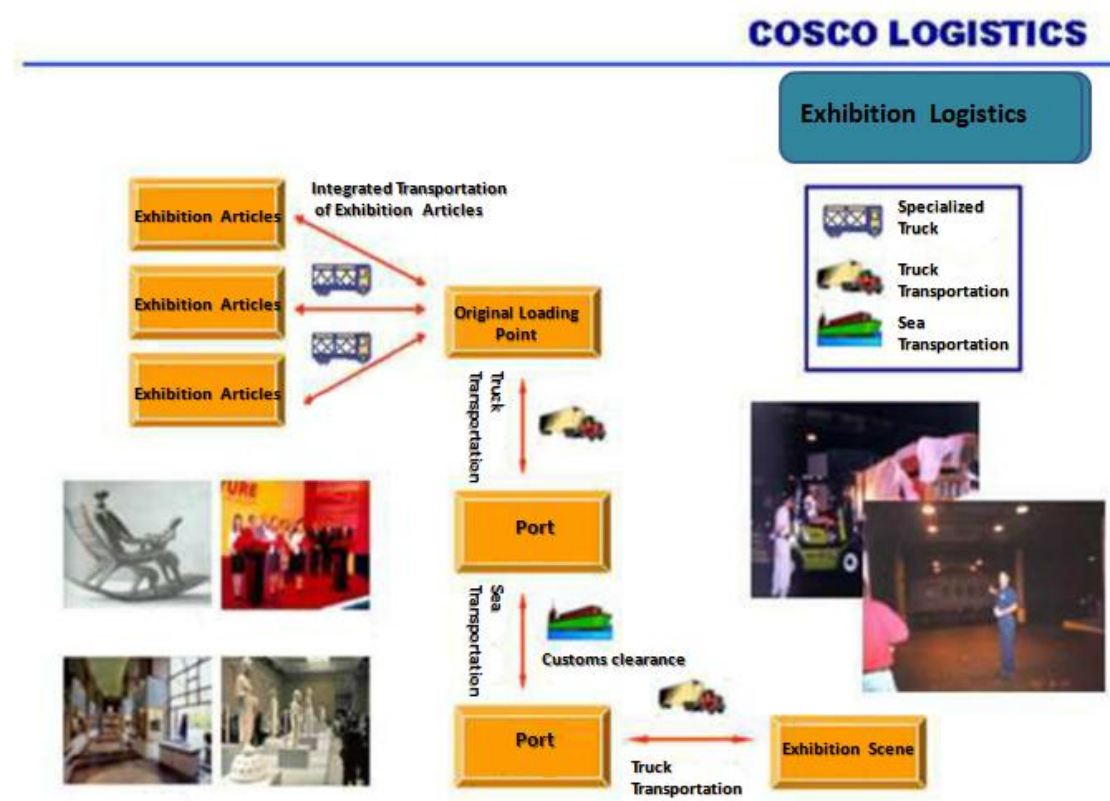
Figure 9. Retail Logistics services of COSCO



For the Automobile Logistics solution, COSCO will help the Car manufacturer to manage the whole transportation process including the JIT manufacturing transportation, sea transportation (Ro-Ro) and inland transportation (truck and railway). In addition, COSCO Logistics will provide the carmakers inventory and distribution management services, even to help them make customs clearance and

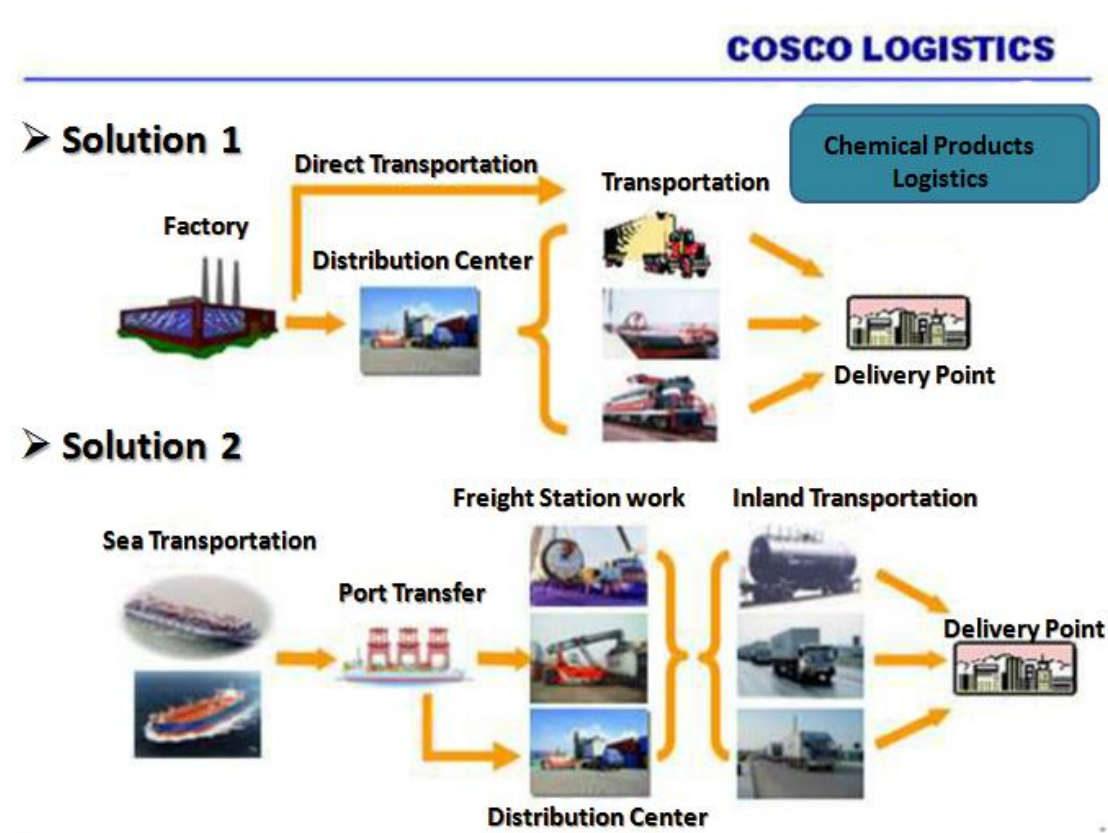
provide transshipment warehouse (see figure 8). As for the Retail logistics, In the Retail Logistics field, COSCO Logistics realized the IT system connection with customers, so as to enhance the significant application of IT system in the Logistics operation. Through the IT system connection, the supply chain between partners becomes visible and information communicated in real-time, so the collaboration becomes closer and effective (showed in figure 9).

Figure 10. Exhibition Logistics services of COSCO



Furthermore, for the Exhibition Logistics, besides the transportation services including Inner River, coastal, sea and aero transportation, transshipment services, COSCO Logistics also provide customs clearance services, and exhibition pavilion layout services for customer as well (see figure 10). Regarding to the last product logistics service---the Chemical products Logistics, COSCO Logistics will help customers form material procurement to final products distribution. Within the overall services, COSCO Logistics will provide inventory and distribution route planning services for the chemical products manufacturers, certainly the safe transportation services will be the most important part for the chemical products. Two transportation solutions could be chosen by customers: Direct transportation and RDC distribution. Customers could find their own option based on their products characteristics and manufacturing routings (see figure 11).

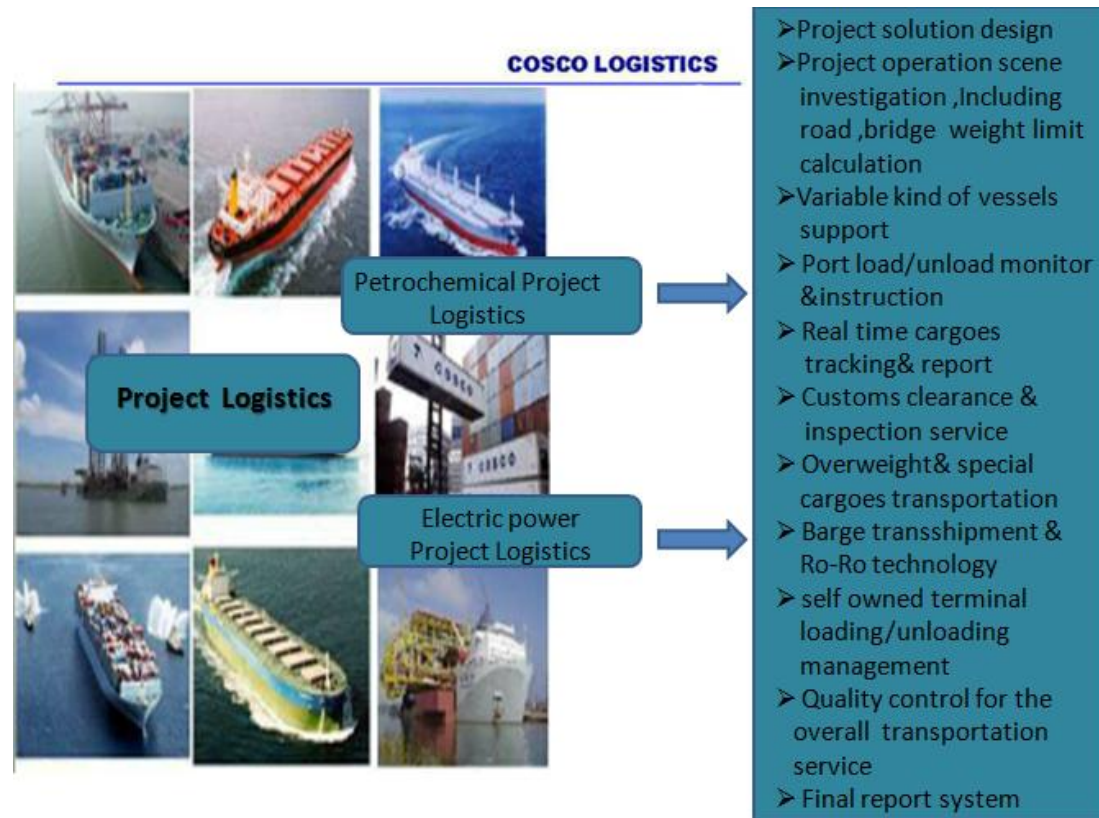
Figure 11. Chemical Products Logistics services of COSCO



Besides the Products Logistics, the Project Logistics service is also a significant component of COSCO Logistics 3PL services. There are mainly two types of project services are under operation: Petrochemical Project and Electric Power Project. To enable the project logistics services keep in viable and in efficiency, COSCO Logistics will participate in the project design job to work together with customers so as to perceive the project clearly and make out a complete logistics solution. Not only work out a solution on paper, COSCO Logistics will also carry out the pragmatic investigation at the reality scene that related with the logistics solution, such as to investigate a bridge or highway to see if it can accommodate the weight or length of the project objects. To ensure the smooth operation of project, COSCO Logistics will provide its specialized equipments and infrastructures to help the safe transportation. In this condition, Variety of vessels and self owned terminals will become the important support resources. In addition, with the strong IT system and strict quality

management standard, COSCO Logistics enables the visibility of the whole operation process of the solution. To customers, they could track the project operation in real time and get a final report for the logistics solution implementation (see figure 12).

Figure 12. Project Logistics services of COSCO



3.1.2 Ship Agent & Freight Forward Services of COSCO Logistics

COSCO Logistics as the biggest ship agent company in China, it has more than 80 sub-companies to provide ship agent services that cover all ports city of China and many overseas ports.

