



Study on Strategic Performance Measurement of Liner Shipping Company

Gao, Ziyi

(Degree)

博士 (海事科学)

(Date of Degree)

2014-03-25

(Date of Publication)

2015-03-01

(Resource Type)

doctoral thesis

(Report Number)

甲第6135号

(URL)

<https://hdl.handle.net/20.500.14094/D1006135>

※ 当コンテンツは神戸大学の学術成果です。無断複製・不正使用等を禁じます。著作権法で認められている範囲内で、適切にご利用ください。



Doctoral Dissertation

Study on Strategic Performance Measurement of Liner Shipping Company

(定期船海運業の戦略的経営成果の評価に関する研究)

January 2014

Graduate School of Maritime Sciences, Kobe University

Ziyi Gao

Table of content

Chapter 1

Introduction	1
1.1 Research background and motivation.....	2
1.2 Scope and organization of the study.....	4
References.....	7

Chapter 2

Analysis on the development trends and status quo of liner shipping industry	9
2. 1 Trends in liner shipping industry.....	10
2.1.1 Bigger container ships	11
2.1.2 Strategic alliance	12
2.1.3 Mergers and acquisitions of global carriers	14
2.1.4 E-commerce	16
2.1.5 Logistics service.....	16
2.2 Analysis of industrial structure	18
2.2.1 Bargaining power of suppliers	19
2.2.2 Bargaining power of buyers	21
2.2.3 Threat of new players.....	22
2.2.4 Threat of substitutes	23
2.2.5 Competitive rivalry	24
2.3 Financial status of liner shipping companies	25
References.....	30

Chapter 3

Performance measurement for liner shipping company	32
3.1 Introduction.....	32
3.2 Methodology	36
3.2.1 The Balanced Scorecard.....	39
3.2.2. Fuzzy Analytic Hierarchy Process	44
3.2.2.1 The consistency calculation for the FAHP method.....	49
3.2.2.2 The prioritization of decision maker	50

3.2.3 The relationship matrix design	51
3.2.4 The relative weight calculation	52
3.3 Performance measurement for liner shipping company	52
3.3.1 Strategies for liner shipping company	52
3.3.2 Cause and effect relationships between the strategies	55
3.3.3 Goals setting and technical measures	56
3.3.4 Empirical results	59
3.4 Performance measurement for logistics service provider	64
3.4.1 Liner shipping company as a logistics service provider	64
3.4.2 Strategies assignment	66
3.4.3 Goal setting and technical measures	68
3.4.4 Empirical results	69
3.5 Implications for liner shipping company	72
References	76
Chapter 4	
Conclusions	82
4.1 Conclusions and Future Study	82
4.2 Limitations and future study	82

Chapter 1

Introduction

International trade proliferation depends on a very large extent on the efficient movement of cargoes from production sources to points of consumption. Shipping business is an essential and desirable part in the developing process of international trade. As a cost-effective means, it provides services to transport large volumes of cargo around the world. According to UNCTAD, about 90% of world trade is carried by the international shipping industry. The liner shipping companies as cargo carriers transport approximately one-third of the total value of global trade (World Shipping Council). They prominently facilitate international trade, not only through empowering the physical transport of the cargoes but also through their involvement in the commercial and marketing aspects of global trade (Panayides and Wiedmer, 2011). Liner shipping industry is not static, but in the continuous development of a dynamic changes with technological and economic development. Liner shipping market also has changed tremendously in past several decades because of globalization and containerization. Nowadays the developments of bigger container ships; strategic alliance; mergers and acquisitions of global carriers; e-commerce and logistics service lead to polarization. Accompanying these changes has been a substantial growth in concentration.

1.1 Research background and motivation

Both horizontal and vertical integrations has led to rapid concentration in the liner shipping industry which results in reduced financial margin and increased pressure. (Notteboom and Whinkelmans, 2001). In 2011, the profit margin deficits are presented in the most of major liner shipping companies. In addition, it is concluded that competitive rivalry shows a relatively strong force in liner shipping industry by analyzing industrial structure.

Under such a stressful and competitive circumstance, for the survival and development by effective management and striving to improve the competitive power in market, the performance measurement is becoming increasingly important to liner shipping companies. As indicated by Kassem (1987), the operational performance is a representative measure of the overall target achievement, and consequently, a constant target companies strive to achieve. The operational performance provides the basis for evaluating how well an organization is progressing towards its predetermined objectives. It can also identify the strong and weak areas, helping make the future initiatives to improve organisational performance. (Amaratunga et al, 2001). Harrington (1991) stated performance measurement more clearly, “Measurement is the first step that leads to control and eventually to improvement. If you can’t measure something, you can’t understand it. If you can’t understand it, you can’t control it. If you can’t control it, you can’t improve it.”

The importance of performance measurement has been recognized in recent years. The traditional financial performance measures based on simple and consistent factors such as financial returns and returns on investment (ROI) have long been used as the

primary criteria to measure performance of organizations. Hossan et al. (2010) indicated that financial ratio analysis is one of the best performance evaluation tools for any companies. The traditional performance measurement is based on efficiency-evaluation which focuses on minimizing costs and maximizing operating efficiency (Dumond, 1994). In the last few decades, top managers are motivated with the valued financial performance and undervalued long term performance indicators such as customer satisfaction, loyalty, learning organisation, innovation etc. Particularly the short-termism and the impatient capital phenomenon drive the business enterprises since its performance expectations are figured on the short-term fiscal outcome. Dot-com crisis and the bankruptcy of Enron are popular examples of the impatient capital sickness. By the early 1980s, the shortcomings of traditional measurement systems have triggered a revolution in the field of performance management (Eccles, 1991; Neely, 1999). The traditional cost management systems are not so comprehensive to meet with all those competitive criteria. According to Bourne and Neely (2003), traditional accounting based performance measures feature the financial side, internally focused, backward looking properties, and are more concerned with local departmental performance than with the overall health or performance of business.

According to lessons learnt in the 20th century, the meaning of performance has dramatically changed, and raised the importance of non-financial (and intangible). In 1978 approximately 80 % of corporate value was due to tangible assets, with 20 % accounted for by intangibles. By 1998, the proportions had been reversed, 80 % of corporate value associated with intangible assets and only 20 % with tangibles (Sullivan, 2000). Under these circumstances, many studies investigate the non-financial measures. The multi-attribute performance measurement methods play an increasingly crucial role

to combine many aspects of business (Ittner and Larcker, 1998; Neely *et al.*, 2002; Kaplan and Norton, 1996; Lonnqvist, 2002). However, a limited number of studies discuss the performance measurement of liner shipping industry in existing literatures. In particular, a multi-attribute performance measurement for liner shipping industry has been rarely discussed. In fact this is precisely what the most important is for improving the competitiveness of liner shipping companies in fierce market competition. The present study aims to fill this gap.

1.2 Scope and organization of the study

Liner shipping industry as critical industry in economic activities has undergone a great change and development during the past several decades. The study investigates the development trends in liner shipping industry, and analyses the present liner industrial structure and financial status of liner shipping companies. It is concluded that liner shipping companies are facing presently strong pressure from the competition and improving performance and competitiveness is an important issue that should be solved urgently. The performance measurement as a principal means is discussed in the study.

In this study, the performance measurement for liner shipping industry is investigated from two perspectives, the traditional liner shipping companies and liner shipping companies as logistics service provider. Since not only are liner shipping companies common carriers, but also liner shipping companies as logistics service providers are recently playing an increasing significant role in liner shipping business. In existing literatures, the performance measurement for liner shipping industry from the two perspectives has never been studied. This study aims to contribute a more

comprehensive performance measurement in liner shipping industry. In addition, implications for liner shipping companies are discussed in this study by analysing the empirical results of performance measurement in two perspectives.

The balanced scorecard (BSC) as a performance measurement system is utilized to ensure comprehensive performance analysis of liner shipping industry in the study. Recently, the BSC is widely used to measure the performance to generate different strategies for organization and it provides a multi-dimensional evaluation framework that supplements traditional financial measures with non-financial measures focused on three other perspectives: customers, internal business processes, and learning and growth. The study utilizes the BSC method to ensure a cumulative analysis of the short/long and tangible/intangible indicators of performance and computes the weight of each criterion by Fuzzy analytic hierarchy process (Fuzzy-AHP) method in the liner shipping industry. The goal related dimensions of BSC and both financial and non-financial technical measures are defined from scientific studies in the literature and reports for the liner shipping industry and screened by experts in this field. After that, the questionnaire method is used to practitioners and experts such as operators, customers and owners in liner shipping and logistics business.

The remainder of the study is organized as follows. Chapter 2 investigates the development and status quo of liner shipping industry. It includes the development trends in liner shipping industry, analysis of liner industrial structure and financial status of liner shipping companies. Chapter 3 investigates the performance measurement for liner shipping industry by using BSC method and Fuzzy-AHP approach from two perspectives, the traditional liner shipping companies and liner shipping companies as logistics service provider. In addition, implications for liner shipping companies are

discussed by analysing the empirical results of performance measurement in two perspectives. Chapter 4 concludes the study.

References

- Amaratunga, D., 2001, Process improvement through performance measurement: the balanced scorecard methodology, *Work Study*, 50 (5), 179-189.
- Bourne, M. and Neely, A. D., 2003, Implementing Performance Measurement Systems: a literature review, *International Journal of Business Performance Management*, 5, 1-24.
- Dumond, E. J., 1994, Making Best Use of Performance Measures and Information, *International Journal of Operations & Production Management*, 14, 16-31.
- Harrington, J.H., 1991, Business Process Improvement-The breakthrough strategy for total quality, productivity, and competitiveness, *McGraw-Hill*, New York.
- Hossan, F., 2010, Performance evaluation and ratio analysis of Pharmaceutical Company in Bangladesh.
- Ittner, C. D. and Larcker, D. F., 1998b, Are nonfinancial measures leading indicators offinancial performance? An analysis of customer satisfaction, *Journal of Accounting Research*, 1-35.
- Kaplan, S. R. and Norton, R. D., 1996. The Balanced Scorecard. Translating Strategy into Action. *Harvard Business School Press*, Boston, Massachusetts.
- Kassem, D.M., 1987, Human resource planning and organisational performance: An exploratory analysis. *Strategy, Manage, J.*, 5(1), 387–392.
- Lönnqvist, A., 2002, The use of performance measurement in Finnish companies. Licentiate Thesis, Tampere University of Technology.
- Neely, A., Adams, C. and Kennerley, M., 2002, The Performance Prism. The Scorecard for Measuring and Managing Business Success. Prentice Hall.
- Notteboom,T.E., Whinkelmans, W., 2001, Structural changes in logistics: how will port authorities face the change, *Maritime policy and manangementy*, 28(1),71-89

Panayides, P. & Wiedmer, R., 2011, Strategic alliances in container liner shipping, *Research in Transportation Economics* 32.

Sullivan, H. P., 2000, Value-Driven Intellectual Capital.

World Shipping Council, 2013, Benefits of Liner Shipping,
<http://www.worldshipping.org/benefits-of-liner-shipping>

Zolfani, S. H. and Radfar, I., 2011, A Research on Hybrid Models of Balanced Scorecard and MADM Methods for Selecting the Best Hybrid Model, *American Journal of Scientific Research*, 36, 83-89.

Chapter 2

Analysis on the development trends and status quo of liner shipping industry

The shipping market can be generally regarded as a single economic unit composed of important subdivisions such as tramp shipping market and liner shipping market (Stopford, 2004). Tramp shipping has no fixed route or itinerary or schedule (timetable). It goes from one port to others depending upon the cargo availability. It refers to global trade in search of cargo, primarily dry bulk and liquid cargoes (Branch, 2001). Liner shipping is distinct from tramp shipping. A shipping company who transports cargoes in containers by sea, with a fixed route and schedule (timetable), it has a fixed port rotation with published dates of calls at the advertised ports. The service will continue to run regardless of whether the ship is filled or not to keep its timings and route.

Liner shipping industry became important in the 1870s (Sjostrom, 2004). To avoid cut-throat price competition and excessive capacity, liner operators set up formal agreement—known as the conference system in the 1870s. The conference system is advocated because it is capable to increase the trade stability due to quality ships, long-standing freight agreements and justified constraints on competition. Meanwhile the conference system has also received criticism during the process of globalization and containerization (Branch, 1984). The system is criticized as less justifiable because it constantly leads to plethora of available shipping, the transparency in freight

negotiations in a society with general intolerance of anything that hinders free competition (BIMCO, 2007). Therefore the liner shipping companies have resorted to other strategies such as mergers, alliances, and consortia. Meanwhile a large number of liner shipping companies have tended to diversify their service to provide with the competition grown in liner market. In particular, more and more liner shipping companies pay attention on providing logistics service to improve their competitiveness and profitability.

In the past several decades, liner shipping industry is in a constantly evolving environment. There are many new changes and trends in liner shipping industry development by the combination of competitive, economic and operational forces, which also affect liner shipping industrial structure. This chapter discusses the development trends and analyses the industrial structure in liner shipping industry, and financial status of liner shipping companies are also investigated in this chapter.

2. 1 Trends in liner shipping industry

The growing international competitive pressure, combined with high capital intensity and traditionally strong dependencies on volatility of the global economic condition, has resulted in an intensified impact on profit margins and continuously rising financial risks for the maritime industry in recent years (Notteboom, 2004). Over the past few several decades, liner shipping market is in a constant state of flux with economic development. Five main trends in liner shipping industry are discussed in this section. They are bigger container ships, strategic alliance, mergers and acquisitions of global carriers, e-commerce and logistics service.

2.1.1 Bigger container ships

The Second World War is the starting point of the use of containers. In 1960, the first 610 teu (twenty foot equivalent unit) ship, specially designed for container transportation, appeared. The container ship assumed fast rapid development since 1980. In 1984, the first container ship with capacity around 4500 teu was built. Thereafter, in almost the coming decade, the large size container ship remained at this level. (Cullinane and M. Khanna, 1992). The container ships are growing in both number and size. The world container fleet consists of some 5,087 ships (August 2012) with a combined capacity of 16 million teu, the capacity has been increased by about 400% over the last fifteen years.

One of the key factors contributing to this trend is the introduction of the so-called post-Panamax container ships. Panamax vessel is a ship that was constructed with the maximum dimensions to safely pass through the Panama Canal. The first post-Panamax container ships were introduced in 1988. Such a ship has a maximum beam of 32.3 m, which exceeds the width limit of the Panama Canal. By 1996 the capacities of post-Panamax container ships reached to 6,600teu. Several years later, Super-post-Panamax container ships -- vessels with capacities of at least 8,000 teu were built and such a vessel became the backbone of the operating fleet of the top global liner shipping companies. Orders for 8,000 teu-plus ships peaked in 2007 at 181 vessels of 2 million teu. Although such mega vessels present some limitations, such as larger volume of carbon air emissions and higher requirement for capacity and productivity of ports, in recent years, the tendency of bigger container ship has not changed. The largest container ships delivered today have a capacity of about 16,020 teu. Table 2.1 shows the generations of container ship. .