The ship agent company established special teams to serve the Liner vessels for slot sales, bookings acceptance, documents produce, freight rate calculation and data communication, which the whole service package of ship agent will be provided. There are four stages included in the Liner vessel services: 1. before the voyage begin, produce the voyage agent plan; 2. while vessel is in port, produce documents and communication telexes according to standard context, time and format, as well as

services guidance notes; 3. After vessel sailing, produce terminal departure report of vessels according to relevant liner companies requirement; 4. Voyage accounts settlement, produce identical voyage accounts bill and translate all charge items for entrusters convenience.

For voyage vessels (non-liner) agent services, COSCO agent will focus on the voyage time and port charge saving. Through its chief coordinator to provide vessels the comprehensive berthing and in-port services so to realize the minimum in-port cost. As for the oil tanks, iron ore bulk vessels, chemical vessels and other special vessels, COSCO agent will make customized solution to provide professional services.

Turning to the freight forwarder services, COSCO Logistics cooperated with many liner companies closely, so that it can provide customers with the lowest cost and the best time to transport cargoes all around the world. The freight forwarder of COSCO Logistics has professional operation abilities, which is familiar with customs clearance, inspections and quarantine regulations, and keeps good relationships with relevant authorities as well. Therefore, it can promise the smooth import and export of cargoes. In addition, the freight forwarder services also provide a whole package services for Less than Container Loading combination, container freight station storing, container trailer service and dangerous cargoes transportation.

Rely on the network of COSCO line around the world, the freight forward company established a global transportation system with the help of overseas agents, which enables it to carry out door to door services through intermodal transportation. The Intermodal transportation includes inner river transportation, railway transportation, truck transportation, sea and aero transportation. Especially for the aero and railway transportation that connect with ocean shipping , has improved COSCO Logistics comprehensive capabilities and realized the seamless effectiveness.

3.2 The performance of COSCOC Container Line before Logistics Services

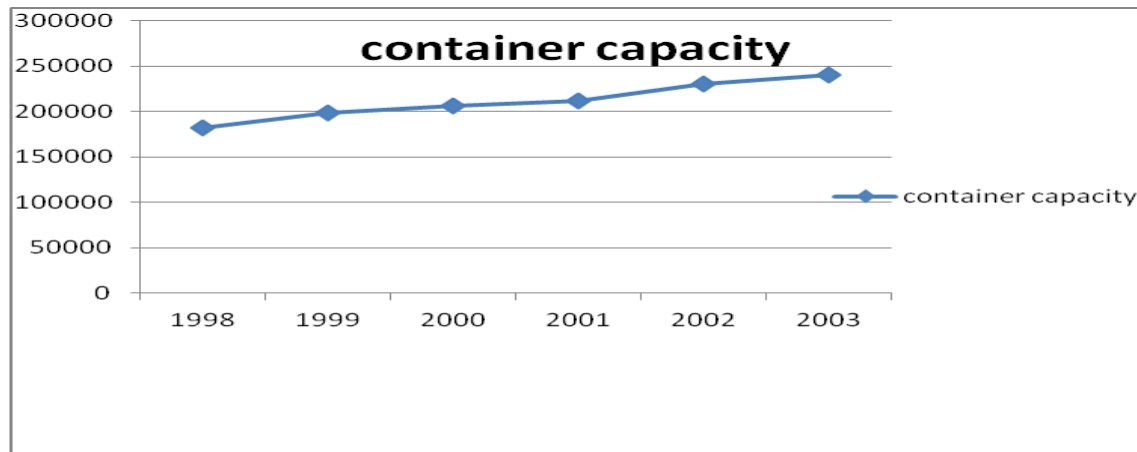
Launching

The COSCO Container Line is a sub-company, a specialized container transportation company, of the COSCO group. It was established in 1998 in Shanghai through a combination of the Shanghai Ocean transportation Company and COSCO Container Center. At the very beginning of the COSCO container Center establishment, COSCO has only one container vessel with 218TEUs capacity to provide only one international service that just between China and Australia. Until the merge with Shanghai Ocean transportation Company, COSCO Container Line became the most significant and well-known shipping line company in the world that possesses 118 container vessels with 182561TEUs capacity. At that time, COSCO line provided about 90 international and domestic services covering over 30 countries with almost 100 ports all around the world. To have a clear perception of the development and performance of COSCO Container Line after 1998 until its new Logistics strategy commencement, performance data from 1998 to 2003 are selected, so that a simple description and evaluation could be carried out. The selected data include the container vessel numbers and capacities, handling cargoes volumes and container line revenue. As before COSCO Container Line was not a public company, so to protect its privacy, the selected data were made some adjustments. However, a clear picture of COSCO line's development could still be depicted as bellow.

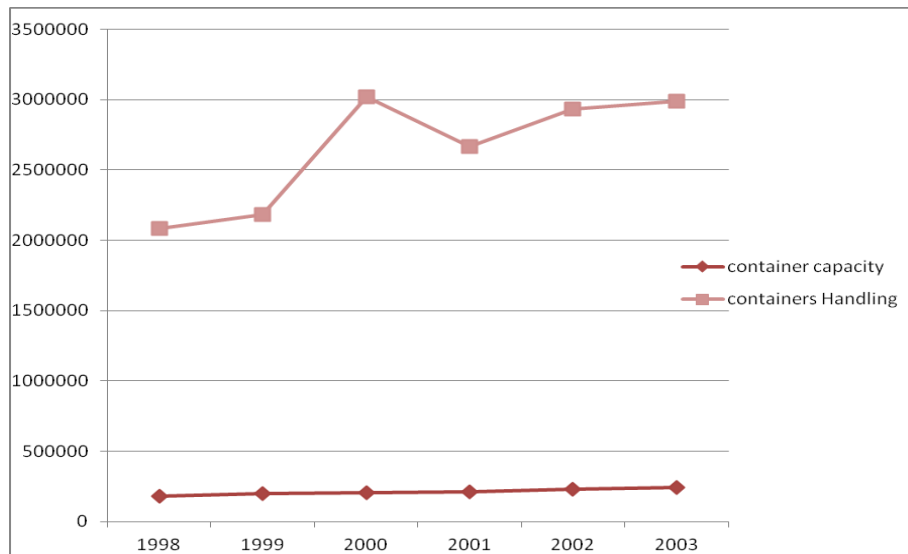
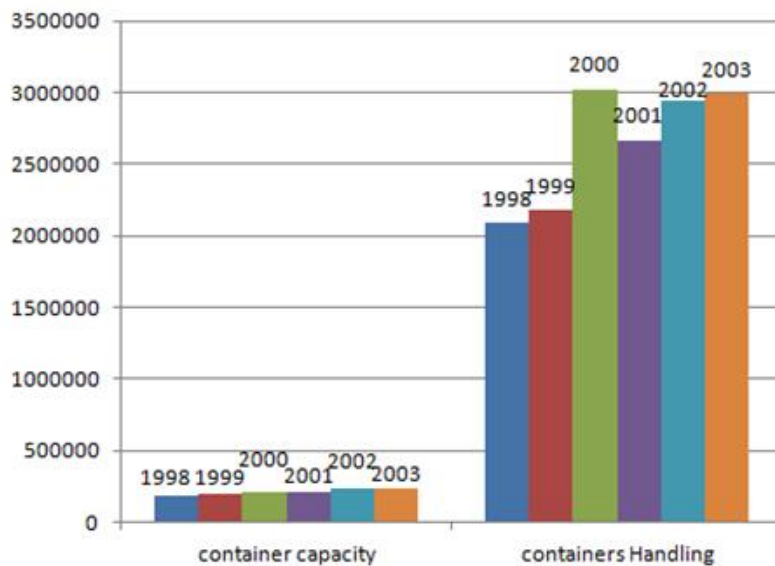
After the merge with Shanghai Ocean transportation Company, the fleet scale of COSCO Line experience a significant growth and become an important Liner service provider of the world. In 1998 its vessel number reached to 118 with 194891TEUs capacity, this fleet scale was ranked at the 7th position in the liner industry. Although the fleet scale of COSCO line was considerably large and kept in a stable market position, its fleet structure was quite old and needs to be rebuilt so as to follow the strong growth of the market needs. Although the vessel number was decreased from 118 to 111 between the year of 1998 and 2001, the capacity of COSCO still kept in a stable increase (see figure 13). This is because the fleet structure adjustment that the

old and low capacity vessels were substituted by the new vessels with bigger capacity. However, before the launching of logistics service, the fleet scale always kept stably under 120 vessels, and the capacity were around 200 thousand TEUs. Because after the merge, the liner market was in a fierce competition situation, especially after China joined the World Trade Organization (WTO) and opened its domestic market, which means the liner shipping giants like MAERSK line, APL, and NYK line can enter into Chinese market to challenge COSCO line directly. So the scale development of COSCO line was in quite discreet, the main efforts of COSCO line was focus on the customers developing for their revenue and capacity utilization.

Figure 13. The fleet container capacity of COSCO Line from 1998 to 2003(Units: TEUs)



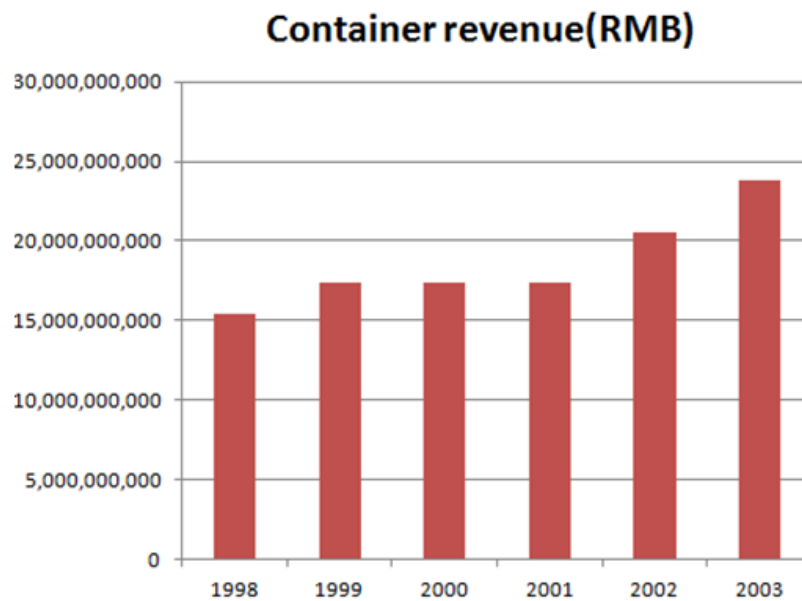
While look at the container handling volume, compared with the capacity growth, the handling volume has experienced a dramatic fluctuation before the logistics service launching (see figure 14). The highest volume of handling was in year 2000 which reached to 3023066TEUs. Compared with the lowest record during that period of 1998 to 2003, it almost has a 45% growth which was a significant improvement for the COSCO line. Although there was a fierce decreasing for cargoes handling in 2001 which was affected by the “9, 11” terrorist attack in U.S.A., the handling volume was almost get recovered to the same level as that of year 2000 before the beginning of logistics strategy. After all, the container cargoes handling volume has an important growth which was about 100 thousand TEUs, it is about 15 times volume as much as that of the capacity (see figure 15), which was an ideal capacity utilization record after the merger of 1998.