Table 2.1 Container ship generations

Year	Type of Ship	Capacity (TEU)
1960-1970	Converted cargo vessel/tanker	500-800
1971-1980	Cellular containership	1,000-2,500
1981-1988	Panamax Class	3,000-4,000
1989-2000	Post Panamax	4,000-6,800
2001-2002	Super Post Panamax	6,800-8,000
2003-2006	New Panamax	11,000-14,500
2007-current	Ultra Large Container Vessel	14,500-16,020

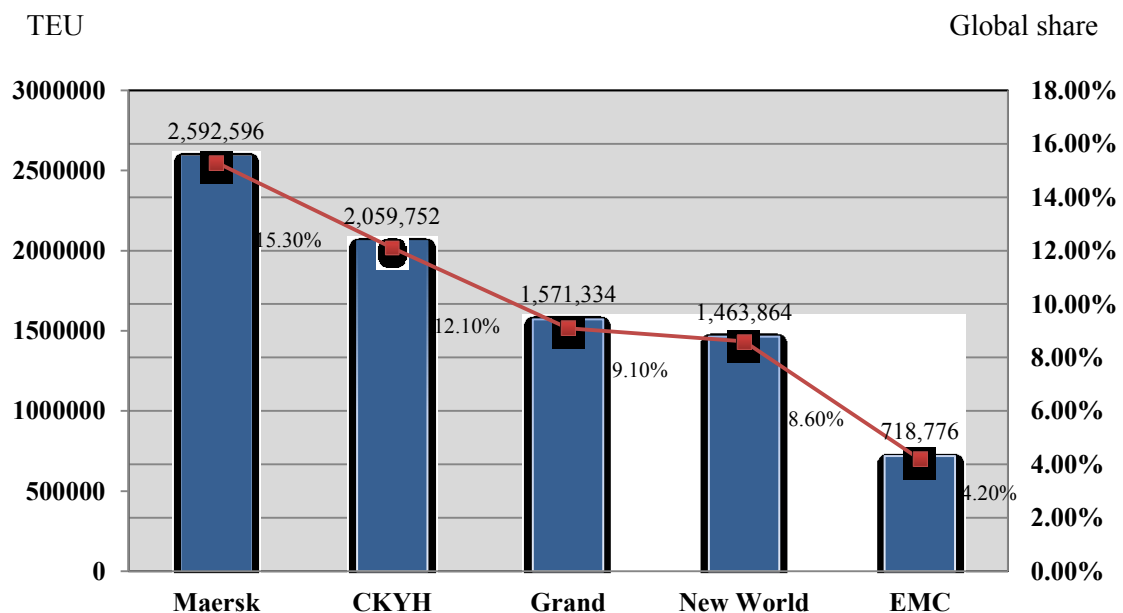
Source: Container handbook

2.1.2 Strategic alliance

The formation of global strategic alliances in the liner shipping industry dates back to the end of 1995. Hung (1992) defined strategic alliances as “long-term cooperative business agreements between two or more companies to pool, exchange and/or integrate specific company resources for achieving some agreed objectives”. Strategic alliances in liner shipping aim at cooperation in the employment and utilization of ships over particular routes including type/size of ship, sailing schedules and itineraries, use of joint terminals and container co-ordination on a global scale (Panayides and Wiedmer,2011).

Liner shipping companies operate in an extremely volatile and uncertain environment. Since the traditional conference system is weakened and gradually collapsed by the US Shipping Act of 1984, many liner shipping companies turned toward strategic alliance from former competitive behavior-price war, which favors cost minimization, economies of scale attainment, market and service network integration, risk sharing and reducing the pressure of competition.

As in Figure 2.1 , container carriers operating in global market can be grouped into five main strategic alliances: (1) Grand alliance: Hapag Lloyd , OOCL and NYK, which occupied 9.1% of market share in the liner industry.(2) The New world alliance: APL, Hyundai M.M and MOL owned 8.6% of the global slots(3) CKYH alliance: COSCO, K-Line, Yang Ming and Hanjin, shared12.1% of global capacities.(4) Maersk sealand ranked as the number one with 15.3% of market share (5) Evergreen Marine Company also owned 4.2% of market share.



Source: ALPHALINER (MAR.2013)

Figure 2.1 Capacities and shares of five main alliances

Furthermore, by March 2012 the G6 Alliance formed following leading container shipping owners: The New World Alliance members - APL, Hyundai Merchant Marine, and Mitsui O.S.K Lines and Grand Alliance members - Hapag-Lloyd, NYK and OOCL, which create one of the largest vessel networks in the Asia-to-Europe trade lane.

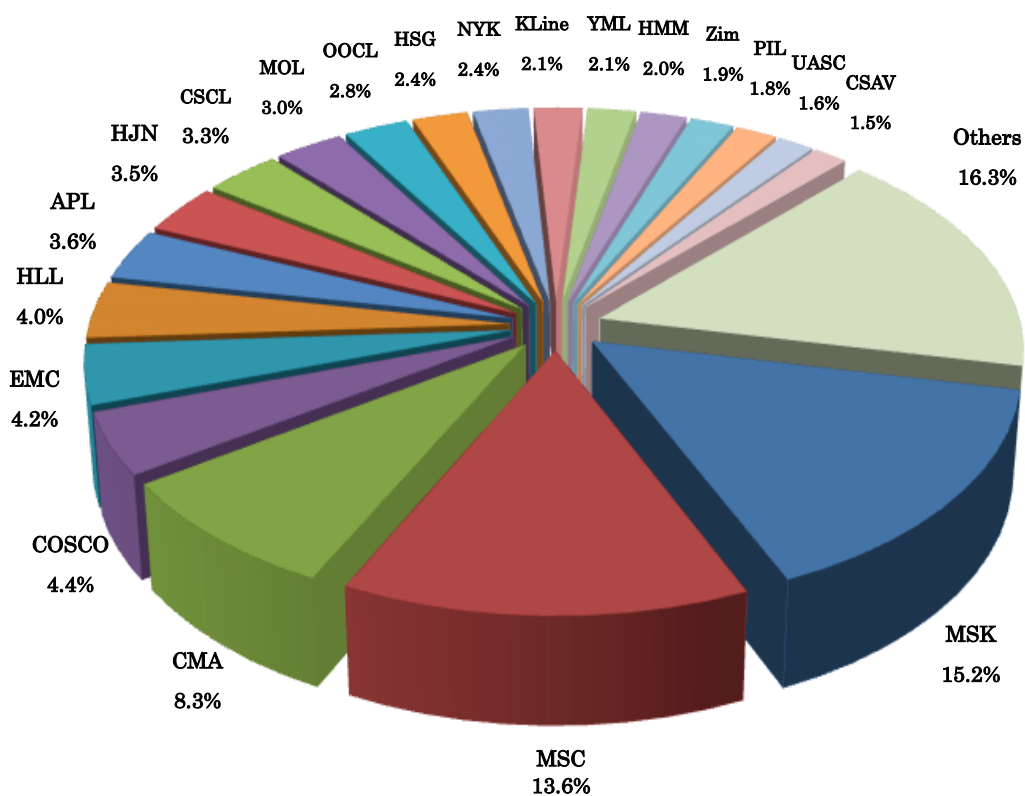
2.1.3 Mergers and acquisitions of global carriers

Due to the growing international competitive pressure and high capital intensity, the shipping industry has experienced significant growth in merger and acquisition activity in recent years. Generally speaking, companies seek mergers and acquisitions to capture economies of scale in production, magnify management efficiencies and achieve synergies between rival operation and markets (Fusillo,2009). Some global carriers have responded to challenges in liner shipping market by traditional conferences or alliances, bigger container ships. Since the US Ocean Shipping Reform Act of 1998 weakened the traditional conference system in US markets, for reducing costs and keeping market share, major carriers sought membership in global alliances. Moreover, containership technology has produced enormous ships that contribute to economies of scale, and hence reduce unit costs, but they demand huge investments and expenditures, such as capital costs, fuel costs and administrative expenses etc. Meanwhile excess capacity in times of recession and irregular runs of cash flows exist. Various carriers are forced to enhance their competitive position by mergers and acquisitions.

Recent mergers, take-overs and shareholding agreements include the acquisition of Norasia Line by CSAV in 2000, the purchase of Farrell Line and Harrison Line and P&O Nedlloyd by Maersk Line in 2000 and 2005, the acquisition of Delmas in 2006, U.S Line, Comanav and Cheng Lie Navigation in 2007 by CMA-CGM, the purchase of Kieng Hung, Columbus Line and Costa Container lines by Hamburg Lines in 2003,2004 and 2008, respectively.

Fig.2.2 shows market share of top 20 in liner shipping industry. The top 20 carriers controlled a combined carrying capacity of 13 million TEUs in 2012, which increased

from 52% of the global container total capacity in 2000 to 83.7% in 2012, according to Alphaliner. Maersk Line, the world’s largest container carrier and the market leader, increased its market share from 12% in 2000 to 15.3% in 2012, MSC, the second largest carrier owned 13.6% of market share, and CMA CGM, the third carrier occupied 8.4% of market share in 2012(see figure 2.2).



Source: ALPHALINER (MAR.2013)

Figure 2.2 The market share of the top 20 carriers

2.1.4 E-commerce

International shipping is a quite complicated service business because of its customers, partners and collaborators, which are scattered all over the world. Under rapid changing business environments with increased flexible distribution operations, tighter inventory control and faster, more efficient processing, information technologies are becoming increasingly important in liner shipping industry. It has also become a key to gain market competitive advantage over rivals.

For customers, it is the norm to go online to perform day-to-day activities such as booking, shipping instructions, remote printing of bills of lading and cargo tracking, which bring more convenience. For shippers and carriers, carrying out these functions online expands automatic transaction, increases efficiencies, and reduces operating cost. Gradually, e-commerce has moved into the mainstream of carriers-to-customers business. Some carriers now depend on e-commerce for more than 50 % of their total container volume. Others see smaller percentages but have rapid growth. Shippers that were early adopters now rely on e-commerce to process as much as 95% of their total ocean container volume (post&parcel).

2.1.5 Logistics service

Midoro and Parola(2006) indicates that carriers started to provide intermodal services since the 1980s, but it is not until recently that the major liner shipping companies put logistics operations into function, and give it a more central strategic role. One of the important reasons behind the decision of providing logistics service is improving profitability, since depressed demand and low freight rates result in relatively low profit

margins for the liner shipping sector during the 1990s (Hwang et al., 2010). Although for cost cutting, bigger ships, strategic alliance, and mergers and acquisitions have emerged in development of liner shipping industry, providing a logistics service to improve long-term profitability and diversify the strategic development already been recently the inevitable and necessary choice of many liner shipping companies.

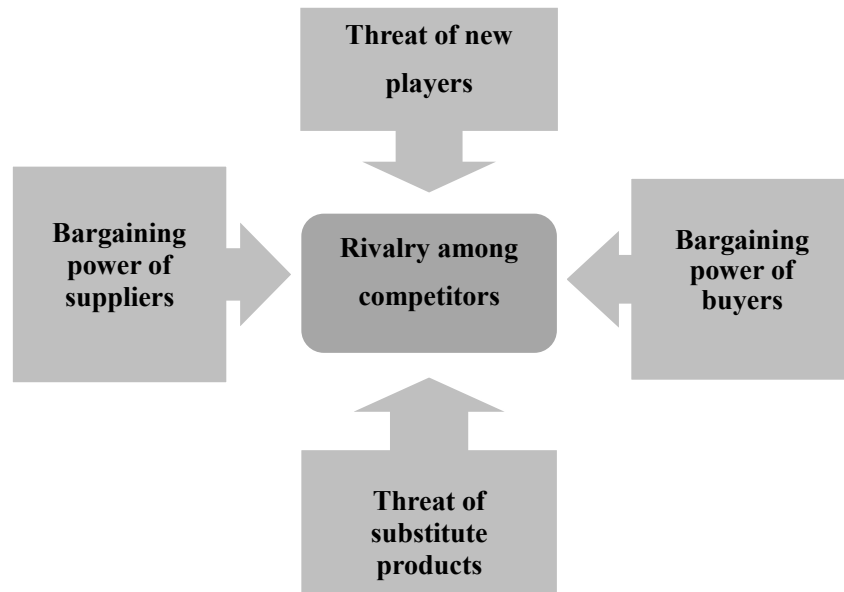
Focusing on cost cutting alone may not be sufficient to ensure survive within the dynamic context of these ongoing developments (Hwang et al., 2010). The shipping industry is a service industry and its quality has increased considerably in recent years (Genestre and Herbig, 1997). In order to gain higher loyalty from customers and to improve the reputation and market share of the business, it is essential for shipping companies to deliver high quality service (Bolton, 1991; Pardee, 1996). As providing logistics services in liner shipping companies increases customer's convenience and choice, the customer loyalty improves.

The logistics service has grown rapidly in liner shipping companies in past two decades. Maersk established the Maersk logistics division in 2000 in the purpose of offering vendor management and labeling, packing, consolidating and preparing necessary paper work, rapid custom clearance, warehoused and cross-docking facilities (Koo et al., 2009). In 1983, NYK set up logistics department in harbor division of NYK and established "Japan Intermodal Transport (JIT Co., Ltd.)" to handle ocean freight forwarding. In 2004, NYK logistics was established to provide integrating multiple logistics functions starting from material and product collection, warehousing, value added services, distribution, and cross-docking. COSCO Logistics was established in 2002, to integrate internal logistics resources, rationalize the management of global supply chains and provide all-round logistics services for the customers. It has

positioned itself around the three key business areas: modern logistics, ship agency and freight forwarding (COSCO Group). Hanjin Logistics was founded in 2001. It offers a wide range of services, including warehousing, trucking, customs clearance, freight forwarding, trans loading, and IT services.

2.2 Analysis of industrial structure

The formation of the complex industrial structure origins from the long-term economic joint force and social trends. (Linton, 2005). Industrial structure (organization) determines the competitive rules and strategies. Analysis of liner shipping industrial structure will provide essential insight for strategy. Porter's five forces analysis is an industrial analysis model created by Michael Porter in 1979 as a tool for developing corporate strategies to become or remain competitive in an industry. It strengthens a company's ability to grasp opportunities and confront difficulties in the external circumstances of business. (Porter, 1980). According to Porter, there are five forces that affect the competitive environment of an industry as illustrated in Figure 2.3. The five forces include rivalry among competitors, threat of new players, bargaining power of suppliers, bargaining power of buys, and the threat of substitute products.



Source: Porter 1979

Figure 2.3 Diagram of Porter's Five Forces

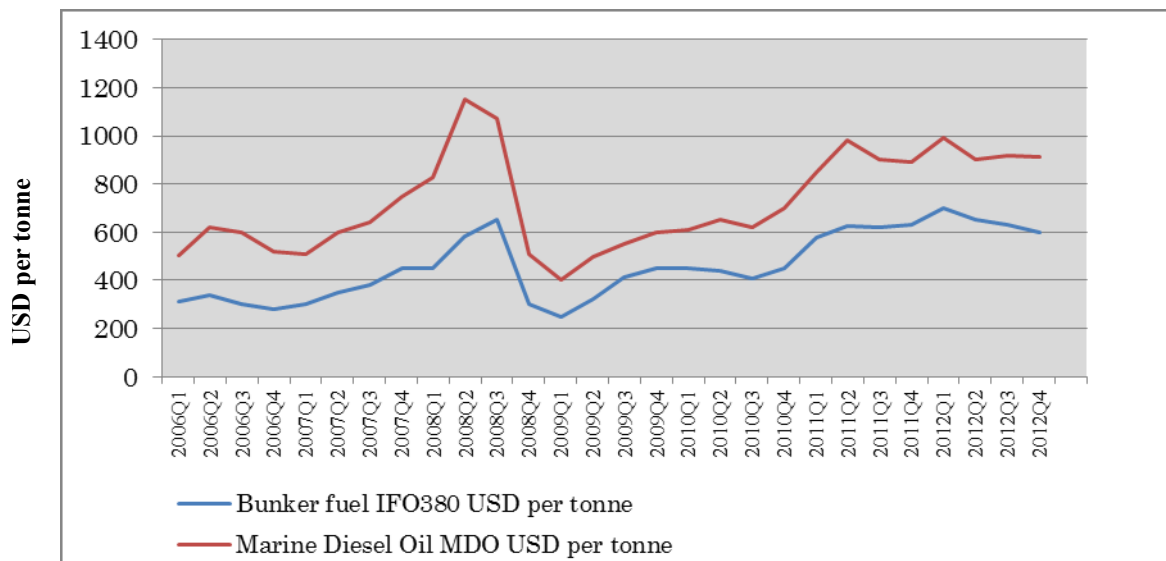
2.2.1 Bargaining power of suppliers

According to Porter, suppliers become powerful in the following situations :(CliIT, 1990)

- 1) The input is of importance to buyers.
- 2) The supplier industry is controlled by a limited number of competent suppliers whose market positions are tenable and not easily challenged by potential competitors.
- 3) The few suppliers are capable to produce unique products to some extent which are difficult or too costly for buyers to obtain from other sources.

The major suppliers to the liner shipping industry include oil producers and shipbuilders.

Although there are ups and downs in maritime diesel oil price in recent years. After financial crisis 2008, enter since 2009 the oil price continues to rise by rising bunker fuel price. Singapore's bunker price has doubled from 2006 to 2012 (See Figure 2.4). A high and unstable bunker price has given liner shipping companies a relatively worse bargaining position.



Source: Bunker world

Fig 2.4 Marine bunker fuel spot prices (Average unit value, FOB-Singapore)

As a result of the economic crisis, global shipbuilding industry has been going through a downturn for the last four years. Global commercial ship orders were down 48% year on year in the first nine months of 2012 and order backlog fell to half of the level in first half of 2008. In addition, traditional shipyards in Europe, Japan and Korea are being changed by the emerging shipyards in China. In the fierce competition and gloomy market environment, shipbuilders do not have much bargaining power.