Figure 14. Container capacity and Containers Handling 1 (1998-2003)**(Unit:TEUs)****Figure 15. Container capacity and Containers Handling 2 (1998-2003)****(Unit:TEUs)**

Accompanied by the growth of container Cargoes handling, the container revenue of COSCO Line also experienced a considerable increasing. Although there was a slight down in 2001 because of “9,11”,the same reason as that caused the plummet of container handling volume, the revenue still got a 54% growth from 1998 to 2003,

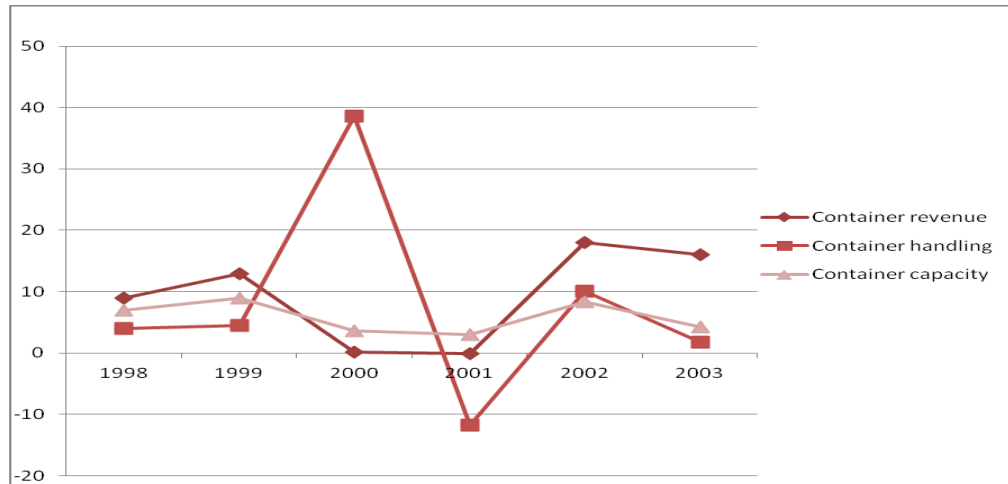
reached at about 24 billion RMB. The steady growth of the revenue signified the right strategy of COSCO line to develop market for customers acquiring and effective capacity utilization. However, the improvement of the revenue was not obviously enough Compared with that after the logistics services providing (comparison will be carried out in next chapter), which was fluctuated within 10 billion RMB (from 15 to 25) and still under the 25 billion RMB (see figure16).

Figure 16. Container Revenue of COSCO Line (1998-2003)



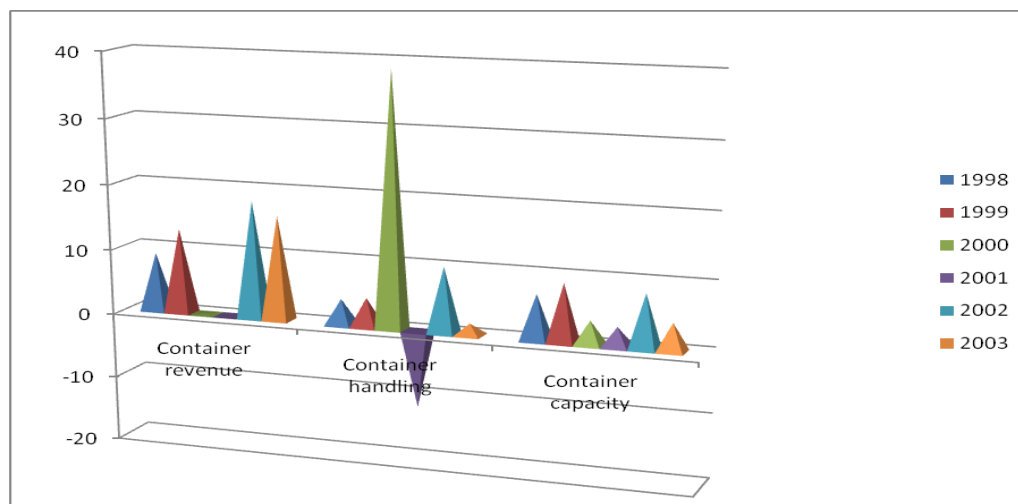
To show a clearer picture of the COSCO line performance before logistics services commencing, the growth rate of the container capacity, container handling volume and the container revenue are displayed as bellow figure 17 and 18. Same As before mentioned, the capacity growth rate kept in a considerably stable situation, except in 1999 and 2002 that the growth rate of capacity have about 8% positive change, in the rest of years during that period, the growth rate were all kept under 4% positive. As for the container revenue, there were almost no positive growth between 2000 and 2001; the growth rate in 2001 was even slightly negative. Although the revenue had a significantly positive change in 2002, the slow down growth rate of 2003 decreased to the same level as that of 1999.

Figure 17. Growth Rate of Container Revenue, Handling and Capacity 1(percent%)



Finally, the most dramatic fluctuation of the container handling volume before year of 2004 told that the handling cargoes volume growth rate could be easier affected by the macro- environment (like political factors). Although the other two growth rates (revenue and capacity) could be kept with little change and above the zero line, handling cargoes volume growth rate could be pulled up and down in a great extent.

Figure 18. Growth Rate of Container Revenue, Handling and Capacity 2(percent%)



From all the analysis about the performance of COSCO Line before the logistics services launching, the revenue and capacity utilization of COSCO Line kept in a quite stable situation with a little increasing during those 5 years. However, while turning to the growth rate of those three indicators (revenue, capacity and handling volume), all these three growth rates experienced the slow down and even negatively

growth. Therefore, the performance of the COSCO Line was not quite ideal, and needs to adjust the development strategy so as to improve its performance with strong capability to face the fierce competition and the uncertainty of the global economic environment.

3.3 The Hypotheses of the benefits of comprehensive logistics services after COSCO Logistics launching

In 2002, COSCO Container Line established its sub-company, the COSCO Logistics to provide customers with comprehensive logistics services including 3PL modern logistics, ship agency and freight forwarding services. This new strategy was carried out to satisfy the ever increasing service demands from customers. More importantly, it was aimed to follow the development trend of the shipping industry, so that COSCO Line could withstand the fierce competition of the international shipping market, especially after China joined the WTO and opened the domestic market to its strong rivalries. The direct challenge from the foreign shipping giants and the complicated economic environment impelled COSCO Line to implement this comprehensive logistics strategy. However, the effectiveness and validity of this new strategy need to be verified. To serve the verification purpose, three benefits hypotheses of the COSCO Logistics was made out as bellow:

Hypothesis 1: Liner companies' comprehensive logistics services benefit the major revenue results of shipping lines

Hypothesis 2: Liner companies' comprehensive logistics services help lines optimize Liners capacity utilization

Hypothesis 3: Liner companies' comprehensive logistics services become the significant part of liners revenue factor to resist the uncertainty of liner industry

To test these three hypotheses, the comparison of the major revenue, capacity utilization and main factors of the revenue before and after the logistics services launching will be carried out, so as to see if the logistics launching has affected these indicators in the significant extent. The most important part of the verification after

the comparison is the relationship validity test through a simple liner regression model between logistics services and major revenues, as well as the relationship with capacity utilization. Only through the founded correlation coefficient between these indicators with logistics services, the relationship validity could be verified.

For hypothesis 1, the turnover during the two different periods (Period 1: year 1998 to year 2003, Period 1: year 2004 to year 2010) will be used. If the later period turnover has a significant growth (not only the absolute quantity has an increasing, but also the turnover growth rate has a stronger growth than before), and the relationship between the logistics services and the turnover has been verified as valid, then the hypothesis stands. Otherwise, the hypothesis will be denied.

For the hypothesis 2, the data of container capacity and the handling containers volume (TEUs) will be used to make comparison between the different periods that before and after the comprehensive logistics services launching. If the indicator has an obvious increasing accompanied by the logistics services development and the relationship between the handling capacities and logistics services is clarified in positive connection, then this hypothesis will be defined as valid. If there is no positive connection or no valid relationship, the hypothesis will be denied.

For the last hypothesis, the data of logistics revenue, container revenue and the total turnover will be applied to make an analysis. The percentage of logistics revenue in total turnover and that of the container revenue will be used to make a comparison, so as to verify if the logistics revenue has increased to a significant extent and affected the structure of the total turnover. In addition, a simple sensitivity analysis will also be carried out between logistics revenue and total turnover to further test the relationship between these two indicators. If the percentage of logistics revenue in the total turnover has a positive growth, and to make up the container revenue losses to some extent if there is percentage decreasing for container revenue, this can identify the significant role of logistics revenue for the total turnover. Furthermore, if the simple

sensitivity outcome also shows the close relationship between logistics revenue and total turnover, which means that the changing of logistics revenue could affect that of the total turnover in the same direction sensitively, then the hypothesis is valid. Otherwise, the hypothesis will be denied if either of the above two tests failed.

Chapter 4 Data analysis and hypotheses test of benefits of COSCO logistics

4.1 Hypothesis 1test and Performance Comparison: Logistics services benefit the total turnover

To test the first hypotheses, which assumes that the comprehensive logistics services of COSCO could benefit the total turnover of the COSCO Line, data of logistics revenue and total turnover was collected from year 2004 to 2010. For the most significant relationship clarification between the logistics revenue and total turnover, the simple linear regression analyzing approach will be used to establish a prediction model as following:

$$\hat{Y}_t = a + bx_t$$

In above formula, Y_t represents the total turnover, which means the dependent variable during the time period of t . X_t represents the logistics revenue, which means the value of Independent variable during the time period of t , a 、 b represent the parameter of the simple linear regression equation.

Parameter a 、 b can be calculated through below equation(\sum represents $\sum_{i=1}^n$):

$$\begin{cases} a = \frac{\sum Y_i}{n} - b \frac{\sum X_i}{n} \\ b = \frac{n \sum X_i Y_i - \sum X_i \sum Y_i}{n \sum X_i^2 - (\sum X_i)^2} \end{cases}$$

To simplify the calculation, several definitions are made as below:

$$\begin{cases} S_{xx} = \sum (X_i - \bar{X})^2 = \sum X_i^2 - \frac{(\sum X_i)^2}{n} \\ S_{yy} = \sum (Y_i - \bar{Y})^2 = \sum Y_i^2 - \frac{(\sum Y_i)^2}{n} \\ S_{xy} = \sum (X_i - \bar{X})(Y_i - \bar{Y}) = \sum X_i Y_i - \frac{\sum X_i \sum Y_i}{n} \end{cases}$$

$$\bar{X} = \frac{\sum X_i}{n}, \bar{Y} = \frac{\sum Y_i}{n}$$

After the definition, a、 b can be get by below new formula:

$$\begin{cases} a = \bar{Y} - b\bar{X} \\ b = \frac{S_{xy}}{S_{xx}} \end{cases}$$

Then put the parameter a、 b into the simple linear regression equation $Y_t = a + bx_t$, the prediction model can be established , therefore, as long as the x_t is given , the prediction value of \hat{Y}_t can be calculated out.

In addition, in the simple linear regression model, the correlation between x、 Y also needs to be clarified for the relevance degree and direction measurement of variables. The correlation coefficient (r) needs to be calculated as below:

$$r = \frac{\sum (x_i - \bar{X})(Y_i - \hat{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} = \frac{S_{xy}}{\sqrt{S_{xx} \bullet S_{yy}}}$$

Just as mentioned in the methodology chapter, the correlation coefficient r is between the values scope as $-1 \leq r \leq 1$. if $r > 0$, the variables have positive linear correlation, that is if X_i get increased, then Y_i will get increased in linear as well. If $r < 0$, it's a negative linear correlation, that means if X_i get increased, then Y_i will get decreased in the linear relationship. In addition, if $|r|=0$, then there is no linear correlation between X and Y; if $|r|=1$, then X and Y have complete linear correlation ; if $0 < |r| < 1$, there is linear correlation between X and Y: $0.7 \leq |r| < 1$ means

high linear correlation; $0.4 \leq |r| < 0.7$ means obvious linear correlation; $|r| < 0.4$ means low linear correlation.