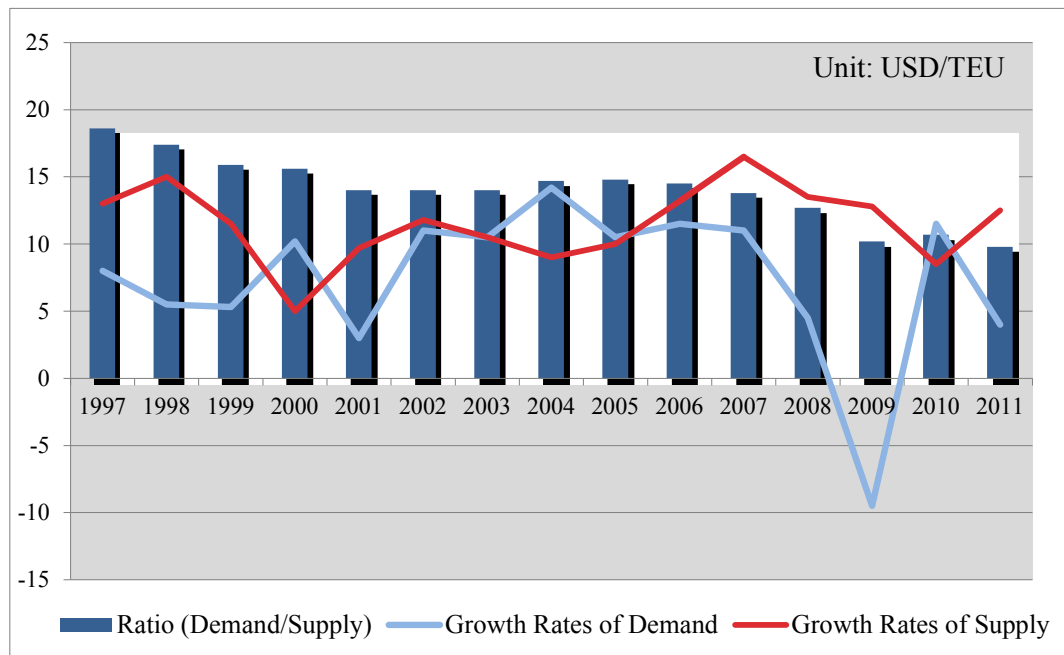
2.2.2 Bargaining power of buyers

Generally, several factors determine bargaining power of buyers.

- 1) Number of customers- if there are a few buyers with significant market share.
- 2) Their size of their orders- if it is large volume.
- 3) Number of firms supplying the product- if there are many alternative suppliers.
- 4) The cost of switching- How much does it cost for customers to switch, the higher their switching costs the less power they have to move.

While apart from above mentioned factors, supply and demand of capacity strongly affects bargaining power of buyers in liner shipping industry. As shown in Figure 2.5, the ratio between demand and supply is decreasing gradually over past 15years. Market is in the condition of oversupply in some major routes. According to the analysts at Alphaliner, carriers will bring on-line a record level of new capacity in 2013. The container fleets of the 21 largest carriers Alphaliner follows are expected to grow by 9.0% in 2013 (net of potential scrapping). That represents some 1.75 million teu worth of new vessel capacity to be delivered this year, after adjusting for some slippage of expected 2012 deliveries into 2013. If accurate, those new ships would exceed the 1.57 million teu that was delivered in 2008, making 2013 the highest level of added capacity ever recorded (SCDigest).

A consequence of this oversupply is the impact on shipping freight rates. According to Alphaliner, the overcapacity situation in the container shipping industry resulted in a collapse of charter rates and relatively low and highly variable freight rates. Oversupply and low freight rates increase bargaining power of buyers in liner shipping industry.



Source: Containerization International(1997-2011)

Figure 2.5 Supply and demand of liner shipping market.

2.2.3 Threat of new players

The following are the factors which define the level of barriers of entry.

- 1) Investment cost-How much will it cost to enter the market.
- 2) Economies of scale- unit costs determine difficulty of newcomers to break into the market and compete effectively.
- 3) Government Regulation-if regulation is a barrier to entry.
- 4) Access to suppliers and distribution channels-if there are accesses and distribution channels for new player to enter the market.

Liner shipping industry depends heavily on a complex chain of logistical support.

Huge amount of capital investment is required for hardware and software. For example,

a 6500 teu vessel costs around USD74 million (UNCTAD, 2010), a fleet of 7 vessels to run a fixed day weekly service means a requirement of about USD518 million capital investments. In addition, building up information system, staff employment and training also have high requirement for capital investment. The high level of sunk costs may prevent new players to enter.

In many less developed countries, shipping industry is managed by government which has a large involvement in capital investment and administrative controls. Various protectionist policies form a barrier to new players.

Distribution channels in liner shipping industry are difficult to open up because of fragmented customers in the market and the particularity of shipping service. Experienced employees especially of professional sales team are important to new players, but this often has to pay higher than market rate to attract talent and they are also hard to penetrate into the market within a short period of time.

Therefore, it is not easy to enter liner shipping industry for a new player. In particular, there are also some restrictions on capital and government policies.

2.2.4 Threat of substitutes

Substitute products refer to the products having ability of satisfying customers' needs effectively. The customers may shift to the substitutes, if the substitute is more attractive in terms of price or performance. The companies have to improve the performance of their products by reducing costs and therefore prices and by differentiation when there is a threat from a rival product. The extent of the threat depends upon:

- 1) Importance of product / service to the customer

2) The extent to which the price and performance of the substitute can match the industry's product

3) Customer loyalty and switching costs

Although economical air transportation system produces some effects on liner shipping industry in recent year, liner shipping as one of transportation industry still has a certain advantage. In general, Air transportation focus on a faster cargo transportation means for light weight or high value cargoes, but also at a much higher freight rate than maritime transportation.

Because of different target customers, liner shipping still dominates the market of large cargo volumes transportation. Therefore, air transportation can rarely be a substitute of liner shipping.

2.2.5 Competitive rivalry

Rivalry refers to the competitive struggle for market share and high profits between companies in an industry. It is also the most common threat that most businesses have to overcome. Porter has said that this is the driving force behind his model since companies must compete in the free market to earn profits. Several factors determine the degree of competitive rivalry and the main ones are (SCDigest):

1) Number of competitors in the market- Competitive rivalry will be higher in an industry with many current and potential competitors

2) Market size and growth prospects- Competition is always most intense in stagnating markets

- 3) Product differentiation and brand loyalty- The greater the customer loyalty the less intense the competition. The lower the degree of product differentiation the greater the intensity of price competition
- 4) Exit barriers- If it is difficult or expensive to exit an industry, firms will remain thus adding to the intensity of competition

As services provided by the carriers in liner shipping market are similar, for customers, the switching cost is not high which has intensified the competition in the market. The carriers have to wage a price war to retain its customers and to maintain its market share.

Liner shipping companies have a high upfront investment in fleets, technical equipments and intangible assets. In recent years, with market demand and an improved technology, bigger ships have become main stream in market. Hence, the resale value of old and small ships has dropped tremendously.

Therefore, the products liner shipping companies provide is little lower the degree of differentiation and high barriers to exit because of high sunk costs, which leads to fierce price competition, especially when market is stagnant.

On basis of above five forces analysis of industrial structure, competitive rivalry and bargaining power of buyers show a relatively strong force in liner shipping industry. For striving for a competitive position in market, liner shipping companies have to take into account of these critical forces in its strategic planning.

2.3 Financial status of liner shipping companies

Liner shipping industry is closely related to change of global economic situation. After the financial crisis in 2008, the liner shipping market is mauled. In 2009, the global

cargo movement volume is 9.9% lower than that of 2008(Drewry) and the consequent the decrease in freight rates and the soaring fuel price. Moreover, a huge number of new ships ordered during the ‘boom’ period of 2006-2008 need to be absorbed, which led to values for vessels decline. Jung et al wrote in Business Week 2009 that ‘a brutal downturn in global trade has left shippers with idle capacity, billions in losses, and even facing potential bankruptcy’ (Widiantoro and Elvenes, 2012).In such circumstances in liner shipping market, as shown in Table 2.2, all of major carriers in liner shipping industry have heavy losses in profit margin, no carriers achieved surpluses in 2009.

In the world of economic recovery, the cargo movement volume headed by that of Asian market had increased gradually since the second half of 2009. The container cargo volume increased 15% in 2010, over 2009. Liner shipping companies took a number of measures to refresh from shock of financial crisis, such as laying up a ship and slow steaming. Average voyage speed in liner shipping companies is decelerated from 24-26 knots to 17-18 knots. Even some big liner shipping companies have a plan to reduce it to below 15 knots. With rise of freight rate and increase of container cargo volume, the liner shipping market had recovered gradually in 2010. In Table 2.2, a significant increase of revenue is presented and the financial performance in 2010 achieved profitability in top 13 liner shipping companies.

In 2011, a number of new deliveries of ships that are delayed in delivery as influence of financial crisis began to enter service. However, the container cargo volume was not increased in correspondence with the increasing ship capacity. Consequently, a direct result of the over-capacity and decrease in freight rates is shown in liner shipping industry. Moreover, oil prices had risen because of the instable political and economic situations in 2011. For example, “The Arab Spring” that began on December 2010,

Tohoku earthquake in Japan that occurred on March 2011, The European sovereign debt crisis have escalated in 2011, and United States debt-ceiling crisis erupted in 2011, and so on. Either low freight rates or high bunker fuel prices lead to the increase of operating cost. Table 2.2 shows most liner shipping companies had decreased in revenue over the previous year. The profit margin performance was as poor as revenue. There were only 2 companies that make a profit in 13 major liner shipping companies (Figure 2.6), they are CMA CGM and OOCL. CMA CGM presents revenue of USD14.87 billion for 2011, 4% increase on 2010, which benefited in the main from selling certain assets and this in particular boosted its liquidity (Global Credit Research, 2011). OOCL achieved profitability, mainly resulted from the main market, Asian market (NYK research group, 2012).

Liner shipping companies are taking series of positive measures to make profit recently. However, they are still facing high pressure on profit because of global political and economic instability.

Table 2.2 Financial results of major carriers, 2009-2011

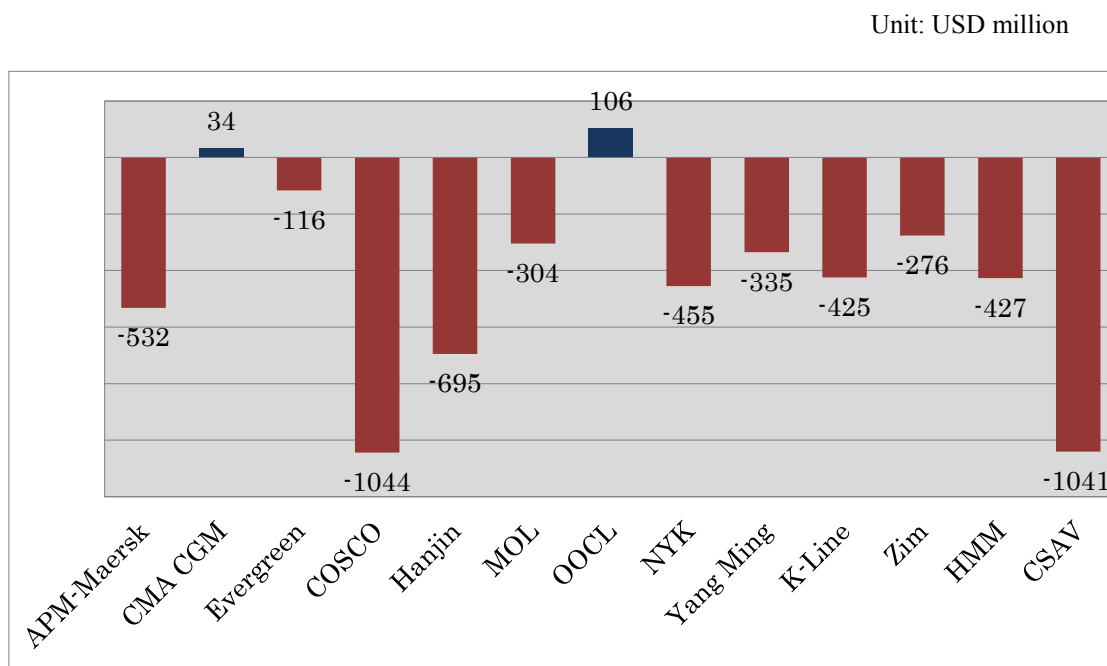
Unit: local currency million

Carrier	Revenue			Net profit margin		
	2009	2010	2011	2009	2010	2011
APM-Maersk	20,611	26,038	2,5108	-1,930	2,875	-532
CMA CGM	10,543	14,291	14,870	-1,440	1,678	34
Evergreen	81,936	109,353	108,156	-12.874	18,756	-3,419
COSCO	27,510	46,312	41,406	-7,813	3,624	-6,359
Hanjin	668,057	9,423,341	9,169,474	-87,055	305,510	-736,911
MOL	468,001	590,228	544,126*	-56,878	38,853	-29,910*
OOCL	4,326	6,009	5,987	-360	868	106
NYK	378,085	462,163	418,744	-55,445	30,248	-44,757
Yang Ming	88,893	130,550	118,555	-16,773	13,231	-9,854
K-Line	530,080	447,409	399,068	-37,293	29,005	-41,772
Zim	2,449	3,717	3,784	-675	212	-276
HMM	6,115,482	8,086,981	7,187,858	-798,191	347,099	-453,458
CSAV	3,028	5,452	5,152	-707	171	-1,041

Source: NYK research group

Note1: There are only data of 13 major liner shipping companies in Top20 in the study because of lack of related data.

Note2: *The data of logistics sector is included.



Source: NYK research group

Note: Non- USD is exchanged at September 2013's exchange rate

Figure 2.6 Profit margin of major carriers, 2011

References

BIMCO, 2007, Do liner conferences still work?

https://www.bimco.org/en/Education/Seascapes/Questions_of_shipping/2007_11_01_liner_conferences.aspx

Bolton, R.N. and James H.D., 1991, A multistage model of customer`assessment of service quality and value, *Journal of Consumer research*, 17(4), 375-384.

Branch, A., 1984, Elements of Shipping, ISBN 0748760393

Branch, A. 2001, Elements of Shipping, Cheltenham, Nelson Thornes

Cullinane, K and Khanna,M., 2010, Economies of scale in large container ships, *Journal of transport economics and policy*, 33(2), 185-208; Fusillo, M., 2009, Structural factors underlying mergers and acquisitions in liner shipping, *Maritime Economics & Logistics*, 11, 209–226.

Genestre, A. and Herbig, P., 1997, Service Quality Journal of customer Service in *Marketing&Manngement*, 3, 65-83.

Hung, C. L., 1992, Strategic business alliances between Canada and the newly industrialized countries of pacific Asia, *Management international review*, 32.

Hwang, K.S., Gray, R. and Cullinane,K., 2010, The Logistics Functions of Shipping Lines: Perceptions of International Shippers in South Korea and the UK, *International Handbook of Maritime Business*, 416

Koo, J. S., Hwang, K. S. and Yeo H.J., 2009, Are Shippers satisfied with the diversified Provision of Logistics Service by Shipping Companies? --A Study between the UK and South Korea, *The Asian Journal of Shipping and Logistics*, 25 (2), 237–251.

Linton, S., 2005, Industry Analysis: The Five Forces, purdue extension ec-722.

Midoro ,R. and Parola,F., 2006, Logistics services and vertical integration: new

challenges for shipping lines, *Proceeding of the third international congress on maritime transport*.

Notteboom, T., 2004, Container shipping and ports: An overview, *Review of Network Economics*, 3 (2), 86-106.

Panayides, P. and Wiedmer, R., 2011, Strategic alliances in container liner shipping, *Research in Transportation Economics*, 32.

Pardee, W.J., 1996, To satisfy & delight your customer: How to manage for customer Value, *Dorest House Publishing*, New York.

Porter, M. E., 1980, *Competitive Strategy*, the Free Press.

Sjostrom, W., 2004, Ocean Shipping Cartels: A Survey, *Review of Network Economics*, 3(2).

Stopford, M., 2004, *Maritime Economics*, London, Routledge.

Widianoro D. M. and Elvenes, V., 2012, Managing risk in financial market in shipping industry, *ACRN Journal of Finance and Risk Perspectives*. 1(1), 32-49.

Chapter 3

Performance measurement for liner shipping company

3.1 Introduction

The performance measurement plays a crucial role in business practice because it provides an important measurement for management control and investigation whether resources are allocated efficiently (Evanset et al., 1996). It assists managers to evaluate the achievement of business goals, points out problems and adjusts direction of possible improvement actions.