After above definition of linear regression calculation formula and prediction model establishment, the collected data of logistics revenue and turnover from 2004 to 2010 could be processed through the spread sheet of Microsoft Excel, and got the outcome as below:

$$\hat{Y}_t = a + bx_t, \text{ Turnover} = 7.414289164 * \text{logistics revenue} - 5738490435$$

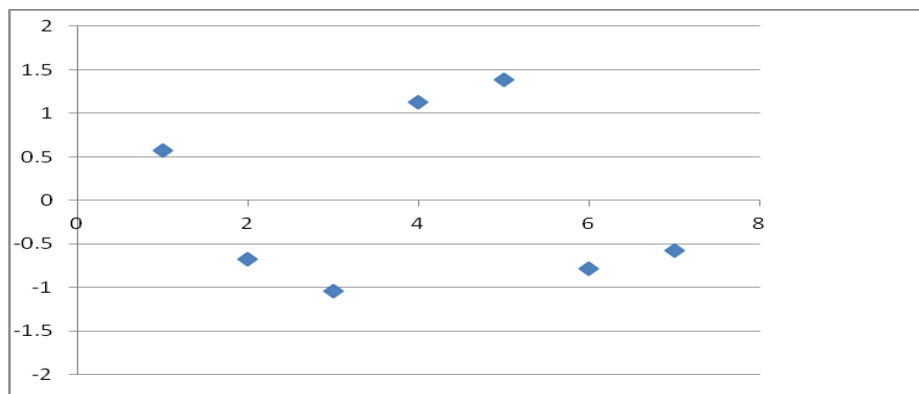
Table 3. Output of the linear regression prediction analysis for Turnover and Logistics revenue

SUMMARY OUTPUT			
Correlation Coefficient	0.808400914	Coefficients	
R Square	0.653512038	Intercept	-5738490435
Adjusted R Square	0.584214445	X Variable 1	7.414289164
Standard Deviation	24031207004		
P-value(Significance F)	0.027754908		
RESIDUAL OUTPUT			
Observations	Estimated Y	Residuals	Standard residuals
1	18041274261	12485857283	0.569158734
2	55079322088	-14916729088	-0.67996826
3	73428568210	-22761219210	-1.037553644
4	82060461598	24813433402	1.131102337
5	1.00388E+11	30297774919	1.381102061
6	84174883410	-17170619410	-0.782710213
7	1.0705E+11	-12748497895	-0.581131016

From the output table, the significance F (same as p value) is 0.027754908, which means the linear regression model is a valid statistics study ($0.05 \geq p > 0.01$), it also told that there is significant linear regression relationship between X and Y (logistics revenue and total turnover). Although the R square only got 0.653512038, which is not quite ideal as in linear regression model, because R square measures the Goodness of fit of the equation, the bigger the values of R square, the better of the fitness of the

equation, and there is stronger linear relation between variables. But from the other side of the Estimated Turnover(the Standard residuals), the absolute values of the Standard residuals are relatively small, which are scattered within the scope between (-2, 2)(see figure 19), this means the confidence degree is reliable, it proved the ideal situation of Goodness of Fit between the equation and the observation value, which means there is still an obvious linear relationship between the variables of X and Y. In addition, the Correlation Coefficient is 0.808400914, which is a positive value and within the scope of $0.7 \leq |r| < 1$, it also means high linear correlation exists between the logistics revenue and total turnover, and the variables have positive linear correlation, that is if logistics get increased, then the turnover will get increased as well.

Figure 19. the Standard residuals of the estimated Turnover from the linear regression analysis



So as a result, the linear regression model for the first hypothesis is valid to some extent and there is a positive linear correlation between logistics revenue and the turnover of COSCO Line. After this relationship verification through the linear regression prediction, the practical performance comparison of the total turnover during two periods will be described as bellow so as to give a pragmatic picture to verify the benefits of logistics services to the total turnover of COSCO Line.

As can be seen from the figures 20 and 21, the absolute logistics revenue got continuously stable increasing from 3 billion RMB to about 15 billion RMB after year 2004 till 2010, except in the year of 2009 which had a slightly decreasing accompanied by the same situation of the total turnover of COSCO Line. Such a same

changing trend between logistics and turnover well explained the linear correlation of the two variables, and testified the logistics services affects for the total turnover that the continuously improvement and expansion of the COSCO Logistics services will benefit the total turnover of the COSCO Line.

Figure 20. Logistics revenue and Total turnover of COSCO Line 1(Year 2004-2010)

(Units:RMB)

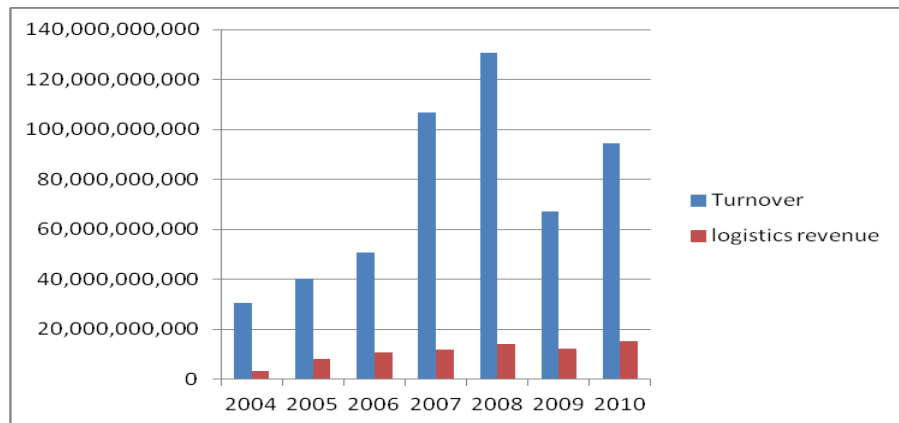
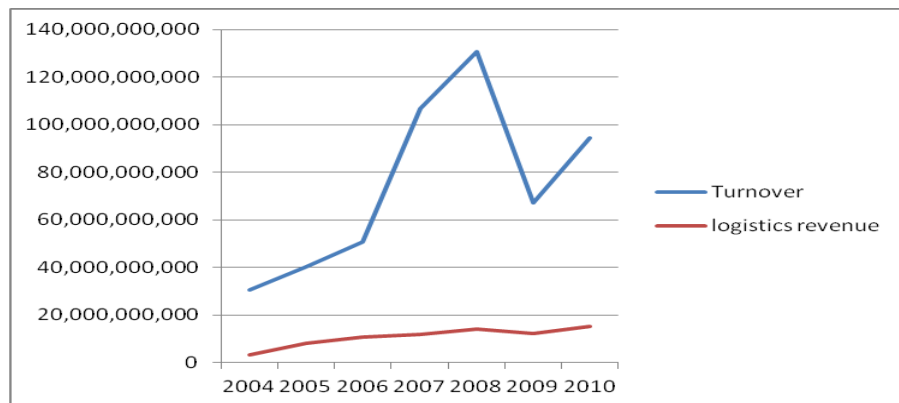


Figure 21. Logistics revenue and Total turnover of COSCO Line 2(Year 2004-2010)

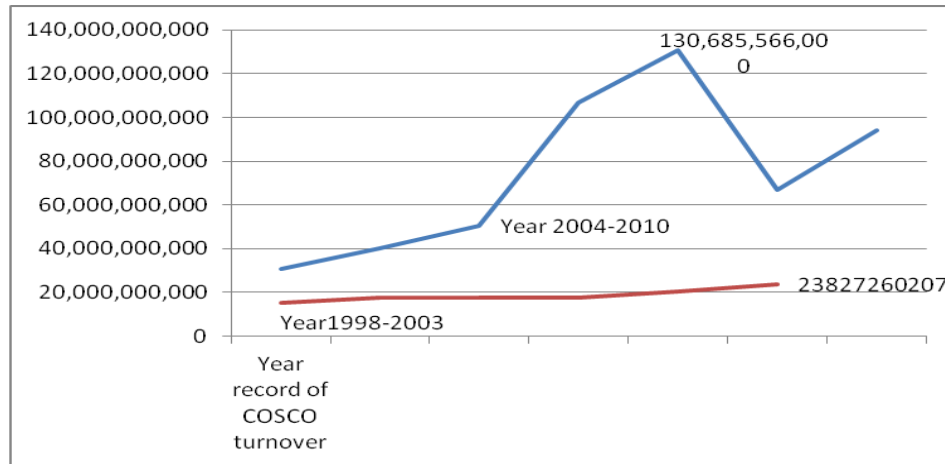
(Units:RMB)



To further clarify the benefits of logistics services for total turnover, the comparison of the two periods' turnover and turnover growth rate are made as in figure 22 and 23. Before the logistics services launching, the total turnover of COSCO Line stayed around 20 billion RMB, the highest record was about 24 billion RMB in 2003. After the logistics services launching, there was a significant increasing for the total turnover, the highest record broke the roof of 100 billion RMB to 130 billion RMB. Although there was a plummet in 2009, the turnover still remain above 60 billion RMB,

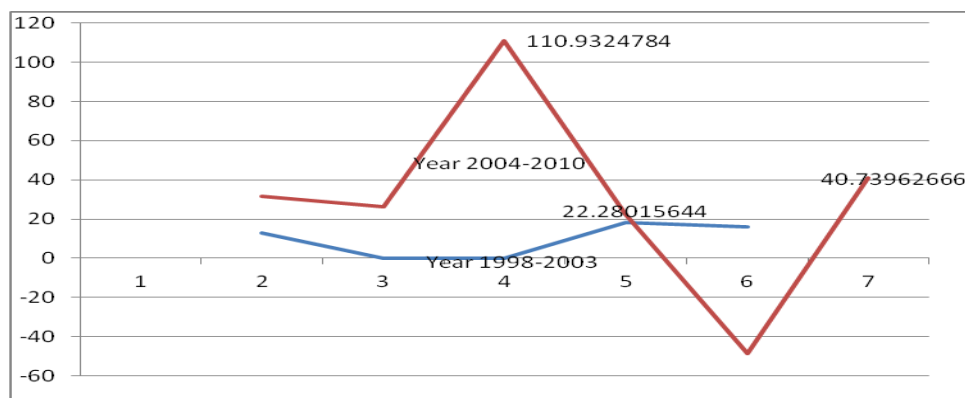
which was still 2 times more than that of the highest record before the logistics services launching.

Figure 22. Total turnover comparison for the two periods before and after logistics launching(Year 1998-2003 and Year 2004-2010)



Regarding with the growth rate of the total turnover, before the logistics strategy, the highest growth rate was recoded at 18%. But after the logistics strategy carried out, the growth rate increased dramatically, which was even recorded as 110%. Although in 2009 there was a negative record of -40%, the growth rate of the total turnover still had a significant improvement compared with the mono-strategic period.