The traditional mainstream approach to organised performance measurement is the accounting-based ratios of performance (Otley, 2002). Hossan *et al.* (2010) evaluate the financial ratio analysis as one of the best tools of performance evaluation for any companies. They evaluated different financial ratios such as liquidity ratios, asset management ratios, profitability ratios, market value ratios and debt management ratios, finally measured the best performance between two pharmaceutical companies in Bangladesh. Chen *et al.* (2006) state that the financial ratios play an important role in financial forecasting. In order to make effective use of financial ratios, it is necessary to classify the large number of possible ratios into meaningful groups. According to Van Horne (2009), a firm's purpose is not only internal control but also better understanding

of what capital suppliers seek in financial condition and performance. Analysis of various ratios should shed light on a better interpretation of the financial condition and performance of the firm than that could be obtained from analysis from the financial data alone.

In the existing literature, there are also many studies that investigate the financial ratios of bankruptcy predictions and performance evaluations of firms; however, they are limited on the fiscal perspective (Altman, 1968; Drake, 1998; Ocal, 2005; Ganesalingam, 2001; Emel *et al.*, 2003).

More and more practitioners, consultancies and academic communities realized that due to increased complexity of organisations and the markets in which they compete, it was no longer appropriate to use financial measures as the sole criteria for assessing success (Kaplan and Norton, 1992; Neely and Adams, 2000; Lynch and Cross, 1991). They have focused attention on multidimensional, explicitly balancing financial and non-financial measures such as customer service quality based performance measurement system that can replace the existing traditional cost based-measurement systems.

The business performance measurement is recently one of the hot issues in the liner shipping industry like in other industries. In particularly, as analysed in chapter 2, there is fierce competition in the present liner shipping market with economic globalization. In current dire circumstances, a large number of liner shipping companies have a great deficit, and some liner shipping companies even went bankrupt. Therefore, improving management performance and competitiveness to expand the market share and achieve profitability by performance measurement are a critical concern in the recent liner shipping business.

Some studies have integrated performance measurement in shipping industry. Varvate (2010) use industry key performance indicators to investigate shipping companies' financial performance measurement in the highly dynamic period 2007-2010. The results indicate that the combined effect of industry benchmarking and risk management in company's performance is efficiency, effectiveness and high growth prospects. In addition to the measures of financial performance, measures of non-financial performance have attracted more attention since the shipping is basically a service industry and its quality has increased considerably in recent years (Genestre, 1997). For gaining the higher loyalty of customer, business reputation, and market share, shipping companies strive to deliver high quality services (Bolton, 1991; Pardee, 1996). The nature of shipping service is distinct from either physical product or manufacturing, because it deals with intangible services and depends on human performances and decisions, the condition of the cargo transported (Harmon, 1997).

It has become more and more clear that the conventional financial accounting measures such as earning-per-share and return-on-investment may give misleading signals for continuous advances and creation-activities of competitive environment demands nowadays. Kaplan and Norton (1992) verify that the conventional financial performance measures may still have advantages in the industrial era, but they appear insufficient in terms of both skills and competencies. They introduced the BSC which covers both financial and non-financial aspects of the business process. It was originally developed for the multi-attribute performance measurement and its philosophy on business process evaluation pioneered the importance of key performance indicators and the quality management issues including the internal customer.

However, BSC is incapable to specify how much each perspective, the relative

importance weight for each perspective and its sub indicators may contribute in the qualitative senses (Zolfani, 2011). In recent years, several Multi Attribute Decision Making (MADM) methods and BSC has been proposed to performance evaluation and solve this problem. Such as Analytical Hierarchy Process (AHP), Analytical Network process (ANP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and The Multi-criteria Optimization and Compromise Solution (VIKOR) as efficient multiple criteria decision making tools have been widely used in BSC studies (Leung et al, 2006; Lee, 2007; Wu et al.,2009;Azar et al., 2011; Zolfani et al. 2011).

According to Zolfani et al. (2011), an evaluation model for selecting MADM methods like AHP, ANP, VIKOR, TOPSIS, and DEMATEL for using with BSC was proposed, it gives a framework that can be used for future researches and can be a guideline for researchers to select the best hybrid model of MADM methods with BSC. Wu et al. (2009) use a fuzzy multi-criteria decision-making (FMCDM) approach based on the BSC perspectives to conduct a performance analysis on banks. The FAHP and the three MCDM analytical methods (i.e. TOPSIS, and VIKOR) were employed in the performance analysis for computing the fuzzy weights of the criteria, ranking the banking performance and improving the gaps of the three banks. In the numerous applications of integrating MCDM method and BSC, more realistic result from BSC by combining MCDM method has been obtained and proved to be effective and reliable for creation of a coherent evaluation framework.

This study utilizes the BSC method to ensure a cumulative analysis of the short/long and tangible/intangible indicators of performance and computes the weight of each criterion by Fuzzy-AHP method in the liner shipping industry. The goal related perspectives of BSC and both financial and non-financial technical measures are

defined from scientific studies in the literature and reports and screened by experts in liner shipping industry. After that, the questionnaire method is used to practitioners and experts such as operators, customers and owners in liner shipping business. The calculation and results are stated in the following Sections. As the study subjects, the performances of traditional liner shipping companies and liner shipping companies as logistics services provider are measured, respectively. For traditional liner shipping companies, the degree of relationship between every single strategy and the performance measure is defined and the sum products of the relationship degree and the priority weight of strategies are used to find normalised priority level of a performance indicator. While liner shipping companies are acting as logistics services provider, the measurement focuses on the relative weights of performance measures and each perspective of BSC. Finally, implications for liner shipping companies are discussed by analysing results of two measurement subjects in this chapter.

3.2 Methodology

The performance measurement process for a liner shipping company is designed in five steps:

Step 1: Preliminary consultation for strategy assignment

Strategy assignment is a significant stage of the entire process. Panayides and Cullinane (2002) manifested the importance of competitive advantages and suggested a number of modern approaches for strategic management perspective. For example, the differentiation and cost leadership are the most mentioned strategic directions for business sustainability and fiscal growth. Porter (1980) illustrates these two major

directions under the fiscal considerations by revising the Return on investment (ROI) indicator. Figure 3.1 indicates how these strategies contribute to ROI ratio and the related market share estimations. Strategy development is a complicated and distinctive part which is assumed to be completed before BSC process as a prerequisite of the method.

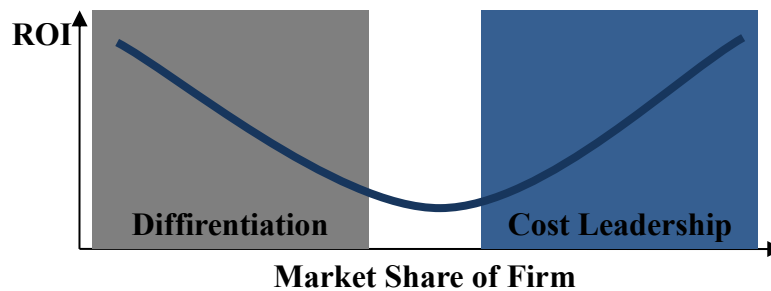


Figure 3.1 Porter (1979)'s approach on strategic management.

In this study, strategies are selected as an illustration by analysing development trends and status quo of liner shipping industry in chapter 2, reviewing the related literature and interviews with business practitioners who are working in liner shipping companies, logistics companies and freight forwarder companies in China, Korea, Turkey and Japan. The intended strategy scheme is based on a world-wide liner shipping company perspective and particularly integrates the cost leadership strategy as the domain of company's vision.

Step 2: Compromised performance measurement and Goals setting by utilising BSC framework.

This step consists of goals setting according to the four perspectives: finance, customer, internal business process and learning and growth.

Step 3: Assignment of Performance measures (indicators) and their measurement procedure (e.g. description of measure).

Once the goals are set, the performance measures (indicators) (PI) should be defined to follow-up with the changes. These PIs are expected to ensure measurability (i.e. numerical and tangible) principle. The performance measures are selected by the related literature and screened by experts in liner shipping industry.

Step 4: Performance measurement for traditional liner shipping companies and liner shipping companies as logistics service provides.

Performance measurement for traditional liner shipping companies, the degree of relationship between every single strategy and the performance measure is defined and the sum products of the relationship degree and the priority weight of strategies are used to find normalised priority level of a performance indicator (see section 3.3.4).

Performance measurement for liner shipping companies as logistics service providers, the relative weights of performance measures and each perspective of BSC are computed by FAHP (see section 3.4.4).

Step 5: Policy development for implementation and corrective actions.

The proposed method suggests the control tools and the most contributing technical measures for improvement and strategy implementation. Implications for liner shipping companies are discussed by analysing the most important performance indicators based on two perspectives in liner shipping companies. For practising the foundations of the method, liner shipping companies should redesign the existing procedures and probably establish a number of new processes while terminating some of them. The final step is more practical and related with the organisational culture.

The following sub-sections introduce the intended methods for the proposed process.

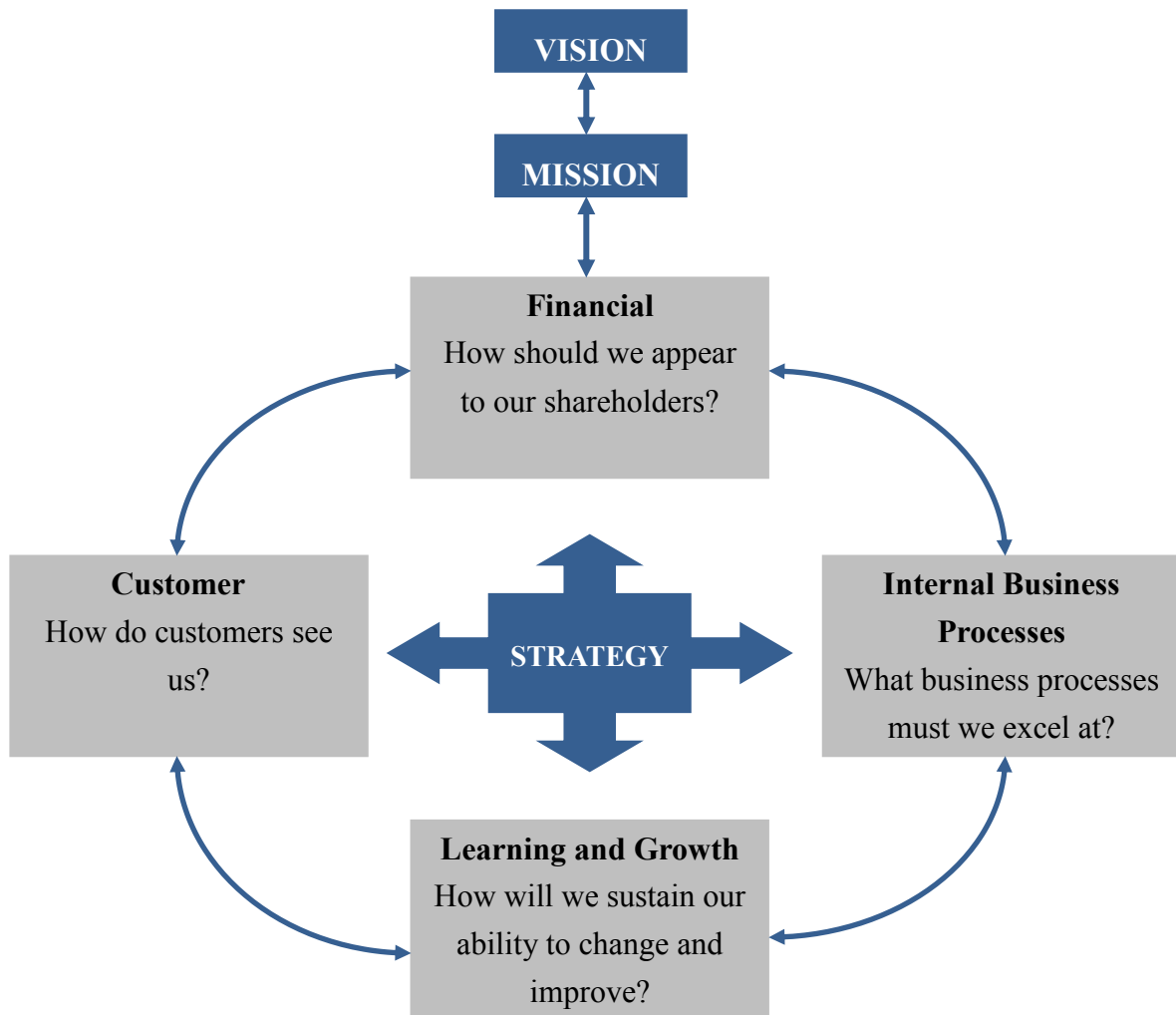
3.2.1 The Balanced Scorecard

The balanced scorecard (BSC) was first introduced and proposed as a framework for performance measurement model by Kaplan and Norton in 1992 at the Harvard Business School. They (1996) defined the BSC as “a multidimensional framework for describing, implementing and managing strategy at all levels of an enterprise by linking, through a logical structure, objectives, initiatives, and measures to an organisation’s strategy”. Wall (2003) indicates BSC ranks the most successful tool for performance management and has been used by half of the global top 1000 companies. BSC as an important strategic performance measurement system, its importance in development and management of organizations is presented in some academic researches (Jelenic.D., 2011; Abe. T., 2006; Kaplan, R.S., 2010 and Figge. F. 2002).

A number of studies discuss the application of the BSC in companies and public organizations. Fernandes *et al.* (2006) investigate how BSC can be implemented successfully using a systematic and structured methodology by a case study of a SME in UK manufacturing sector. This study lists the experimental results of the proposed deployment method and highlights the experiences, successes and lessons learnt during the implementation process. Wu (2012) presents a structural evaluation methodology for integrating key performance indicators (KPIs) into a BSC strategy map in bank institutions. The Decision Making Trial and Evaluation Laboratory (DEMATEL) method is a multiple criteria analysis tool which can be used in several aspects: (1) determining the casual relationships between KPIs, (2) identifying the critical central and influential factors, (3) establishing a visualized strategy map to improve banking performance. Three most important KPIs in an example of empirical application can be customer satisfaction, sales performance, and customer retention rate. Farooqa and

Hussain (2011) investigate effects of BSC and change on organizational performance. A questionnaire was proposed, and responses were collected from organizations which were separated on the basis of public and private sectors as well as manufacturing and service industry. Guimarães et al. (2010) assess the application potential of BSC in the waste utilities in Portugal. A string of performance indicators was suggested in distinct management models such as the municipalities, semi-autonomous utilities, municipal companies and mixed companies. The implementation is demonstrated using these four case studies.

The BSC broke the traditional financial performance measures which only paid attention to financial indicators. Kaplan and Norton argued that although the traditional financial measures are capable to describe the past events, they cannot predict the future and provide guidance. On the contrary, BSC takes the financial and non-financial indicators into account for the purpose of determining the corporate performance level. The BSC achieves a balance between financial and the non-financial measures, short-term and the long-term objectives, internal and external performance, leading and lagging indicators (Kaplan and Norton, 1996). It cannot just be regarded as a performance measurement tool but also be regarded as a performance management system allowing organisations to clarify their vision and strategy. Figure 3.2 provides a graphical representation of how mission and values-focused strategy drives the four perspectives.



Source: Balanced Scorecard Institute, USA www.balancedscorecard.org

Figure 3.2 The Balanced Scorecard Model

From four different perspectives: financial, customer, internal business process, and learning and growth, the BSC evaluates the performance of the firm, emphasizes its strategic comprehensiveness and growth (Kaplan and Norton, 1992). It shows how these measures are interrelated and effect one another, enabling an organisation's past, present, and potential performance to be tracked and managed (Airport Cooperative Research Program Report).

Financial perspective

Financial indicators based on financial data show execution of financial performance of an organisation or a company. But not all long-term strategies can get a quick profit improvement of non-financial indicators (quality, time of production, productivity and new product, etc.) that are means for achieving a purpose. The financial perspective gives access of shareholders' view of the firm, and the primary financial goals desired from the shareholders' consideration (Siakas *et al.*, 2005). Common measures are profitability, return on investment, unit cost, and et al.

Customer perspective

Based on the target customers and market segment, firm/organisation should pay more attention not only to core customers, but to all customers in order to meet the financial objectives. Customers' concerns can be divided into 5 categories: cost, time, quality, performance and service. These are leading indicators. If a customer is not satisfied, he/she can find other suppliers and it may cause a customer loss. Generic measures are customer satisfaction, customer retention and loyalty, new customer acquisition and market share.