Figure 23. Turnover growth rate comparison between periods of Year 1998-2003 and Year 2004-2010 (Units:%)



With the reality data support, and the verification of the linear correlation between logistics revenue and total turnover of COSCO Line, the hypothesis 1 about the benefits of the logistics services could contribute to the turnover of COSCO Line stands in steady.

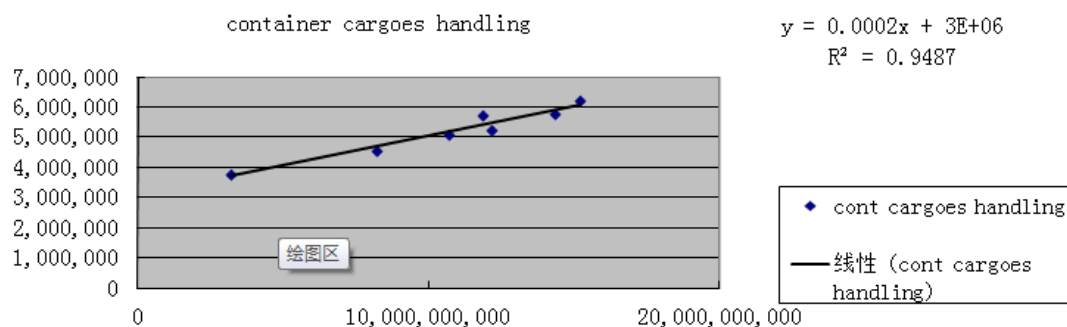
4.2 Hypothesis 2 test and Performance Comparison: COSCO Logistics services benefit the Liners capacity utilization

To test the second hypothesis about the COSCO logistics services benefit the Liners capacity utilization, data of logistics revenue and the handling volume of container cargoes were collected from year 1998 to 2010. Same as hypothesis 1, the first step of the test is the relationship verification between the two variables of logistics revenue and the handling containers volume. The simple linear regression approach will also be applied to make prediction model so as to clarify the validation of the linear correlation between the variables. Use the same equation in hypothesis 1 and processed the data with the spread sheet of Microsoft Excel, the result are as follows (see table 4 and figure 24):

$$\hat{Y}_t = a + bx_t, Y = 0.0002x + 3062337$$

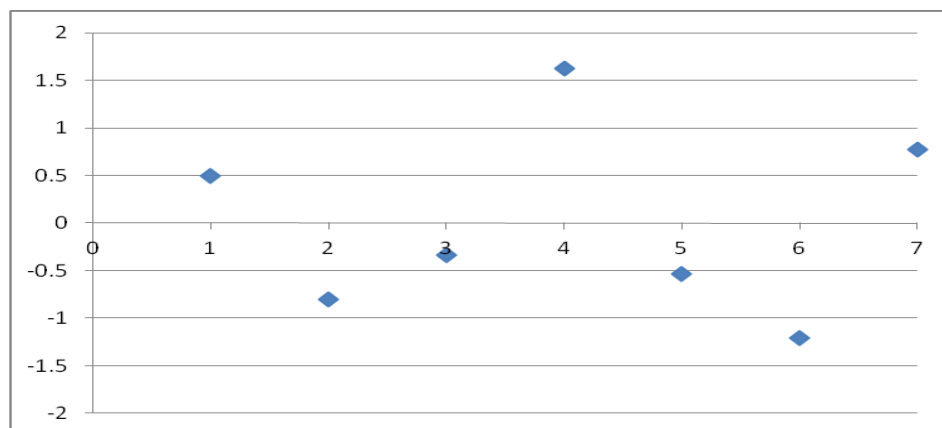
In above equation, the linear regression model was established in the same way as that of hypothesis 1, Y_t represents the container cargoes handling volume, which means the dependent variable during the time period of t . X_t represents the logistics revenue, which means the value of Independent variable during the time period of t , a 、 b represent the parameter of the simple linear regression equation.

Figure 24. The linear correlation between logistics revenue and containers handling volume



From the output table, the significance F (same as p value) is 0.0206566, which means this linear regression model is a valid statistics study ($0.05 \geq p > 0.01$), and there is significant linear regression relationship between X and Y (logistics revenue and containers handling volume). The R square is 0.948664416, which is a quite ideal value as in linear regression model, because R square measures the Goodness of fit of the equation, the bigger the values of R square, the better of the fitness of the equation, so there is stronger linear relation between these two variables. In addition, from the aspect of the estimated containers handling volume (the Standard residuals), the absolute values of the Standard residuals are relatively small, which are scattered within the scope between (-2, 2)(see figure 25), this means the confidence degree is reliable, it also proved the ideal situation of Goodness of fit between the equation and the observation value, which means there is still an obvious linear relationship between the variables of X and Y. for the most important value of Correlation Coefficient, which is 0.973994053, it is a positive value and within the scope of $0.7 \leq |r| < 1$ and that is very close to 1, it also means very high linear correlation exists between the logistics revenue and containers handling volume, and the variables have positive linear correlation, that is if logistics get increased, the containers handling volume will get increased as well.

Figure 25. The Standard residuals of the estimated containers handling volume from the linear regression analysis



After above linear regression prediction, the strong liner correlation between logistics revenue and container handling volume was proved, and the logistics revenue will affect the container handling volume in a positive direction. From figure 26, a significant increase of container handling volume can be seen after COSCO provide its comprehensive logistics services after 2002. Before the logistics strategy launching, the handling container volume always stayed below or around 3 million TEUs, after

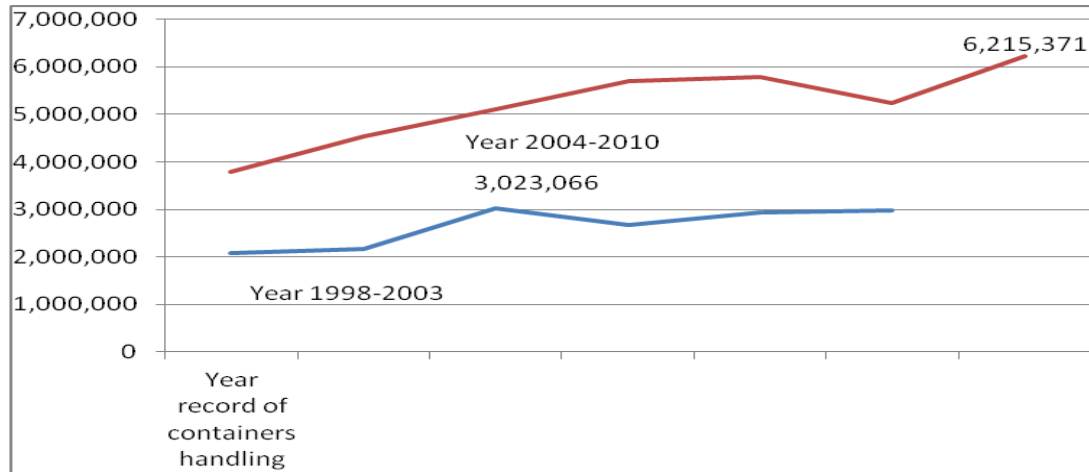
Table 4. Output of the linear regression prediction analysis for containers handling volume and Logistics revenue

SUMMARY OUTPUT			
Correlation Coefficient	0.973994053		Coefficients
R Square	0.948664416	Intercept	3062337.251
Adjusted R Square	0.938397299	X Variable 1	4796.594593
Standard Deviation	204795.9345		
P-value(Significance F)	0.0206566		
RESIDUAL OUTPUT			
Observations	Estimated Y	Residuals	Standard residuals
1	4037175308	-829886763.8	-0.901387273
2	7616192736	586591264.1	0.637130176
3	10381563823	296069176.8	0.321577593
4	13247106992	-1405249992	-1.526322039
5	13650227191	663522808.6	0.720689907
6	10972283634	1154755366	1.254245562
7	15678121860	-465801860.1	-0.505933926

2004 till 2010, the container handling volume got a 2 times increase reached over the 6 million record. Meanwhile, after the logistics strategy, the capacity of COSCO Line has also got an important development, the vessal number increased to 150 from 111 and the capcity reached to 614092 TEUs from 182561 TEUs. Under this capacity improvement situation, the container handling volume still kept in a strong growth trend, and the capacity utiliztion indicator (Handlin Volume TEUs/ Capacity TEUs) stayed in the same level of about110% as that of the before smaller fleet scale, the logistcs services has contributed a significant part to the capacity utilization with the positive affect on the container handling volume. So as in result, the logistics services development of COSCO do benefit its capacity utilization with its significant

contribution to the container handling volume increasing. The hypothesis 2 stands in the valid position.

Figure 26. Container handling volume comparison for the two periods before and after logistics launching(Year 1998-2003 and Year 2004-2010)(UNITS:TEUs)



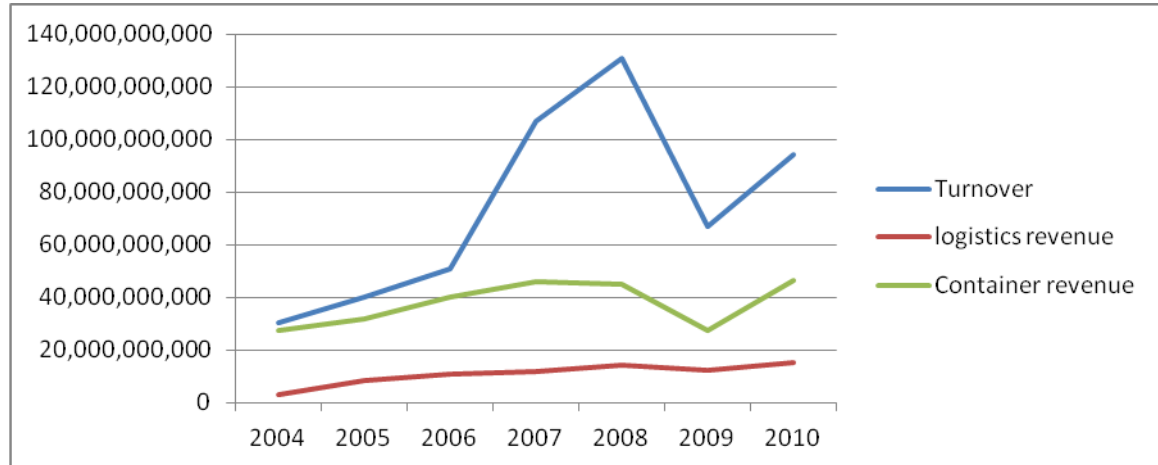
4.3 Hypothesis 3 test and Performance Comparison: COSCO logistics services become the significant part of liners revenue factor to resist uncertainty

To test this hypothesis, data of the COSCO turnover, logistics revenue and container revenue will be collected to make analysis. As showed in the figure 27 and 28, at the beginning year of the logistics strategy launching, the container revenue was still the major part of COSCO's turnover. In 2004, the container revenue was about 27 billion RMB, which took up 89% of the total turnover of COSCO Line. Meanwhile, the logistics revenue was only about 10% of the total turnover which was recorded at about 3 billion RMB. However, in year 2006, although the container revenue got a 12 billion RMB growth, its proportion in total turnover slipped to 78%, there was an almost 10% decrease. On the contrary, the logistics revenue in 2006 had a 3 times increasing compared with that of 2004, which was about 10 billion RMB and recorded as 21% of the total turnover, a significant sector growth for the COSCO Line revenue. The significant contribution of logistics revenue was occurred in year 2008 and 2009 when there was a severe global economic crisis. Both of the proportion of the container revenue and logistics revenue experienced a dramatic decreasing in 2008 compared with that of 2006, more than half was lost for container proportion

which only got 34% left and the same situation for the logistics revenue as well.