Internal business processes perspective

The internal business processes is a critical step because it has the greatest impact on customer satisfaction and meeting shareholder expectations regarding financial returns. The firm or organisation usually has the objectives and measures of financial perspective and customer perspective first. Then, they set objectives and measures of internal business processes to satisfy shareholders and customers. Those measures

include cost, efficiency, quality, and the new product to market lead time.

Learning and Growth perspective

The objectives of Learning and Growth provide the infrastructure and drive for achieving the objectives of the other three perspectives. The firm cannot ensure that they can achieve the future goals depending on existing techniques. Therefore, the firm and its employees must learn, improve, and innovate to create long-term growth and improvement. Efficient and effective use of the employee, manufacturing learning, and information system availability are considered as measures.

Figure 3.3 displays how the four perspectives mentioned above have cause-and-effect relationship. Learning and growth lead to better business processes that result in satisfying market needs, increasing the customer loyalty, and, thus, improvement of financial performance.

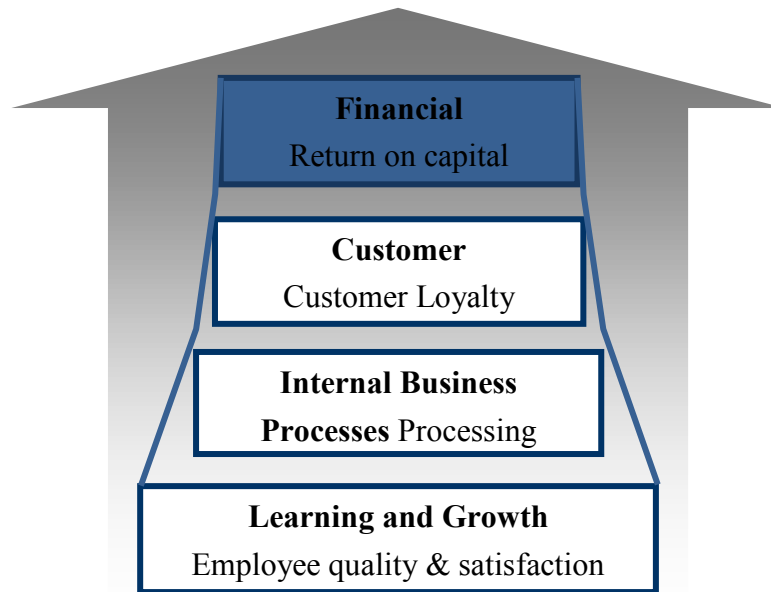


Figure 3.3 Cause and Effect relationships among the four perspectives.

3.2.2. Fuzzy Analytic Hierarchy Process

The analytic hierarchy process (AHP) was proposed to overcome the decision making problem and evaluate multiple alternatives by using pairwise comparison matrix (Saaty, 1977). However, Laarhoven and Pedryc (1983) criticized the AHP method for not reflecting the decision maker's thought form and they proposed the triangular fuzzy number to overcome this problem of vagueness for AHP and their approach was called fuzzy-AHP method (FAHP). After that, many scholars proposed a new approach to simplify the calculation by using a different algorithm (Buckley, 1985; Bulut *et al.*, 2012; Chang, 1996; Crawford & Williams, 1985; Duru *et al.*, 2012a; Forman & Peniwati, 1998; Mikhailov, 2003). FAHP is also applied and developed in studies of different industries. Bulut *et al.* (2012) investigate the shipping asset management (SAM) problem in the dry bulk shipping market. The study contributes to the literature

by ensuring a proper consistency control mechanism, expertise classification and use of DNI values. Shaw *et al.* (2012) present an integrated approach for selecting the appropriate supplier in the supply chain, addressing the carbon emission issue by fuzzy-AHP and fuzzy multi-objective linear programming. Cost, quality rejection percentage, late delivery percentage, greenhouse gas emission and demand as factors are considered in the study. These weights of the multiple factors are used in fuzzy multi-objective linear programming for supplier selection and quota allocation. Huang *et al.* (2008) present a fuzzy AHP method and utilize crisp judgment matrix to evaluate subjective expert judgments made by the technical committee of the Industrial Technology Development Program in Taiwan. The results indicate that the scientific and technological merit is the most important evaluation criterion considered in overall technical committees. The relative importance of the evaluation criteria changes under various risk environments via simulation is demonstrated in the study.

In this study, the Chang's method is first applied as a FAHP method and second Bulut *et al.*'s approach (2012) is used to compute the weight of each criterion by using six different fuzzy numbers (Table 3.1 and Figure 3.4).

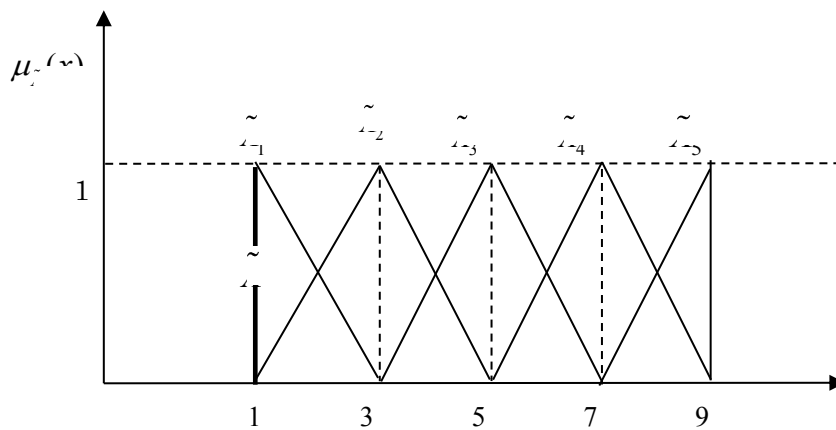


Figure 3.4 Fuzzy number of linguistic variable set.

Table 3.1 Transformation for TFNs membership functions.

Fuzzy number	Linguistic scales	Membership function	Reciprocal
$\tilde{A}_1$	Equally important	(1,1,1)	(1,1,1)
$\tilde{A}_2$	Moderately important	(1,1,3)	(1/3,1,1)
$\tilde{A}_3$	More important	(1,3,5)	(1/5,1/3,1)
$\tilde{A}_4$	Strongly important	(3,5,7)	(1/7,1/5,1/3)
$\tilde{A}_5$	Extremely important	(5,7,9)	(1/9,1/7,1/5)

Definition 1: A fuzzy set $\tilde{A}$ in a universe of discourse R is characterized by a membership function $\mu_{\tilde{A}}(x)$ which associates with each element x in R is a real number in the interval $[0, 1]$. The function value $\mu_{\tilde{A}}(x)$ is termed the grade of membership of x in $\tilde{A}$.

Definition 2: A fuzzy number is a fuzzy subset in the universe of discourse R that is both convex and normal.

Definition 3: A triangular fuzzy number denotes as $\tilde{A} = (l, m, u)$, where $l \leq m \leq u$, has the following triangular type membership function;

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x < l, \\ (x-l)/(m-l), & l \leq x < m, \\ 1, & x = m, \\ (u-x)/(u-m), & m < x \leq u, \\ 0, & u < x. \end{cases} \quad (\text{eq. 1})$$

where l and u are the lower and upper bounds of the fuzzy number $\tilde{A}$, respectively, and m is the midpoint (Figure 3.5).

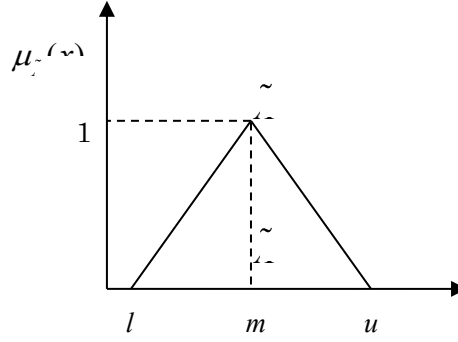


Figure 3.5 A triangular fuzzy number $\tilde{A}$.

The Chang approach for the FAHP method is stated in as follows:

Let $X = \{x_1, x_2, x_3, \dots, x_n\}$ be an object set and $U = \{u_1, u_2, \dots, u_m\}$ be a goal set. The extent analysis for each goal is performed under each object. Therefore, m extent analysis values for each object are indicated with the following parameters:

$$M_{g_i}^1, M_{g_i}^2, \dots, M_{g_i}^m, \quad i=1, 2, \dots, n, \quad (\text{eq. 2})$$

where all the M_g^j ($j=1, 2, \dots, m$) are TFNs.

Step 1: The value of fuzzy synthetic extent with respect to the i th object is defined as

$$S_i = \sum_{j=1}^m M_{g_i}^j \otimes \left[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j \right]^{-1} \quad (\text{eq. 3})$$

To obtain $\sum_{j=1}^m M_{g_i}^j$, the fuzzy addition operation of m extent analysis values for a particular matrix is performed such as:

$$\sum_{j=1}^m M_{g_i}^j = \left(\sum_{j=1}^m l_j, \sum_{j=1}^m m_j, \sum_{j=1}^m u_j \right) \quad (\text{eq. 4})$$

And to obtain $\left[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j \right]^{-1}$, the fuzzy addition operation of $M_{g_i}^j$ ($j=1, 2, \dots, m$)

values is performed such as:

$$\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j = \left(\sum_{i=1}^m l_j, \sum_{i=1}^m m_j, \sum_{i=1}^m u_j \right) \quad (\text{eq. 5})$$

and then the inverse of the vector in Eq. (9) is computed, such as:

$$\left[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \right). \quad (\text{eq. 6})$$

Step 2: The degree of possibility of $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ is defined as

$$V(M_2 \geq M_1) = \sup_{y \geq x} \left[\min(\mu_{M_1}(x), \mu_{M_2}(y)) \right] \quad (\text{eq. 7})$$

and can be expressed as follows:

$$V(M_2 \geq M_1) = \text{hgt}(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1, & \text{if } m_2 \geq m_1, \\ 0, & \text{if } l_1 \geq u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & \text{otherwise.} \end{cases} \quad (\text{eq. 8})$$

Figure 3.6 illustrates Eq. 8 where d is the ordinate of the highest intersection point D between μ_{M_1} and μ_{M_2} . To compare M_l and M_2 , we need both the values of $V(M_l \geq M_2)$ and $V(M_2 \geq M_l)$.

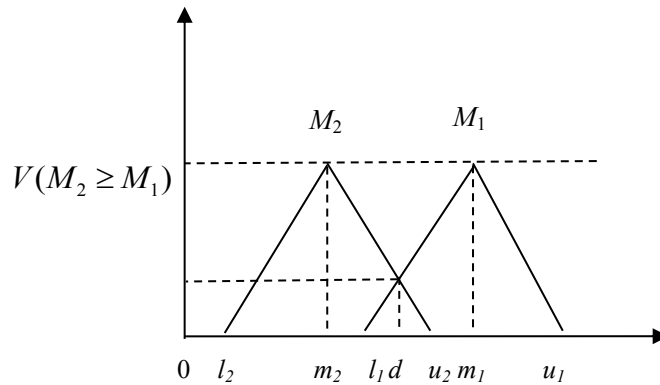


Figure 3.6 The intersection between M_1 and M_2 .

Step 3: The degree possibility for a convex fuzzy number to be greater than k convex

fuzzy $M_i (i=1,2,...,k)$ numbers can be defined by

$$\begin{aligned} V(M \geq M_1, M_2, \dots, M_k) &= V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_k)] \\ &= \min V(M \geq M_i), i=1,2,3,\dots,k. \end{aligned} \quad (\text{eq. 9})$$

Assume that $d'(A_i) = \min V(S_i \geq S_k)$ for $k=1,2,\dots,n; k \neq i$. Then the weight vector is given by

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad (\text{eq. 10})$$

where $A_i (i=1, 2, \dots, n)$ are n elements.

Step 4: Via normalization, the normalized weight vectors are

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T, \quad (\text{eq. 11})$$

where W is a non-fuzzy number.

3.2.2.1 The consistency calculation for the FAHP method

The consistency calculation for the pairwise matrix is considered and calculated just for traditional AHP method. However, the acceptance of pairwise matrix is based on the value of consistency. Bulut *et al.* (2012) proposed the centric consistency index (CCI) for the FAHP method that is based on the geometric consistency index (GCI) (Aguarón and Moreno-Jiménez, 2003; Crawford and Williams, 1985) to calculate the consistency of each pairwise matrix.

The calculation of CCI is as follows:

Let $A = (a_{Lij}, a_{Mij}, a_{Uij})_{n \times n}$ be a fuzzy judgment matrix, and let $w = [(w_{LL}, w_{ML}, w_{UL}), (w_{L2}, w_{M2}, w_{U2}), \dots, (w_{Ln}, w_{Mn}, w_{Un})]^T$ be the priority vector derived from A using the RGMM. The centric consistency index (CCI) is computed by

$$\begin{aligned} CCI(A) &= \frac{2}{(n-1)(n-2)} \sum_{i < j} \left(\log\left(\frac{a_{Lij} + a_{Mij} + a_{Uij}}{3}\right) - \log\left(\frac{w_{Li} + w_{Mi} + w_{Ui}}{3}\right) \right. \\ &\quad \left. + \log\left(\frac{w_{Lj} + w_{Mj} + w_{Uj}}{3}\right) \right)^2 \end{aligned} \quad (\text{eq. 12})$$

where n is the number of elements.

When $CCI(A)=0$, we consider A fully consistent. The thresholds of GCI Aguarón *et*

al. (2003) is used for the CCI and its scale is $\overline{GCI}=0.31$ for $n=3$; $\overline{GCI}=0.35$ for $n=4$ and $\overline{GCI}=0.37$ for $n>4$.

3.2.2.2 The prioritization of decision maker

In the traditional AHP and FAHP method, the influence of pairwise matrix of each decision maker on the aggregating matrix is assumed equal. However, the experience and knowledge of each participant is different from each other. Bulut *et al.* (2012) proposed that reverse CCI ratio can be used as a prioritization of decision maker by using individual priorities (AIP) (Forman & Peniwati, 1998; Ramanathan & Ganesh, 1994) . The algorithm of their new approach is as follows;

Let $D = \{d_1, d_2, \dots, d_m\}$ be the set of decision makers, and $\lambda_k = \{\lambda_1, \lambda_2, \dots, \lambda_m\}$ be the weight of decision makers. The weight of decision makers (λ_k) is the normalized I_k for the group of experts which is calculated as follows:

$$I_k = \frac{1}{CCI_k} \quad (\text{eq. 13})$$

where I_k is the inverse of the CCI,

$$\lambda_k = \frac{I_k}{\sum_{k=1}^m I_k} \quad (\text{eq.14})$$

where $\lambda_k > 0$, $k = 1, 2, \dots, m$, and $\sum_{k=1}^m \lambda_k = 1$.

Let $A^{(k)} = (a_{ij}^{(k)})_{n \times n}$ be the judgment matrix provided by the decision maker d_k .

$w_i^{(k)}$ is the priority vector of criteria for each decision maker calculated by

$$w_i^{(k)} = \frac{\left(\prod_{j=1}^n a_{ij} \right)^{1/n}}{\sum_{i=1}^n \left(\prod_{j=1}^n a_{ij} \right)^{1/n}} \quad (\text{eq. 15})$$

The aggregation of individual priorities is defined by

$$w_i^{(w)} = \frac{\prod_{k=1}^m (w_i^{(k)})^{\lambda_k}}{\sum_{i=1}^n \prod_{k=1}^m (w_i^{(k)})^{\lambda_k}} \quad (\text{eq. 16})$$

where $w_i^{(w)}$ is the aggregated weight vector.

3.2.3 The relationship matrix design

The relationship matrix is frequently used in quality function deployment (QFD) as a part of House of Quality. Duru *et al.* (2012) suggested a multi-layer quality function deployment (ML-QFD) method for multi-agent problem in shipping asset management and this study applies the part of ML-QFD method. Figure 3.7 illustrates the proposed form of the relationship matrix which is inspired from Duru *et al.* (2012)'s study. A number of business practitioners in liner shipping industry and scholars in logistics research are asked to evaluate the relationship degree between each technical measure (performance indicator) and the strategy. The scale between 9 and 0 is used as in QFD tradition and Duru *et al.* (2012)'s suggestion.

	Technical Measures (PIs)
Strategies	Relationship Degrees Strong – 9 Medium – 5 Low – 1 No relationship/ ignorable – 0
	Sum products and normalised priorities

Figure 3.7 The relationship matrix.