Figure 27. The total turnover, container revenue and logistics revenue of COSCO

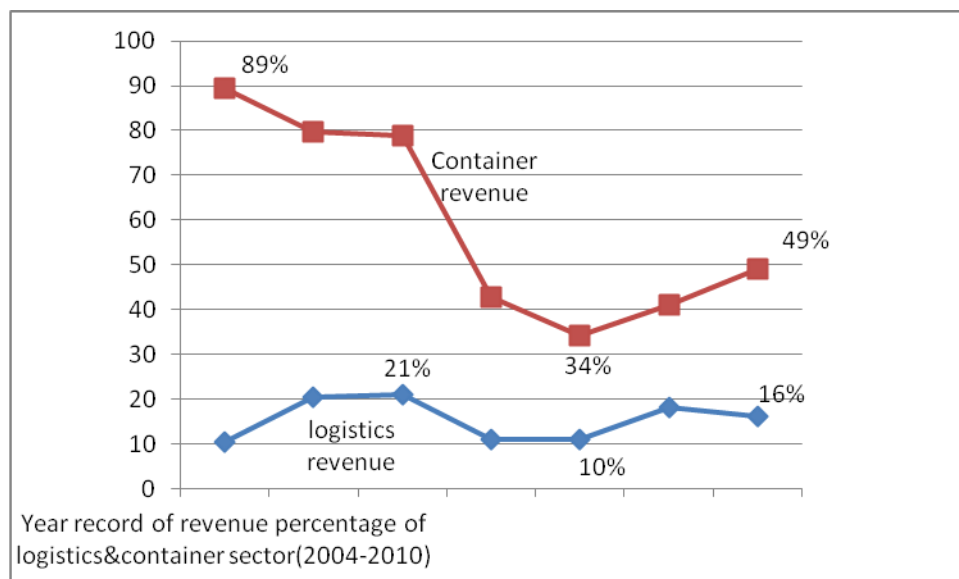
from year 2004 to 2010(Units: RMB)



However, the logistics revenue still kept the proportion of 10% which was the same as that of 2004. But in the next year of 2009, the container sector slipped into a worse situation, the container revenue plummeted to the lowest record after the logistics strategy launching, only 27 billion RMB was recorded, the same record as that of the year of 2004. And the container proportion only got 41% left in the total turnover.

Figure 28. The respective proportion of container revenue and logistics revenue in total turnover

from year 2004-2010(Units:%)



Fortunately, although the logistics revenue had a slightly decreasing compared with that of the year of 2008; the 12 billion RMB logistics revenue helped it take up about

18% of the total turnover of COSCO Line, and the revenue has almost 3 times increasing compared with the logistics revenue in 2004. Although there was a slightly recover for the container revenue in 2010, and the logistics proportion had a 2% decreasing, the important contribution of the logistics revenue for the total turnover of COSCO Line is obvious, especially for the lost make up during the serious global economic crisis that the logistics services could ensure a stable revenue to resist the uncertainty of the macro-environment to some extent.

After the revenue comparison between logistics sector and container sector of COSCO, to further test the importance degree of logistics revenue in the total turnover, a simple sensitivity analysis between logistics revenue and turnover was made out as bellow, in the analysis, a simple sensitivity model was established by using the linear regression equation got from the first hypothesis. From hypothesis 1, the linear relation equation between logistics revenue and turnover as following:

$$\hat{Y}_t = a + bx_t, \text{ Turnover} = 7.414289164 * \text{logistics revenue} - 5738490435$$

The sensitivity model used the logistics revenue of year 2010(X_1) as a beginning data; then to change the logistics revenue within the scope between 20% and -20%, and 5% sensitivity changing(N_x) was applied to calculate the new logistics revenue (X_t).

$$X_t = (1 + N_x) * X_1, N_x = (20\%, -20\%) \quad X_1 = 15,212,320,000$$

Then through the linear equation, the new turnover (Y_t) was got, compared with the beginning turnover (Y_1), the sensitivity changing of the turnover (N_y) can be calculated out (see Table 5).

$$N_y = \frac{(Y_t - Y_1) * 100\%}{Y_1}$$

From the simple sensitivity analysis, the result showed a very sensitive relationship between the logistics revenue and turnover (see figure 29). While the logistics

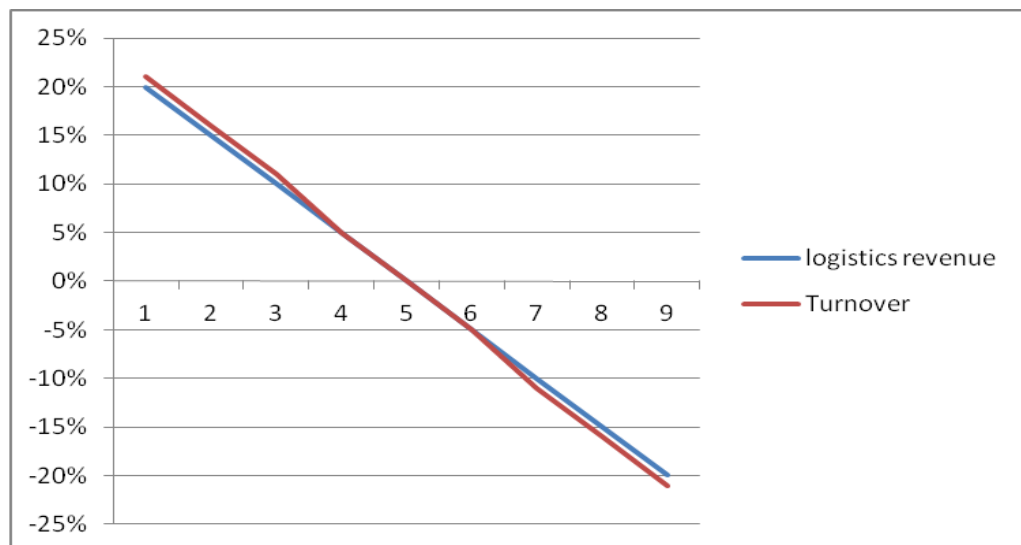
revenue got 20% increasing, the outcome of the turnover would have a 21% increasing. And once there was more than 5% changing in logistics revenue, the sensitivity changing of turnover would get a 1% more than that of the logistics changing. If the changing degree was within 5%, the turnover would have the same sensitivity changing as that of the logistics revenue. So the turnover could be affected

Table 5. Result of the simple sensitivity analysis between logistics revenue and total turnover

logistics revenue(X_1)			Turnover(Y_1)
15,212,320,000			107,050,213,741
N_x	logistics revenue(X_1)	Turnover(Y_1)	N_y
20%	18,254,784,000	129,607,954,576.14	21%
15%	17,494,168,000	123,968,519,367.34	16%
10%	16,733,552,000	118,329,084,158.54	11%
5%	15,972,936,000	112,689,648,949.74	5%
0%	15,212,320,000	107,050,213,740.94	0%
-5%	14,451,704,000	101,410,778,532.14	-5%
-10%	13,691,088,000	95,771,343,323.34	-11%
-15%	12,930,472,000	90,131,908,114.54	-16%
-20%	12,169,856,000	84,492,472,905.74	-21%

by the logistics revenue in a considerably high sensitivity, which means the turnover could be affected by the logistics revenue easily with almost the same changing direction and percentage degree as that of the logistics revenue.

Figure 29. The sensitivity changing of Turnover affected by logistics revenue

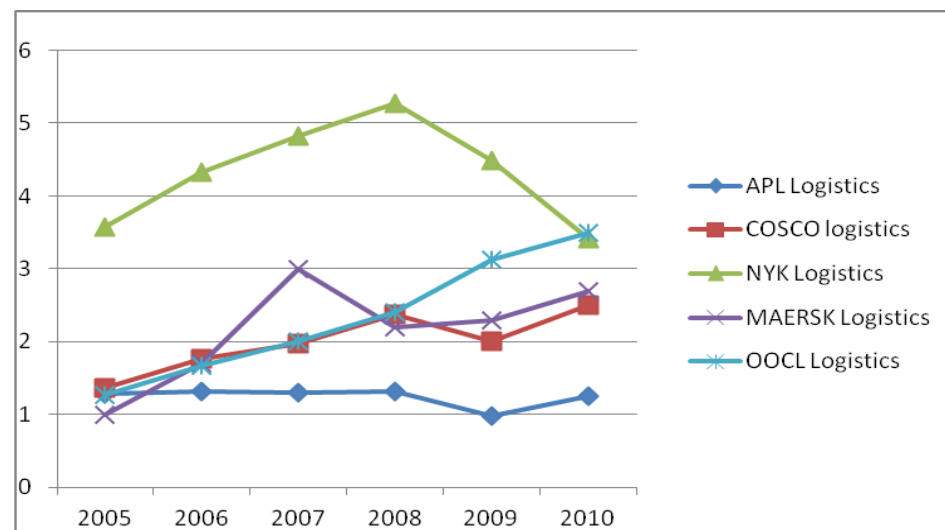


As a result for the hypothesis 3, the logistics revenue do become the major part of the total turnover of COSCO Line, especially when there was a downtime of the container revenue, the logistics revenue become a significant revenue to mke up the lost to some extent. More importantly, the logistics revenue could also affect the total turnover in a quite sensitive degree. With the further development of the comprehensive logistics services of COSCO Logistics, the significant contribution of the logistics revenue could help the liner company to fight against the complicated uncertainty of the macro-environment.

4.4 Comparison of COSCO Logistics with Other major carriers

After the hypotheses analysis of the COSCO logistics benefits, all the results showed that the comprehensive logistics services of COSCO do bring advantages to the whole operation of the COSCO Line. However, as an inevitable evolution trend for the shipping line industry, the international industrial community will not neglect this significant opportunity of comprehensive logistics services development for the business expansion. Major carriers like MAERSK, NYK, APL and OOCL have also regarded the comprehensive logistics services as their development strategies to keep competitive advantages. To have a preliminary perception about the logistics strategy development of the international shipping line community, a simple comparison

Figure 30. Logistics revenue of major carriers from Year 2005-2010(Units:billion US\$)



Source: Annual Report of carriers published on website(NYK,MAERSK,APL,OOCL,COSCO)

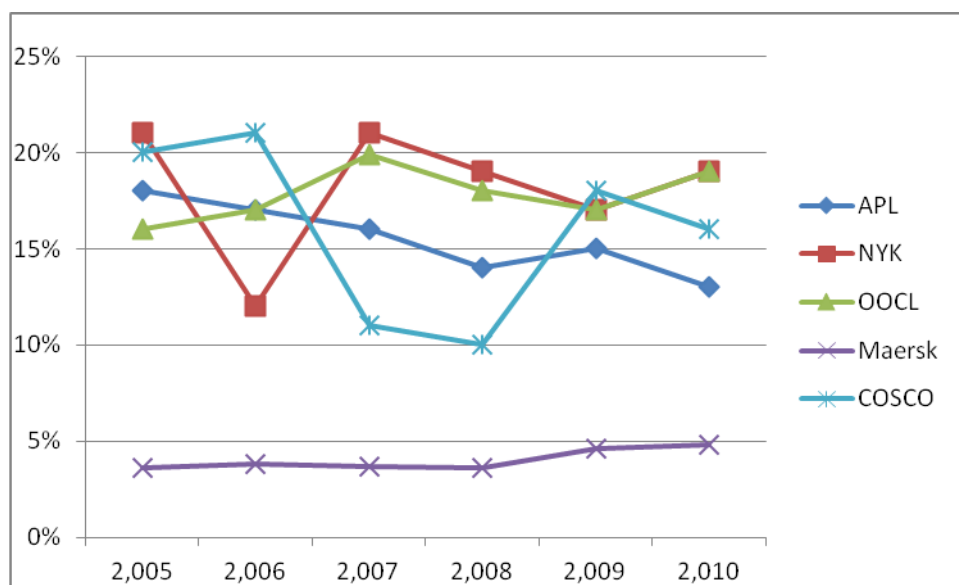
between COSCO Logistics with other major carriers' logistics performance was carried out. Logistics revenue of five major shipping line companies from year 2005 to 2010 were collected, and the respective turnover as well.

As can be seen from the figure 30, the logistics revenue of NYK was quite outstanding compared with other four carriers. In January 2004, NYK restructured its overseas subsidiaries under the NYK Logistics brand, draws on both of its management resources accumulated over many years in the shipping business and global partnerships with customers to build supply-chain management systems for high-quality services that encompass everything from marine and air transportation to warehousing, land transportation and harbor terminal operations (NYK, 2004). After its resources consolidation, the NYK Logistics revenue experienced a significant increasing from 3.2 billion US\$ in 2005 to about 5 billion US\$ in 2008, which was almost 2 times more than that of COSCO, MAERSK and OOCL in 2008, and was 4 times more than APL. Although affected by the economics crisis after 2008, NYK logistics revenue still kept over 3 billion US\$ in 2010. So as an important strategy for the whole group, the NYK logistics regarded as significant revenue resource. Form year 2005 to 2010, the revenue of NYK logistics always kept around 20% contribution to the total turnover except the year of 2006 (see figure 31&32)(NYK, 2010), compared with COSCO logistics, the NYK logistics was a relatively matured competitor with stronger resource focusing on the comprehensive logistics strategic development.

As a world-class provider of innovative logistics and supply-chain services and solutions, the OOCL Group's strategy is to build and leverage its IT capabilities on their existing open platforms that provide superior quality and cost efficiency for Transportation and Logistics applications. OOCL Logistics has an extensive network of some 92 offices in 30 countries around the world providing advanced customer-specific solutions through their IT technology and value-creating services in

supply-chain management; through innovative end-to-end international logistics services, the OOCL Logistics' International logistics group focuses on serving customers with global sourcing and supply-chain-management needs(OOCL, 2010). As showed in figure 30, the revenue of OOCL logistics had a significant growth from 1.2 billion US\$ in 2005 to about 3.5 billion US\$ in 2010. Rely on its considerably advanced IT technology, its logistics services become its important part of total turnover, which steadily increased from 16% in 2005 to about 20% in the year of 2010(see figure 31 &32). This significant increasing made its logistics revenue reach at the same level as NYK logistics, which makes OOCL logistics strong competitor in this strategy expansion field of liner companies.

Figure 31. Logistics revenue of major carriers 1 (proportion in turnover) from Year 2005-2010



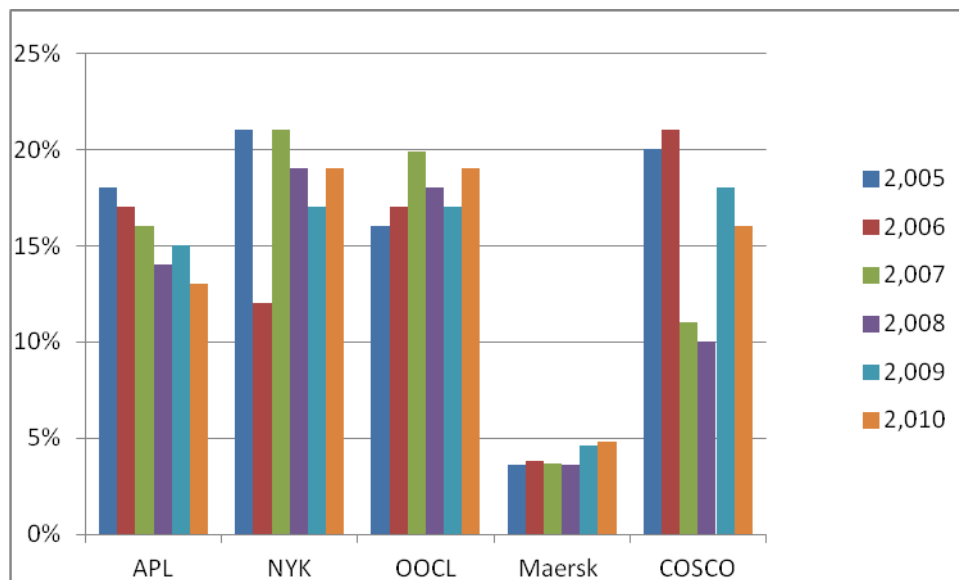
Source: Annual Report of carriers published on website(NYK,MAERSK,APL,OOCL,COSCO)

Turning to the Giant liner company of MAERSK, its logistics services sub-sector of Maersk Logistics/Damco is also the 10th largest global supplier of Supply Chain Management (SCM) and forwarding services. Maersk Logistics/Damco has offices in more than 90 countries, operates in two business areas: Forwarding activities that are marketed under the Damco name, and Global Supply Chain Management solutions under the name of Maersk Logistics. Although it's logistics revenue was recorded as the same level of COSCO (see Figure 30), its logistics revenue only took up about 5%

proportion in MAERSK total turnover in 2010. But it doesn't mean MAERSK logistics service is in the inferior position. On the contrary, due to the diversified business strategy of MAERSK, the Maersk Logistics/Damco will play an indispensable role for the MAERSK development. From figure 31 and 32, an obvious improvement of MAERSK logistics can be seen clearly (MAERSK, 2010). Supported by the superior shipping network of MAERK Line and stronger resourcing capability (including capital resourcing and business resourcing), the future of MAERSK logistics should not be underestimated.

The last carrier in this comparison is APL logistics. APL Logistics designs and operates global supply chains that deliver products to everywhere around the world. Their innovative end-to-end solutions use data connectivity for greater visibility and control so as to provide the resources to support customers supply chain, their services include: Supply chain design and engineering; Shipment consolidation and deconsolidation; Global freight forwarding and customs management; Regional warehousing and distribution networks management; IT solutions that increase supply

Figure 32. Logistics revenue of major carriers 2 (proportion in turnover) from Year 2005-2010



Source: Annual Report of carriers published on website(NYK,MAERSK,APL,OOCL,COSCO)

chain performance within manageable costs. As can be seen from figure 30, the logistics revenue of APL kept in a relatively lower level compared with other four liner companies, and its logistics revenue proportion in total turnover decreased from

18% in 2005 to about 13% in year 2010(see figure 31 and 32) (APL,2010). Compared with other four carriers, APL logistics had no obvious competitive edge, but its following strategy in logistics services still told that to provide comprehensive logistics services is a common development perception for liner companies.

From above simple comparison for the major carriers' logistics services development, the significance of the comprehensive logistics services for liner companies is obvious. Liner companies regard this logistics strategy as their new business opportunity for revenue increasing, and an important way to provide customers with satisfied services. In this logistics sector, although COSCO Logistics has achieved a preliminary success, compared with other Liner companies, COSCO Logistics has no outstanding advantages to ensure its future development in this field. COSCO Logistics needs to differentiate himself from other major rivalries so as to make the comprehensive logistics services as its competitive edge and as its stable revenue point to mitigate the negative effects of the uncertain economic environment for the frangible shipping line industry.

Chapter 5 Conclusion

5.1 Conclusion of COSCO Logistics study

As a significant strategy for COSCO Line, the comprehensive logistics services not only benefit the total turnover of the parent company, but also influence the liner capacity utilization in a positive way. After the data analysis and hypotheses test, COSCO Logistics revenue was proved to be a major part of the total turnover for the liner company which will affect the total revenue in the same linear direction. With the comprehensive logistics services, the container handling volume of COSCO has increased to a considerable level and capacity utilization stayed in a stable situation while the fleets scale of COSCO had an advanced development both in technique and slot space. More importantly, the COSCO Logistics has already taken up about 20% proportion of the total turnover of COSCO Line and could make up the lost of the

container sector to some extent, which made COSCO logistics an indispensable factor to fight against the uncertainty of the macroeconomic environment. However, as a business opportunity of the comprehensive logistics services, the major liner companies such as MAERSK, NYK, OOCL and APL etc., have already established their own logistics operation sector as well. Compared with these major carriers, COSCO Logistics almost has no competitive advantage to promise its future expansion. To keep its existing achievement and continue to exploit the benefits of the comprehensive logistics services, COSCO Logistics should cultivate its own different unique capability so as to satisfy customers' ever increasing transportation requirement with the new added value from logistics services, therefore, to help the whole COSCO Line to keep customers loyalty and stand fast in the global liner shipping industry to withstand against the fierce competition and economic fluctuation.

5.2 Limitation and future study

Due to the limitation of data resources and relatively short study time, this study has many works could be addressed in the future relevant research. For the hypothesis 2 which is about the logistics services benefit to the capacity utilization, the logistics revenue data should be changed to the logistics cargoes volume which is more suitable for the linear regression analysis with the container handling volume. Because of the data resources limits and the complicated logistics cargoes measurement, the logistics volume data were not able to be collected. In the future study may be a standard measurement approach of the logistics cargoes will be applied, and then this second hypothesis could be analyzed in more valid way. Another significant limitation of this study is the relatively short time period of the COSCO logistics developing; the logistics data only got 8 years record from year 2004 to 2010. For a valid research study, the longer the time period data used of the study objectives, the more representativeness and persuasiveness of the study. For example, the shipping industry fluctuation cycle time is about 20 years, so for this

study, if the logistics services data have the same time period record, the results could be more accurate and meaningful. In conclusion, the benefits of the comprehensive logistics services for the liner companies need further deep study for a long time period, and accurate data are needed. Only in this way, the real effects of the comprehensive logistics services of liner shipping companies could be studied and verified.