In section 3.3, under the matrix, the sum of products of strategy priorities and relationship degrees is normalised for entire matrix (relative weight for global result) and also for perspectives (relative weight in perspectives).

3.2.4 The relative weight calculation

In section 3.4, after the calculation of the weight for each criterion by using FAHP method, the relative weight method is proposed to determine the most important dimension of BSC respectively for the selection of strategy for the liner shipping company. The relative weight is computed as follows:

Let $B = \{b_1, b_2, \dots, b_m\}$ be the number of dimensions of BSC; $w_d = \{w_1, w_2, \dots, w_g\}$ be the total weight of criteria related with the same dimension of BSC, and $w_n = \{w_1, w_2, \dots, w_s\}$ is the total weight of all criteria. The formulation of relative weight calculation is as follows:

$$w_b = \frac{\sum_{d=1}^g w_d}{\sum_{n=1}^s w_n} \quad (\text{eq. 17})$$

where w_b is the relative weight of each dimension of BSC; d is the number of criteria related with each dimension of BSC; n is the number of criteria.

3.3 Performance measurement for liner shipping company

3.3.1 Strategies for liner shipping company

Strategy can be defined as “the plans and activities developed by an organisation in

pursuit of its goals and objectives, particularly in regard to positioning itself to meet external environmental demands relative to its competition” (Kinsella, 2002). The creation of strategy ensures that the direction of performance measures is developed in each perspective. It also helps employees visualize and understand the relationships between the performance measures and achievement of strategic objectives. An appropriate strategy will bring many benefits for the organisation. For example, it can help employees make concerted efforts toward common goals, so as to concentrate and conserve valuable resources and increase work efficiency. A challenging strategy objective may help to excite the work enthusiasms of employees, thus, bring advancement in the organisation. In this study, strategy is also a critical step for a multi-dimensional evaluation framework. It is the centre of liner shipping company’s efforts to implement performance-based management, and involves setting long-term goals, translating those goals into plans, as well as implementing programs, monitoring performance, and measurement.

In this section, seven strategies are selected by analysis on development trends and status quo of liner shipping industry in chapter 2, reviewing the related literature and interviews with business practitioners (Table 3.2). Due to the generic nature of liner shipping, the service offered by liner shipping companies are similar, and gives little rooms to differentiate its product in the market. In addition, because of high upfront investment, fierce competition and high bunker price in recent, lowering cost of operations is becoming very important for liner shipping companies. Cost leadership has become one of the common goals set in liner shipping industry. The intended strategy scheme is based on a world-wide liner shipping company perspective and particularly integrates the cost leadership strategy as the domain of company’s vision.

Table 3.2 Strategies for liner shipping company.

Strategies	Symbol
1. Profitable growth	S1
2. Increased customer satisfaction	S2
3. Reduction of costs	S3
4. Improved (extending) service coverage (delivery service)	S4
5. Improved internal business processes	S5
6. Increased satisfaction of internal customers	S6
7. Improving convenience & IT based interfaces	S7

First and foremost, due to lower freight caused by over-supply and intense competition in the globalised liner shipping market, liner shipping companies still are currently characterized by low profit margin despite the economy's modest recovery . The level of capacity utilization depends on the growth of cargo, the speed with which existing operators introduce new and larger vessels into liner shipping service, even exits of operators from the market. Therefore, reduction of costs and profitable growth to survive that is prior to all others for all of liner shipping companies.

Besides, customer service is highly important to liner shipping industry that itself is service industry. As analysed before, services provided by the carriers in the market are very similar, i. e. differences among carriers are small, but a better service and operating process will help to make a company more distinctive in the market. Providing cheaper, faster, more accurate and convenient services is fundamental guarantee for the invincible status. Therefore, increasing customer satisfaction by high quality services is an indispensable strategy to liner shipping companies. To make customer satisfied, more broadly service coverage and more efficient business process are very influential factors. In addition, as e-commerce has been widely used in liner shipping industry, development of IT also becomes more and more important. As result,

increased customer satisfaction, improved (extending) service coverage (delivery service), improved internal business processes and improving convenience & IT based interfaces as critical strategies are suggested.

Last but not least, increased satisfaction of employees as a necessary strategy cannot be ignored. Employees' satisfaction should be paid great attention while most liner shipping companies nowadays only focus on financial aspect or business process. Since employees' enthusiasm and creativity are a fountainhead which the company grows strong. High efficiency and innovation are conducive to customer loyalty and costs down, which is good for profits.

3.3.2 Cause and effect relationships between the strategies

These strategies are not simply a collection of independent strategies. In the case of liner shipping company, Figure 3.8 illustrates the cause and effect relationship between the identified strategic objectives. It can also help employees understand the priorities and relationships among four perspectives of the BSC. Drucker (1997) stated the long-term success and competitiveness of an organisation uniquely results from the originally innovative ideas of creative peoples, because once the original thoughts prove successful, they can be rapidly duplicated by any other aspects of the organisations. Therefore, the people could be considered as the foundation for strategic success. Increased satisfaction of employees will lead to improved order process, enhancing quality of service delivered to customers. For example, a fast, accurate, and inexpensive service is always of importance to the customer. Higher customer satisfaction will lead to loyal customers and increased market share, which directly affect the bottom line -profitable growth.

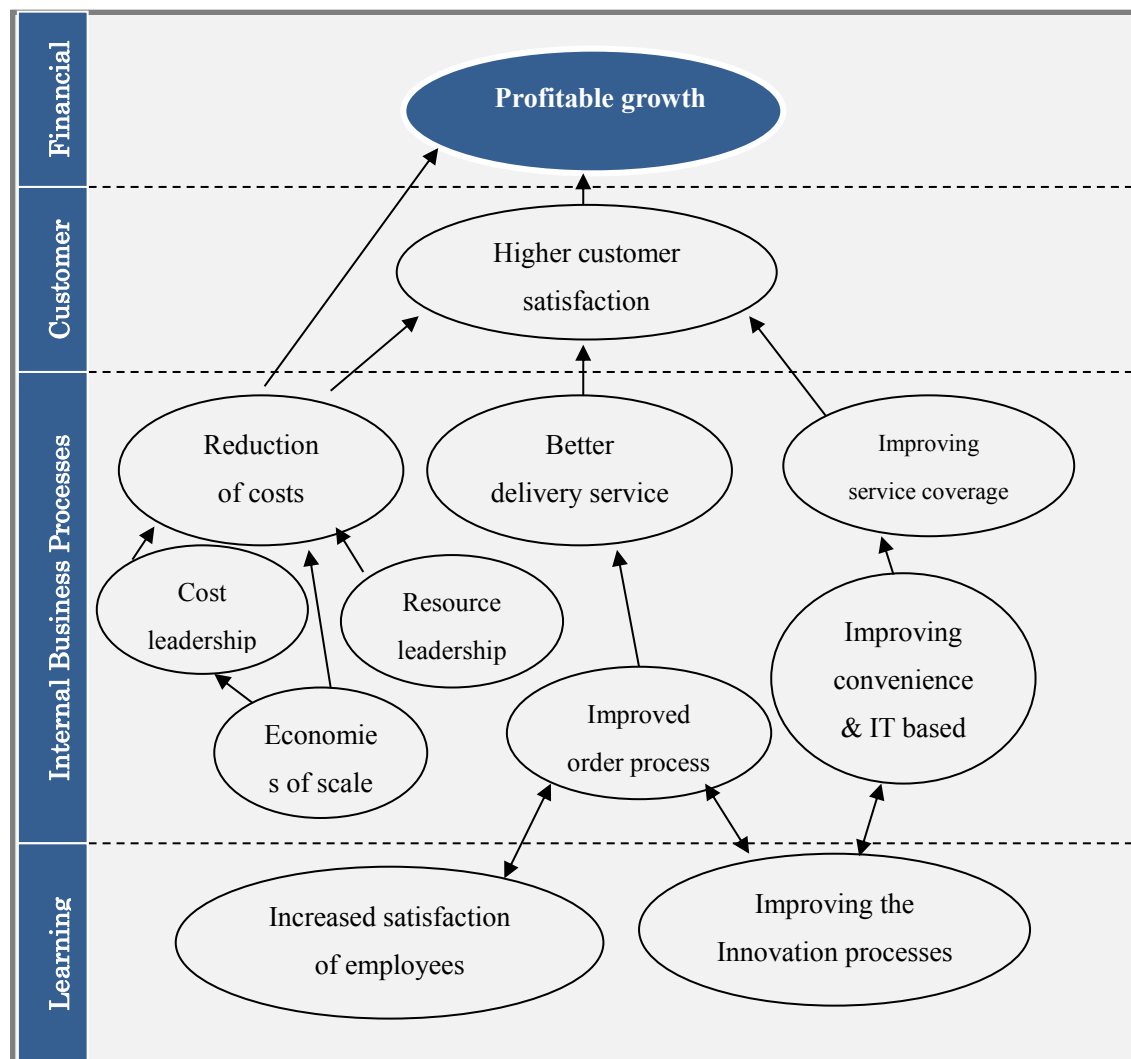


Figure 3.8 Cause and effect relationships between the strategic objectives

3.3.3 Goals setting and technical measures

For each strategic objective that must be performed well, it is necessary to set goals and measures in a reasonable period of time. The BSC translates strategy into a set of goals distributed among four perspectives: financial perspective, customer perspective, internal business processes perspective, and learning and growth perspective. The setting goals and measures play significant role to assist achieve the strategic objectives

and the measures must also focus on the outcomes necessary to achieve the strategic objectives. Table 3.3 presents the goals and technical measures for liner shipping measurement based on strategies. They are synthesized from the relevant literature and screened by a committee of experts.

As shown in Table 3.4, the main focus of liner shipping company is on customer satisfaction and internal business processes, learning and growth, all of which are non-financial performance measures. It is not difficult to discern that non-financial performance measures are dominant in all performance measures of liner shipping while only 2 of 24 performance measures represents a financial measures (see Table 3.4). Likewise, leading indicators account for a very big proportion (16 of 24 performance measures), which help to monitor progress toward achieving sustainability objectives.

Table 3.3 Goal setting and technical measures

Perspective	Goal	Measure	Unit	Description
Financial	Profitable Growth	Turnover(C ₁)	USD	Turnover per year
		Market Share (C ₂)	%	Market share of company in the industry
		Cargo volume growth (C ₃)	%	Cargo volume percentage change on previous year
	Profitability	Net Profit(C ₄)	%	Net profit rate per year
		Return on net assets(C ₅)	%	A comparison of net income with the net assets of liner shipping company
Customer	Increased customer Satisfaction	Customer satisfaction index(C ₆)	Survey	Index of customer satisfaction according to questionnaire
		Complaint number(C ₇)	No.	Number of complaints received
		Complaint quota(C ₈)	No.	Number of complaints divided by number of orders
		Tailor-made service(C ₉)	%	The number of customized service divided by the number of all service
	Higher customer Loyalty	Top ten customer volume(C ₁₀)	mton	Top 10 customer volume of shipping company
		Customer give-up rate (C ₁₁)	%	The number of customers who discontinue a service divided by the average total number of customers in the same time period
Internal Business	Enhancement of delivery service	On time delivery(C ₁₂)	%	Confirmed customer delivery date divided by actual
		Cargo missing/damage rate(C ₁₃)	%	The number of the missing/damage cargo divided by the total number of cargo
		Extending service Coverage(C ₁₄)	No.	The number of increased routes
	Process improvement	Share of web-based Orders(C ₁₅)	%	Share of web-based orders per month
		Accuracy of invoices (C ₁₆)	%	The number of line items invoiced correctly divided by the total number of line items invoiced
		Order process cycle time (C ₁₇)	Days	The moment customers place an order to the moment the company receives payment for that order
Learning& growth	Increased satisfaction of employees	Employee satisfaction (C ₁₈)	Survey	Index of employee satisfaction according to questionnaire
		Training hours of Employee(C ₁₉)	Hours	Hours of training a year for every employee
	Improving the intellectual level of company	MSc degree in senior staff(C ₂₀)	%	The number of MSc degree in senior staff divided by the number of all staff
		PhD degree in managers & consultants (C ₂₁)	%	The number of PhD degree in managers & consultants divided by the number of all staff
		Participation to industrial conferences, seminars (C ₂₂)	No.	The number of Participation to industrial conferences, seminars etc by senior officers, managers divided by the number of all senior officers, managers.
	Improving the innovation processes	Workshop organization (C ₂₃)	days	The number of days for workshop organization per year
		No. of employed researcher(C ₂₄)	No.	The number of employed researcher

Table 3.4 Particulars of technical measures

Technical Measure	Financial/ Non-financial	Lead/Lag	External/Internal
Turnover	Financial	Lagging	External
Market share	Non-financial	Lagging	External
Cargo volume growth	Non-financial	Lagging	External
Net profit	Financial	Lagging	External
Return on net assets	Non-financial	Lagging	External
Customer satisfaction index	Non-financial	Leading	External
Complaint number	Non-financial	Leading	External
Complaint quota	Non-financial	Leading	External
Customized service	Non-financial	Leading	External
Top ten customer volume	Non-financial	Lagging	External
Customer give-up rate	Non-financial	Lagging	External
On time delivery	Non-financial	Leading	Internal
Cargo missing/damage rate	Non-financial	Leading	Internal
Extending service coverage	Non-financial	Leading	Internal
Share of web-based orders	Non-financial	Leading	Internal
Accuracy of invoices	Non-financial	Leading	Internal
Order process cycle time	Non-financial	Leading	Internal
Employee satisfaction	Non-financial	Lagging	Internal
Training hours of employee	Non-financial	Leading	Internal
MSc degree in senior staff	Non-financial	Leading	Internal
PhD degree in managers & consultants	Non-financial	Leading	Internal
Participation to industrial conferences, seminars	Non-financial	Leading	Internal
Workshop organization	Non-financial	Leading	Internal
No. of employed researcher	Non-financial	Leading	Internal

3.3.4 Empirical results

The pairwise comparison survey is performed to define comparative priorities of the strategies and the each strategy is required to be compared against the remaining strategies. Table 3.5 presents a sample of the survey for the first pairwise comparison between S1 and S2. The subjects are asked to rate the degree of importance for the company's vision. A world-wide liner shipping company with a particular motivation for cost leadership is proposed for illustration and the subjects are informed about company intentions for business perception and future expectations.

Table 3.5 Sample for the pairwise comparisons

Profitable Growth-S1 vs. Increased Customer Satisfaction-S2					
Degree of Importance					
Equally	Slightly	Moderately	More	Strongly	Extremely
☐	☐	☐	☐	☐	☐

Although, each subject defines a linguistic term for comparison, these indications are transformed to fuzzy representatives and the numerical solution is conducted respectively. The final outcome is the normalised priority degree of strategies for satisfying the long term perspective of the liner shipping company.

The questionnaire method is used to generate the aggregated FAHP judgement matrix and, as it is explained in methodology, the result of CCI is used to compute the weight of each decision makers. Table 3.6 displays the result of weight for each strategy requirements and CCI is found less than the critical value of 0.37. Profitable growth is the major requirement. The second important strategy is the improved (extending) service coverage (delivery service) and increased customer satisfaction, reduction of costs, improved internal business process, improving convenience and IT based interfaces and increased satisfaction of internal customers are following strategies, respectively.

Table 3.7 indicates the numerical results for the relationship matrix and the priority degrees of technical measures. The relationship matrix is designed for eliciting the priority degrees of performance indicators by investigating their contribution level to satisfy the strategies. For this aim, the degree of relationship between every single strategy and the performance measure is defined and the sum products of the

relationship degree and the priority weight of strategies are used to find normalised priority level of a performance indicator. In addition, weights of performance indicators are computed. As shown in Table 3.7, market share (C_2), customer satisfaction (C_6), cargo missing / damage rate (C_{13}) and No. of employed researchers (C_{24}) is the important performance indicator for financial, customer, internal business process and learning and growth perspectives, respectively.