References

- APL. (2010), Annual Report, American President Lines Co., Ltd, Retrieved February 5th, 2012 from World Wide Web
<http://www.nol.com.sg/wps/portal/nol/investorrelations/reportsandannouncements/annualreports>
- Brooks, M. R. (2000), 'Restructuring in the Liner Shipping Industry: A Case Study in Evolution', Retrieved May 5th, 2012 from world wide web
<http://cosmic.rrz.uni-hamburg.de/webcat/hwwa/edok01/cibs/DP-176.pdf>
- Chan, J. O. (2005), 'Toward a Unified View of Customer Relationship Management, *Journal of American Academy of Business*, Cambridge; Mar 2005; 6, 1; ABI/INFORM Complete, pg. 32, from ProQuest database, accessed 11 April 2012.
- Christopher, M. and Towill, D.R. (2000), 'Supply Chain Migration from Lean and Functional to Agile and Customised', *International Journal of Supply Chain Management*, Vol. 5, No.4, pp 206-213, from ProQuest database, accessed 11 April 2012.
- Crum, M. R., Morrow, P. (2002), 'The influence of carrier scheduling practices on truck driver fatigue', *Transportation Journal*, Vol.42, pp. 20-41, from ProQuest database, accessed 11 April 2012.
- COSCO, Annual Report (2010), China Ocean Shipping Company, Retrieved February 5th, 2012 from World Wide Web
<http://www.chinacosco.com/ChinaCosco/articleList.do?method=viewCatalog&catalogId=2c91c2c40d0a8ca9010d0a99909c0021&orderBy=createdate&sort=desc>
- Cullen, A.C. and Frey, H.C. (1999). Probabilistic Techniques in Exposure Assessment. Plenum Press: New York.
- Ding JF (2010), 'Critical factors influencing customer value for global shipping carrier-based logistics service providers using fuzzy AHP approach', *Afr. J. Bus. Manage*, Vol. 4, No.7, pp. 1299-1307. From ProQuest database, accessed 1st April 2012.
- Drewry Shipping Consultants (2011), 'The Drewry Container Market Review'. Retrieved February 5th, 2012 from world wide web
<http://www.drewry.co.uk/publications/>

-
- Fraedrich, D.S. and Goldberg, A. (2000), 'A Methodological Framework for the Validation of Predictive Simulations', *European Journal of Operational Research*, Vol. 124, No. 1, pp. 55-62. from ProQuest database, accessed 11 April 2012.
- Helmick, J. S. (2001), 'Intermodal ports and liner shipping: A 21st century status report', *Logistics Spectrum*, Vol. 35, no. 1, pg. 20, ProQuest Research Library
- Hout, T., Porter, M.E., & Rudden, E. (1982), 'How Global Companies Win Out', *Harvard Business Review*, September-October, pp. 98-108. Retrieved March 5th, 2012 from world wide web
http://members.home.nl/c.schalkx/Papers%20International%20Management/IM2006_Week_1_Hout_Porter_Rudden.pdf
- Hox, J. J. & Boeije, H. R. (2005), 'Data collection, Primary VS. Secondary', *Encyclopedia of Social Measurement*, Vol. 1. Elsevier Inc. from ProQuest database, accessed 17 April 2012.
- Jenssen, J. I., & Randoy, T. (2006), 'The performance effect of innovation in shipping 614 companies', *Maritime Policy and Management*, Vol. 33, No. 4, pp. 327-343, from ProQuest database, accessed 17 April 2012.
- Leonard-Barton, D. (1990), 'A dual methodology for case studies: synergistic use of a longitudinal single site with replicated multiple sites', *Organization Science*, Vol. 1, No. 1, pp. 248-266
- Lun Y.H.V., Pang K.W. and Panayides P.M. (2010), 'Organizational growth and firm performance in the international container shipping industry', *International Journal of Shipping and Transport Logistics*, 2(2): pp. 203-226
- MAERSK. (2010), Annual Report, MAERSK Line Co., Ltd, Retrieved February 5th, 2012 from world wide web <http://investor.maersk.com/financials.cfm>
- Mentzer, J. T., Konrad, B. P. (1991), 'An efficiency / effectiveness approach to logistics performance analysis', *Journal of Business Logistics*, Vol. 12, No. 1, pp. 33-62.
- Notteboom, T. (2011), Lecture material of Course 'Maritime Logistics', Shanghai Maritime University, November 2011
- Notteboom, T. & Rodrigue, J. P. (2008), 'Containerisation, Box Logistics and Global Supply Chains: The Integration of Ports and Liner Shipping Networks', *Maritime Economics & Logistics*, (10), pp. 152-174, From ProQuest database, accessed 1st April 2012.

NYK. (2010), Annual Report, NIPPON YUSEN KABUSHIKI KAISHA Co., Ltd, Retrieved February 5th, 2012 from world wide web
<http://www.nyk.com/english/ir/library/annual/>

OOCL. (2010), Annual Report, Orient Overseas Container Line Co., Ltd, Retrieved February 5th, 2012 from World Wide Web
<http://www.oocllogistics.com/pressandmedia/ooclannualinterimreport/Pages/default.aspx>

Panayides, P. M. (2003), ‘Competitive strategies and organizational performance in ship management’, *Maritime Policy & Management: The flagship journal of international shipping and port research*, Volume 30, Issue 2, pp. 123–140 From ProQuest database, accessed 1st April 2012.

Pearson, K. (1900), “Mathematical contributions to the theory of evolution”, *The Royal Society*, Retrieved February 15th, 2012 from World Wide Web
<http://rspl.royalsocietypublishing.org/content/by/year>

Randy T., Down J. and Jenssen J. (2003), ‘Corporate Governance and Board Effectiveness in Maritime Firms’, *Maritime Economics & Logistics*, Vol. 5, No. 1, pp. 40-54(15), from ProQuest database, accessed 11 April 2012.

Rayport, J. F. & Sviokla, J. (1995), ‘Exploiting the Virtual Value Chain,’ *Harvard Business Review*, Vol. 73, No. 6, p75-85, from ProQuest database, accessed 11 April 2012.

Saltelli, A., Chan, K., and E.M. Scott. Eds (2000), ‘Sensitivity Analysis’, John Wiley and Sons, Ltd.: West Sussex, England.

Stank, T. P., Davis, B.R. & Fugate, B. S. (2005), ‘A STRATEGIC FRAMEWORK FOR SUPPLY CHAIN ORIENTED LOGISTICS’, *Journal of Business Logistics*, Vol. 26, No. 2, pp. 27-46, from ProQuest database, accessed 18 April 2012.

Stewart, G. (1995). Supply chain performance benchmarking study reveals keys to supply chain excellence, *Logistics Information Management*, Vol. 8, No.2, pp 38–44.

Ting, S. C. and Tzeng, G. H. (2004), ‘An optimal containership slot allocation for liner shipping revenue management’, *Maritime Policy and Management*, Vol. 31, No. 3, pp. 199-211.

United Nation Conference on Trade and Development (UNCTAD), Review of Maritime Transport 2011, Retrieved February 7th, 2012 from world wide web
http://www.unctad.org/en/docs/rmt2011_en.pdf

Wong, Y.L. (2002), 'Development of the supply chain Concept and its Impact on Shipping Industry', Master Thesis of the University of Hong Kong. from ProQuest database, accessed 18 April 2012.

Zhu, Q.B. (2009), 'arket investigation and Prediction', Science Technology University of China, Hefei, Anhui Province.

Appendices

Appendix 1. 2011 operating profit of world major liner companies

Carrier/Group	Revenue			Operating Profit			Operating Profit Margin		Net Profit		
	2010	2011	%	2010	2011	%	2010	2011	2010	2011	%
3 months (Jul-Sep)											
AP Moller-Maersk (container shipping & related activities)	7,293	6,886	-6%	1,213	-213	n.m	16.6%	-3.1%	1,077	-286	n.m
AP Moller-Maersk (all activities)	14,825	14,596	-2%	2,257	1,988	-12%	15.2%	13.6%	1,755	347	-80%
APL (including terminals)	2,157	1,904	-12%	301	-88	n.m	14.0%	-4.6%	n.a	n.a	n.a
NOL group (including APL)	2,429	2,213	-9%	319	-72	n.m	13.1%	-3.3%	282	-91	n.m
CMA CGM	3,751	3,856	3%	816	-109	n.m	21.7%	-2.8%	541	-224	n.m
CSAV	1,614	1,401	-13%	175	-339	n.m	10.8%	-24.2%	149	-343	n.m
Evergreen Marine Corp.	1,093	910	-17%	298	-40	n.m	27.3%	-4.4%	279	-42	n.m
Hanjin Shipping (container)	2,059	1,676	-19%	357	-144	n.m	17.3%	-8.6%	n.a	n.a	n.a
Hanjin Shipping (all activities)	2,419	2,090	-14%	325	-114	n.m	13.4%	-5.5%	203	-76	n.m
Hapag-Lloyd	2,422	2,066	-15%	358	46	-87%	14.8%	2.2%	296	13	-96%
Horizon Lines	298	322	8%	18	-113	n.m	6.1%	-35.2%	8	-126	n.m
Hyundai Merchant Marine (container)	1,464	1,142	-22%	287	-64	n.m	19.6%	-5.6%	n.a	n.a	n.a
Hyundai Merchant Marine (all activities)	1,947	1,602	-18%	261	-84	n.m	13.4%	-5.2%	136	-4	n.m
Matson	268	304	14%	40	6	-85%	15.1%	2.0%	n.a	n.a	n.a
OOCL (revenue from services)	1,571	1,441	-8%	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Regional Container Lines	133	112	-16%	15	29	93%	11.3%	25.9%	12	26	117%
Samudera Shipping Line	97	117	20%	6	4	-35%	6.6%	3.6%	6	4	-40%
Seaboard Marine	214	226	5%	13	-8	n.m	5.9%	-3.6%	n.a	n.a	n.a
STX Pan Ocean (container)	179	172	-4%	5	-16	n.m	2.7%	-9.3%	n.a	n.a	n.a
STX Pan Ocean	1,404	1,240	-12%	34	-47	n.m	2.5%	-3.8%	48	-37	n.m
Trailer Bridge	29	31	6%	2	1	-73%	8.4%	2.1%	0	-2	n.m
Tropical Shipping	84	78	-7%	4	-4	n.m	4.3%	-4.7%	n.a	n.a	n.a
Wan Hai	630	545	-13%	119	27	-77%	18.9%	5.0%	95	16	-83%
Yang Ming Marine Transport	1,272	1,010	-21%	270	-82	n.m	21.2%	-8.1%	247	-88	n.m
Zim	1,054	973	-8%	102	-63	n.m	9.7%	-6.5%	37	-66	n.m
K Line (containerships)[1]	1,538	1,369	-11%	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
K Line group (all activities)[1]	3,192	3,281	3%	323	-110	n.m	10.1%	-3.4%	126	-193	n.m
*MOL (containerships)[1]	1,940	1,852	-5%	208	-72	n.m	10.7%	-3.9%	n.a	n.a	n.a
MOL group (all activities)[1]	4,860	4,780	-2%	521	-18	n.m	10.7%	-0.4%	328	-109	n.m
NYK (liner shipping)[1]	1,528	1,456	-5%	206	-91	n.m	13.5%	-6.3%	n.a	n.a	n.a
NYK group (all activities)[1]	6,056	6,016	-1%	553	10	-98%	9.1%	0.2%	256	-64	n.m

Notes: Local currency numbers were converted into US dollars using exchange rate at end of relevant financial period;

n.a = not available; n.m = not meaningful;

Results for Taiwanese carriers Evergreen, Wan Hai and Yang Ming are consolidated. For these carriers EBIT = Interest expense + Income from continuing operations before income tax

CSAV's EBIT = gross margin + other income - admin expenses - other expenses;

[1] Results for K Line, MISC, MOL and NYK relate to second quarter fiscal period from July through September.

* MOL (containerships) operating profit is "ordinary income" = income other than capital gain.

Source: Drewry Maritime Research, derived from ocean carrier financial reports

Appendix 2 5 Major carriers Annual report Website Resources

COSCO, Annual Report

<http://www.chinacosco.com/ChinaCosco/articleList.do?method=viewCatalog&catalogId=2c91c2c40d0a8ca9010d0a99909c0021&orderby=createdate&sort=desc>

OOCL, Annual Report

<http://www.oocllogistics.com/pressandmedia/ooilannualinterimreport/Pages/default.aspx>

NYK, Annual Report

<http://www.nyk.com/english/ir/library/annual/>

MAERSK , Annual Report

<http://investor.maersk.com/financials.cfm>

APL , Annual Report

<http://www.nol.com.sg/wps/portal/nol/investorrelations/reportsandannouncements/annualreports>