Table 3.6 The aggregated fuzzy judgment matrix

	S1	S2	S3	S4	S5	S6	S7	Weight
S1	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.60)	(1.00, 1.27, 3.35)	(1.00, 1.00, 3.00)	(1.00, 3.00, 5.00)	(1.00, 1.68, 3.82)	(1.00, 1.84, 3.98)	0.22
S2	(0.62, 1.00, 1.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 3.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.56)	(1.00, 1.00, 1.56)	(1.00, 1.00, 1.92)	0.15
S3	(0.30, 0.79, 1.00)	(0.33, 1.00, 1.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.79)	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.79)	0.13
S4	(0.33, 1.00, 1.00)	(1.00, 1.00, 1.00)	(0.56, 1.00, 1.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 3.00)	(1.00, 1.00, 3.00)	(1.00, 1.00, 1.27)	0.16
S5	(0.20, 0.33, 1.00)	(0.64, 1.00, 1.00)	(1.00, 1.00, 1.00)	(0.33, 1.00, 1.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.79)	(1.00, 1.00, 1.00)	0.12
S6	(0.26, 0.60, 1.00)	(0.64, 1.00, 1.00)	(1.00, 1.00, 1.00)	(0.33, 1.00, 1.00)	(0.56, 1.00, 1.00)	(1.00, 1.00, 1.00)	(0.61, 1.00, 1.00)	0.11
S7	(0.25, 0.54, 1.00)	(0.52, 1.00, 1.00)	(0.56, 1.00, 1.00)	(0.79, 1.00, 1.00)	(1.00, 1.00, 1.00)	(1.00, 1.00, 1.63)	(1.00, 1.00, 1.00)	0.12
CCI=0.02								

Table 3.7 Indicates the numerical results for the relationship matrix and the priority degrees of technical measures

			Financial					Customer					Internal Business Process					Learning								
Max. value in row	Relative weight		Turnover (C ₁)	Market share (C ₂)	Cargo volume growth (C ₃)	Net profit(C ₄)	Return on net assets (C ₅)	Customer satisfaction index(C ₆)	Complaint number (C ₇)	Complaint quota (C ₈)	Customizedservice (C ₉)	Top ten customer volume(C ₁₀)	Customer give-up rate (C ₁₁)	On time delivery (C ₁₂)	Cargo missing/damage(C ₁₃)	Extending service Coverage(C ₁₄)	Share of web-based orders(C ₁₅)	Accuracyof invoices(C ₁₆)	Order process cycle time(C ₁₇)	Employee satisfaction(C ₁₈)	Training hours of Employee (C ₁₉)	MSc degree in senior staff(C ₂₀)	PhD degree in managers & consultants(C ₂₁)	Participation to industrial conferences(C ₂₂)	Workshop organization (days)(C ₂₃)	No. of employed Researcher (C ₂₄)
9	0.22	S1	■	▲	▲	■	■					▲	▲													
9	0.15	S2						■	■	■		▲	■	▲	■			▲								
9	0.13	S3		■	■						▲				▲		●	●					▲	▲	■	
9	0.16	S4		■	▲			▲						●		■										
9	0.12	S5		▲	▲	■	■	▲			▲			▲	▲		■	▲	■	●	■	▲	▲	▲	■	
9	0.11	S6																		■			▲	▲		
9	0.12	S7															■								■	
Max. value in column			9	9	9	9	9	9	9	9	5	5	9	5	9	9	9	5	9	9	9	5	5	5	5	9
Sum product			1.95	4.25	3.63	3.00	3.00	2.75	1.39	1.39	1.24	1.85	2.47	1.51	2.63	1.40	2.24	1.49	1.05	1.09	1.71	0.58	0.58	1.78	1.78	3.29
Relative weight (Global)			0.04	0.09	0.08	0.06	0.06	0.06	0.03	0.03	0.03	0.04	0.05	0.03	0.05	0.03	0.05	0.03	0.02	0.02	0.04	0.01	0.01	0.04	0.04	0.07
Relative weight in perspective			0.12	0.27	0.23	0.19	0.19	0.25	0.13	0.13	0.11	0.17	0.22	0.15	0.26	0.14	0.22	0.14	0.10	0.10	0.16	0.05	0.05	0.16	0.16	0.30

'■', strong relationship (9), '▲' moderate relationship (5), '●' low relationship (1) and 'Ø' no relationship.

3.4 Performance measurement for logistics service provider

3.4.1 Liner shipping company as a logistics service provider

Logistics services represent quite significant market in recent years. For instance, the global logistics market generated total revenues of \$3,566 billion in 2008, representing a compound annual growth rate (CAGR) of 6 % for the period spanning 2004-2008. The industry is forecast to grow at a CAGR of 2 % for the five-year period 2008-2013, to reach \$3,895.5 billion by the end of 2013(Datamonitor). As discussed in chapter 2, more and more liner shipping companies have realized the importance of diversified services and provide logistics service. The underlying reasons can be summarized by (Haralambides and Acciaro, 2010) as following: increasing shipper demand for integrated supply chain solution; service and price differentiation; revenue stabilisation; and long-run profitability and market share. In annual report 2012, NYK states that it provides high-value-added one-stop logistics services that cover shipping, air transportation, land transportation, and warehousing. In such an environment, having a broad array of service options that match customer needs contributes to increase the NYK Group's overall container handling volume. In short, the ultimate goal of liner shipping company is to gain the maximum profit by various strategies.

As a logistics service provider, providing high quality services to satisfied customers is very important. In a competitive liner shipping market, attracting and keeping more customers is the key to the sustainable development of liner shipping companies. Robledo (2001) indicates that providing high-quality services is essential to incubating customers' loyalty and guarantee firms' long-term survival and success. Therefore, a comprehensive performance measurement for liner shipping companies as

logistics service providers is essential. It not only includes traditional financial perspective, but also includes non-financial perspectives, such as customer perspective.

The importance of service quality led some scholars to identify the service quality factors in logistics service industry. Tuna (2002) finds the reliability and competency are the most important service quality factors for logistic transport in a case study of Turkish shipping companies. Duru et al. (2011) apply multi-layer QFD to improve the service qualities for both major customer and service provider. Huang et al. (2012) find developing new business processes and getting an ISO certificate is the most important measure to improve the service quality of a logistics company. Meng et al. (2010) investigates the factors may affect client satisfaction in logistics outsourcing. They propose a possible structure of service criteria for air cargo logistic providers. The validation of the proposed structure has been empirically illustrated. In addition, the scales of service criteria and client satisfaction have also been discussed, and the theoretical and practical applications have been proposed. As a result, empirical evidences support the five crucial service criteria including delivery value, knowledge innovation value, service value-added, information value, and performance satisfaction value; four key client satisfaction factors can be reliability, agility, customization, and flexibility.

There are also several previous studies which discusses the performance measurement using BSC in logistics industry. Ackermann (2002) make a comparison between the characteristics of traditional and modern performance measurement systems. The traditional performance measurement systems are found being not able to sufficiently support the boundary-spanning approach of supply chain management. In contrast, BSC can be used to discuss the non-financial measures in a case study of

supply chain performance measurement. Bhagwat and Sharma (2007) use the BSC framework to evaluate supply chain management in small and medium sized enterprises in India. Several indicators, such as on-time delivery, inventory, lead-time, cash flow, range of services, responsiveness to urgent deliveries, have been considered in the study. Brewer and Speh (2000) design a framework of BSC for the supply chain performance measurement. Four measurement dimensions, financial revenue, supply chain management, management goal and customer profitability, are proposed. Leem et al. (2007) propose several dimensions of the BSC which allow the managers to examine the business from four important perspectives. The evaluation criteria are introduced as customer satisfaction and retention, new business acquisition, operating efficiency, execution capability, solvency, profitability, human resource and organization system.

In the existing literature, most studies investigated a financial performance measurement based on quantitative analysis for the different issues. They utilize the BSC in supply chain management while few studies have discussed to define the criteria and their priority to rank and select the significant strategy for the logistics companies. In this section, the criteria based on four dimensions of BSC method are defined to be ensured a comprehensive analysis of financial and non-financial aspects. The weight of each criterion is computed by FAHP method. The relative weight of each dimension of BSC is computed to measure the each dimension of BSC respectively to pay attention for the selection of the strategy of the liner shipping companies as logistics provider.

3.4.2 Strategies assignment

To face the competitions of increasing number of logistics service providers, it is necessary to utilize appropriate strategy to cope with the coming challenges such as market uncertainty (Mollenkopf and Dapiran, 2005). Due to the importance of logistic

business which provides 11 millions of jobs and contribute to 4.9% economy added value, experts in EU transport commission held a conference in Brussels to discuss bottleneck issues of logistic performance such as administrative efficiency solution, customer service, and revenue growth and employee education in 2012. In addition, according to a 2012 report of Global Intelligence Alliance (GIA), the main performance problems of logistics operators are bureaucracy, lack of market intelligence, poor efficiency and fierce competition. Moreover, considering the fact that the businesses of the whole industry can not get further increases by simply cutting off the rates because barely 50% of containerized cargo is on time delivery, Nils Anderson, the executive of APM, emphasizes that Daily Maersk service provides customer with reliability (Lloyd's Fairplay, July-2012). Following Daily Maersk's bold strategy, many firms started forming alliances or partnership to protect their own markets. Therefore, designing appropriate strategies could remarkably improve the performance of logistics firms. In this study, the empirical work consists of five strategy selection tasks as shown in Table 3.8.

The brief explanation of proposed strategies shows us the managerial meaning and make clear if it fit to the expectation of logistics firms. First of all, the strategy of profit growth reflected the revenue, profitability of companies and consideration of financial investment. The logistics service providers have clear strategy to expand market share and reduce cost, especially fuel and labor cost. Second, customer satisfaction is the key management task for logistics providers since minor failure and complaints could lose customer's loyalty. Third, strategy of streamline business process stresses the importance of efficiency and cost effective analysis because the management of supply chain becomes complex and difficult. Efficient business process would help firms to

stay competitive and deliver quality service to customer (Brewer and David, 2001). Fourth, reliable alliance partner is indispensable for expanding service range, exchanging information, sharing resources and risk pooling. With an aim to provide global service, logistics service providers must have strong partnership with local or other related business. The strategy of alliance and partnership may have the synergy effect to their performance. Fifth, excellent staff and intelligence is essential for growth of firms and future prospects. The employee must work closely with their customer and hear the voice of customer. A well trained employee may contribute better service quality and more value to the company (Lloyd's Fairplay , October-2012).

Table 3.8 Strategies for logistics service provider

Strategies	Symbol
1. Profit growth	S1
2. Enhancement of customer satisfaction	S2
3. Streamline business process and efficiency excellence	S3
4. Reliable alliance partner	S4
5. Excellent staff and intelligence	S5

3.4.3 Goal setting and technical measures

There are fifteen criteria that is based on each dimension of BSC are found out by pre-survey among the experts and practitioners from the logistics business and related studies in literature. The selected criteria and brief description are shown as Table 3.9.

Table 3.9 Goal setting and technical measures

Perspective	Goal	Measure	Description
Financial	Profitability	Return on investment (C ₁)	Profit gained by investment
		Increased Market Share (C ₂)	Expand market in the industry
		Cost saving measure (C ₃)	Reduction of cost to increase revenue
Customer	Increased customer Satisfaction	Quick response /complaints handling (C ₄)	Instant response to customer request and handling complaints.
		Worldwide service network /customer partnership (C ₅)	Global service network and reliable partner for support
		On time delivery (C ₆)	Punctuality of delivery cargo
		Safety and reliability (C ₇)	Low damage and safety of delivery cargo
Internal Business Process	Process improvement	Technology capability (C ₈)	Application of technology for efficiency improvement
		New product introduction (C ₉)	New product and innovation developing
		Administrative performance (C ₁₀)	Documentation and paperwork efficiency
		Labour productivity /Design productivity (C ₁₁)	Measure productivity per employment and equipment
Learning& customer External	Research and deloping	Profitable client number (C ₁₂)	Identify major revenue generating
		Employee satisfaction (C ₁₃)	Employee commitment and loyalty
		Green logistics policy (C ₁₄)	Policy for CO2 emission reduction and environmental friendly logistics.
		Human resource management (C ₁₅)	Trained staff for providing value and idea

3.4.4 Empirical results

The first step for the measurement technique is based on defining of the requirements and their priority weights. The aggregated fuzzy judgment matrix (AFJM) for the criterion of all dimension of BSC is calculated from the individual fuzzy judgment matrix of decision makers by using FAHP method as shown in Table 3.10. The CCI of AFJM is found consistent, 0.02, since it is less than the threshold of 0.37. The contribution of the return on investment, cost saving measure, safety and reliability,

increased market share, and on time delivery is calculated as 0.13, 0.11, 0.11, 0.09, 0.08, respectively (Table 3.11). The priority weight of the safety and reliability that is one of the significant indicators for the customer satisfaction has same degree as cost saving measure and it is found superior than increased market share which are financial dimension of BSC.

In this study, each dimension of BSC has own criteria. The logistics service providers could not be expected to consider all these criteria in same degree. The result of the calculation of priority weight defines the most significant one for each dimension of BSC and the strategy for the logistics service provider might be based on this important criteria. The relative weight is used to define which dimension of BSC is important to pay attention respectively for the logistic service provider. Return on investment (C_1) for the financial perspective, safety and reliability (C_7) for the customer perspective, administrative performance (C_{10}) for the internal business process, employee satisfaction (C_{13}) play the most significant role for each dimension of BSC, respectively.

Table 3.10 The aggregated fuzzy judgment matrix

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1 (1,1,1)	(1,00,1.26,334)	(1,00,1.71,385)	(2,19,2.58,512)	(1,71,3.85,589)	(2,19,2.58,512)	(1,42,1.67,281)	(2,38,3.57,586)	(1,63,3.08,537)	(1,40,2.78,498)	(2,38,3.57,586)	(1,63,3.88,598)	(1,63,3.08,537)	(2,78,4.98,704)	(3,57,4.66,715)
C2 (0.30,0.79,1.00)	(1,1,1)	(1,26,1.40,150)	(1,26,2.39,329)	(1,40,1.50,221)	(1,22,2.76,362)	(0,90,1.40,257)	(1,00,1.26,334)	(1,76,2.28,463)	(1,00,1.71,385)	(1,00,1.71,385)	(1,00,1.76,228)	(1,00,2.38,449)	(1,40,1.63,388)	(1,00,2.38,449)
C3 (0.26,0.59,1.00)	(0.67,0.71,0.79)	(1,1,1)	(1,22,2.19,325)	(1,00,1.26,239)	(0,72,1.71,276)	(0,72,1.71,276)	(1,00,2.15,428)	(1,40,3.50,554)	(1,00,2.15,428)	(1,71,2.19,453)	(1,00,1.00,300)	(1,00,1.71,385)	(1,40,3.50,554)	(2,38,4.49,652)
C4 (0.20,0.39,0.46)	(0.30,0.42,0.79)	(0.31,0.46,0.82)	(1,1,1)	(1,00,1.00,176)	(0,72,1.26,140)	(0,72,1.26,140)	(1,40,1.50,221)	(0,74,1.06,095)	(0,74,1.40,210)	(0,46,0.74,195)	(0,46,0.82,205)	(1,26,1.95,418)	(0,95,1.80,245)	(1,40,2.05,253)
C5 (0.17,0.26,0.59)	(0.45,0.67,0.71)	(0.42,0.79,1.00)	(0.57,1.00,1.00)	(1,1,1)	(0,72,1.00,126)	(0,54,0.83,126)	(1,00,1.26,195)	(0,84,1.20,253)	(0,46,0.59,126)	(0,59,1.00,176)	(0,46,0.74,195)	(0,59,1.00,176)	(1,00,1.40,205)	(1,00,1.00,176)
C6 (0.20,0.39,0.46)	(0.28,0.36,0.82)	(0.36,0.59,1.40)	(0.71,0.79,1.40)	(0.79,1.00,1.40)	(1,1,1)	(0,54,0.83,126)	(0,74,1.95,245)	(0,74,1.06,245)	(1,26,1.40,210)	(1,00,1.00,176)	(0,82,1.63,227)	(1,76,2.28,463)	(1,63,1.80,419)	(1,63,3.08,537)
C7 (0.36,0.60,0.71)	(0.39,0.71,1.11)	(0.36,0.59,1.40)	(0.71,0.79,1.40)	(0.79,1.21,1.84)	(0,79,1.21,1.84)	(1,1,1)	(1,40,2.05,432)	(1,63,3.08,537)	(1,00,1.26,334)	(1,00,2.38,449)	(1,40,1.63,388)	(2,05,4.32,641)	(1,63,3.08,537)	(2,78,3.95,633)
C8 (0.17,0.28,0.42)	(0.30,0.79,1.00)	(0.23,0.47,1.00)	(0.45,0.67,0.71)	(0.51,0.79,0.79)	(0,41,0.51,136)	(0,23,0.49,0.72)	(1,1,1)	(1,19,1.50,221)	(0,61,1.00,126)	(0,72,1.00,148)	(1,00,1.45,255)	(1,00,1.45,255)	(1,26,2.03,361)	(1,26,1.65,387)
C9 (0.19,0.32,0.61)	(0.22,0.44,0.57)	(0.18,0.29,0.72)	(1,05,0.95,134)	(0,40,0.83,157)	(0,41,0.95,134)	(0,19,0.32,0.61)	(0,45,0.67,0.84)	(1,1,1)	(0,52,0.72,126)	(0,61,0.72,126)	(0,72,1.45,255)	(0,72,1.82,284)	(0,72,1.71,276)	(0,72,1.71,276)
C10 (0.20,0.36,0.72)	(0.26,0.59,1.00)	(0.23,0.47,1.00)	(0,48,0.71,136)	(0,79,1.71,219)	(0,48,0.71,0.79)	(0,30,0.79,1.00)	(0,79,1.00,1.64)	(0,79,1.40,192)	(1,1,1)	(1,00,1.00,148)	(1,18,1.84,405)	(1,18,1.60,261)	(1,00,1.71,385)	(1,26,1.65,267)
C11 (0.17,0.28,0.42)	(0.26,0.59,1.00)	(0.22,0.46,0.59)	(0,51,1.36,219)	(0,57,1.00,1.71)	(0,57,1.00,1.00)	(0,22,0.42,1.00)	(0,67,1.00,1.40)	(0,79,1.40,1.63)	(0,67,1.00,1.00)	(1,1,1)	(1,18,1.84,405)	(1,40,1.77,281)	(1,00,1.18,324)	(0,54,0.85,1.76)
C12 (0.17,0.26,0.61)	(0,44,0.57,1.00)	(0,33,1.00,1.00)	(0,49,1.22,219)	(0,51,1.36,219)	(0,44,0.61,1.22)	(0,26,0.61,0.72)	(0,39,0.69,1.00)	(0,39,0.69,1.40)	(0,25,0.54,0.85)	(0,25,0.54,0.85)	(1,1,1)	(0,59,1.00,1.26)	(0,54,0.85,1.76)	(0,54,0.85,1.76)
C13 (0.19,0.32,0.61)	(0,22,0.42,1.00)	(0,26,0.59,1.00)	(0,24,0.51,0.79)	(0,57,1.00,1.71)	(0,22,0.44,0.57)	(6,41,4.32,205)	(0,28,0.69,1.00)	(0,35,0.55,1.40)	(0,38,0.62,0.85)	(0,36,0.56,0.71)	(0,79,1.00,1.71)	(1,1,1)	(0,85,1.00,2.55)	(1,00,1.00,1.26)
C14 (0.14,0.20,0.36)	(0,26,0.61,0.72)	(0,18,0.29,0.72)	(0,41,0.55,1.05)	(0,49,0.72,1.00)	(0,24,0.55,0.61)	(0,19,0.32,0.61)	(0,28,0.49,0.79)	(0,36,0.59,1.40)	(0,26,0.59,1.00)	(0,31,0.85,1.00)	(0,57,1.18,1.84)	(0,39,1.00,1.18)	(1,1,1)	(0,42,1.00,1.26)
C15 (0.14,0.21,0.28)	(0,22,0.42,1.00)	(0,15,0.22,0.42)	(0,40,0.49,0.72)	(0,57,1.00,1.00)	(0,19,0.32,0.61)	(0,16,0.25,0.36)	(0,26,0.61,0.79)	(0,36,0.59,1.40)	(0,37,0.61,0.79)	(0,57,1.18,1.84)	(0,57,1.18,1.84)	(0,79,1.00,1.00)	(0,79,1.00,2.38)	(1,1,1)

CCI=0.02.

Table 3.11 Mean aggregated weight for each criteria and relative weight for each dimension of BSC.

	<u>Financial</u>			<u>Customer</u>				<u>Internal Business Process</u>					<u>Learning and External</u> ⁴⁾		
	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅ ⁴⁾
Mean aggregated weight ⁴⁾	0.13	0.09	0.11	0.06	0.05	0.08	0.11	0.06	0.05	0.07	0.06	0.04	0.05	0.02	0.02 ⁴⁾
Relative weight for each dimension ⁴⁾	0.34			0.30				0.23					0.13 ⁴⁾		

3.5 Implications for liner shipping company

The financial perspective gives access of shareholders' view of the firm, and the primary financial goals desired from the shareholders' consideration (Kaplan and Norton, 1992). The goal to increase wealth is prior to all others for the owners of a company. Therefore, the financial perspective needs to gain absolute priority to be considered for liner shipping companies. After close therewith is customer perspective, which addresses the question of how the firm is viewed by its customers and how well the firm is serving its targeted customers (Kaplan and Norton, 1992). Table 3.12 presents that the most indicators are grouped mainly on financial and customers perspectives and the result of the relative weights for the each perspective and the financial and customer perspective is found superior than others in both traditional liner shipping companies and logistics service provider.

It seems that increasing market share is very significant for any liner shipping company. Since it is one of the most important indicators whether as traditional liner shipping companies or logistics service provider. The soaring liner industry concentration index shows large carriers dominance in the market. According to Alphaliner figures, the combined world market share of the Top-20 carriers led Maersk Line and MSC has reached 83.7% as of 2012. Despite the fact that larger carriers have dominated liner market gradually, the industry still remains highly competitive. Since liner market is very fragmented, no single carrier has occupied more than 20% of the market share. According to Alphaliner, the top three carriers are: Maersk, with a 15.2% market share; Mediterranean Shipping Company, 13.6%; and CMA CGM, 8.3%. Compañía Sud Americana de Vapores, ranked at 20, has a 1.5% market share (Ports

forwarding & maritime forum, 2011). Therefore, obtaining more market share has become the keystone for liner shipping companies.

There are many factors impact on customer's views and customer satisfaction. One of the most important is safety and reliability of service when liner shipping companies are acting as logistics service providers. Logistic services involve a series of activities, such as planning, managing, and executing the transport of goods in supply chains to ensure the efficient movement of production inputs and finished products. There is no doubt that supply chains are complex, and this complexity creates a high degree of scientific uncertainty and risk. However, safety and reliability of service is a key to keep customer. The performance of customer perspective is a leading indicator of future change in financial perspective. In other words, the customer perspective and financial perspective has the cause-and-effect relationships. For example, good service leads to higher customer satisfaction and loyalty that result in better profitability, and vice versa.

Internal business process is used to determine the most critical processes for satisfying customers and shareholders (Kaplan and Norton, 1992). It means that a fast and accurate internal business process helps to satisfy customers and shareholders. Conversely, a poor performance in internal business process can easily lead to customer complaints, even customer loss. For traditional liner shipping companies, cargo missing / damage rate is an important indicator that requires a great deal of emphasis in internal business process. In addition, administrative performance is also very critical indicator for liner shipping companies.

The people are the foundation for strategic success. This is a well-known fact in management practices. However, it often is ignored by employers, especially in time of recession. Actually, employees would produce superior quality performance in optimal

time and lead to growing profits if they are satisfied. Satisfied employees are also more likely to be creative and innovative that helps company grow, upgrades competitiveness and faces challenge positively in an unceasingly changing liner shipping market environment. The quality of employees and their development through training and education are also critical factors in determining long-term profitability of a business. Training can help the employees to reduce the costs associated with errors, increased job satisfaction and morale among them. Long tradition and high-qualified staff can ensure quality shipping and port agency services. Besides the common employee, the top talents like senior officers, managers and researchers are playing increasing important role in liner shipping industry. They can bring innovation in strategies and new skills, which directly translate into reduced costs, improved productivity, and increased efficiency for businesses. Therefore, with the severe competition in liner shipping market, the battle for attracting talented human resources may step into a strategic stage.

Table 3.12 The most important performance indicators in liner shipping companies

	Traditional liner shipping company			Logistics service provider		
	The most important indicators in each perspective	The most indications (global)	Related weight for each perspective	The most important indicators in each perspective	The most indications (global)	Related weight for each perspective
Financial	Market share (C ₂)	Market share (C ₂) Cargo volume growth(C ₃) Net profit (C ₄) Return on net assets (C ₅)	0.33	Return on investment (C ₁)	Return on investment(C ₁) Cost saving measure(C ₃) Increased market share(C ₂)	0.34
Customer	Customer satisfaction (C ₆)	Customer satisfaction index (C ₆)	0.24	Safety and reliability (C ₇)	Safety and reliability (C ₇) On time delivery(C ₆)	0.30
Internal business process	Cargo missing / damage rate(C ₁₃)		0.21	Administrative performance (C ₁₀)		0.23
Learning and growth	No. of employed researcher (C ₂₄)	No. of employed researcher (C ₂₄)	0.23	Employee satisfaction (C ₁₃)		0.13

References

Abe, T., 2006, The role of Balanced scorecard for improving of management system in Japanese companies, Master thesis in Massachusetts institute of technology.

Ackermann, I., 2002, Using the Balanced Scorecard for Supply Chain Management-Prerequisites, Integration Issues, and Performance Measures, Univ. der Bundeswehr.

Aguarón, J., and Moreno-Jiménez, J. M., 2003, The geometric consistency index: Approximated thresholds, *European Journal of Operational Research*, 147, 137-145.

Altman, E.I., 1968, Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy, *Journal of Finance*, 23, 589-609.

Azar, A., Olfat, L., Khosravani, F. and Jalali, R., 2011, A hybrid approach for supplier selection based on balanced scorecard; case study: sapco company, *Research Journal of International Studies*, 20, 37-48.

Bernardo Guimarães Pedro Simões Rui Cunha Marques, Does performance evaluation help public managers? A Balanced Scorecard approach in urban waste services, *Journal of Environmental Management*, Volume 91, Issue 12, December 2010, pp. 2632–2638.

Bolton, R.N. and James H.D., 1991, A multistage model of customer's assessment of service quality and value, *Journal of Consumer research*, 17(4), 375-384.

Bhagwat, R. and Sharma, M. K., 2007, Performance measurement of supply chain management: A balanced scorecard approach, *Computers & Industrial Engineering*, 53, 43-62.

Brewer, A. M. and Hensher, D. A., 2001, Identifying the Overarching Logistics Strategy of Business Processes: An Exploratory Analysis, *International Journal of Logistics Research and Applications*, 4(1), 1-41.

Buckley, J. J., 1985, Fuzzy hierarchical analysis. *Fuzzy Sets and Systems*, 17, 233-247.

Bulut, E., Duru, O., Kececi, T. and Yoshida, S., 2012, Use of consistency index, expert prioritization and direct numerical inputs for generic fuzzy-AHP modeling: A process model for shipping asset management. *Expert Systems with Applications*, 39,

1911-1923.

Calabro, L., 2001, On Balance, Electronic Version, CFO Magazine.

Chang, D.Y., 1996, Applications of the extent analysis method on fuzzy AHP, *European Journal of Operational Research*, 95, 649-655.

Chen, S.K. and Olinsky, A.D., 2006, An application of confirmatory factor analysis to the apriori classification of financial ratios, *Advances in business management and forecasting*, 4, 57-75.

Crawford, G. and Williams, C., 1985, A note on the analysis of subjective judgmentmatrices. *Journal of Mathematical Psychology*, 29, 387-405.

Datamonitor, Global Top 10 Logistics Companies Industry, Financial and SWOT Analysis, www.datamonitor.com/store

Drake, L., 1998, The Economics of Mutuality, LUBC-BSA Project Paper 3, London, Building Societies Association.

Drucker, P.L., 1997, Managing in a Time of Great Change.

Duru, O., Bulut, E., and Yoshida, S., 2012, Regime switching fuzzy AHP model for choice-varying priorities problem and expert consistency prioritization: A cubic fuzzy-priority matrix design. *Expert Systems with Applications*, 39, 4954-4964.

Emel, A.B., Oral, M., Reisman, A., and Yolalan, R., 2003, A credit scoring approach for the commercial banking sector, *SocEcon Plan Sci*, 37, 103-123.

Evanset, H., Ashworth, G., Chellew, M.D and Towers, D., 1996, Exploiting activity-based information: Easy as ABC, *Manage. Account*, 74(7), 24-29.

Farooqa, A. and Hussain, Z., 2011, Balanced scorecard perspective on change and performance: a study of selected Indian companies, *Procedia - Social and Behavioral Sciences*, 24, 754–768.

Fernandes, K. J. Vinesh R., and Andrew W., 2006, Lessons from implementing the balanced scorecard in a small and medium size manufacturing organization, *Technovation*, 26, (5–6), 623-634.

Figge. F., 2002, The sustainability balanced scorecard-linking sustainability management to business strategy, *Business Strategy and the Environment*, 11, 269–284.

Ganesalingam, S., 2001, Detection of financial distress via multivariate statistical analysis, *Detection and Prediction of Financial Distress*, 27(4), 45-55.

Genestre, A. and Herbig, P., 1997, Service Quality, *Journal of customer Service in Marketing & Manngement*, 3, 65-83.

Haralambides H.E. and Acciaro, M., 2010, Bundling Transport and Logistics Services in Global Supply Chains, *International Handbook of Maritime Business*, 416.

Harmon, H.A., 1997, Customer Satisfacyion, *Journal of Customer Service in Marketing and Management*, 13(3), 34-51.

Hossan, F., 2010, Performance evaluation and ratio analysis of Pharmaceutical, Company in Bangladesh.

Huang, C. C, Pin-Yu C, Yu-Hsiu C., 2008, A fuzzy AHP application in government-sponsored R&D project selection Original Research Article, *Omega*, 36, (6), 1038-1052.

Jelenic. D., 2011, The importance of knowledge management in organizations-with emphasis on the balanced scorecard learning and growth perspective, *Management, knowledge and learning international conference*.

Kaplan, S. R. and Norton, R. D., 1992, The balance scorecard-Measures that Drive Performance, HBR.

Kaplan, S. R. and Norton, R. D., 1996, The Balanced Scorecard. Translating Strategy into Action. *Harvard Business School Press*, Boston, Massachusetts.

Kaplan, R.S., 2010, Conceptual Foundations of the Balanced Scorecard, Working Paper, Harvard Business School, Harvard University

Kinsella, A., 2002. Strategic Planning.

Laarhoven, P. J. M., and Pedrycz, W., 1983, A fuzzy extension of Saaty's priority theory, *Fuzzy Sets and Systems*, 11, 229-241.

Lee, M. C., 2007, A Method of Performance Evaluation by Using the Analytic Network Process and Balanced Scorecard, *International Conference on Convergence Information Technology, IEEE*, 235-240.

Leem, B., Hong, M., Kang, J. and Yim, B. J., 2007, Modeling the metrics for measuring the performance on logistics centers by BSC and ANP in Korean context, *In Proc of Int. Conf. Manage. Eng. Technol.*, State University Press, Portland, 2412-2417.

Leung, L.C., Lam K.C. and Cao, D., 2006, Implementing the balanced scorecard using the analytic hierarchy process and the analytic network process. *Journal of the Operational Research Society*, 57, 682–691.

Lynch, R. L. and Cross, K. F., 1991, Measure Up: Yardsticks for continuous improvement, *Blackwell Publishers*, Cambridge.

Meng, S. M , Gin-Shuh L., Kuang L., Shiou-Yu C., 2010, Criteria for services of air cargo logistics providers: How do they relate to client satisfaction? *Journal of Air Transport Management*, 16 (5), 284-286.

Micheli, P. and Manzoni, J.-F., 2010, Strategic performance measurement: benefits, limitations and paradoxes, *Long Range Planning*, 43(4), 465-476.

Mollenkopf, D. and Dapiran, G. P., 2005, The importance of developing logistics competencies: a study of Australian and New Zealand firm, *International Journal of Logistics Research and Applications*, 8 (1), 1-14.

Neely, A., Adams, C. and Kennerley, M., 2002, The Performance Prism, *The Scorecard for Measuring and Managing Business Success*. Prentice Hall.

Ocal, M.E., Oral, E., Erdis, E. and Vural, G., 2005, Industry financial ratios- application of factors analysis in Turkis construction industry, *Journal of Building and Environment*, 42, 385-389.

Otley, D.T., 2002, Performance measurement-functional analysis, Business performance measurement: theory and practice. *Cambridge University Press*, Cambridge, 3-21.

Panayides, P.M. and Cullinane K., 2002, Competitive Advantage in Liner Shipping: A Review and Research Agenda, *International Journal of Maritime Economics*, 4(3), 189-209.

Pardee, W.J., 1996, To satisfy & delight your customer: How to manage for customer Value, *Dorest House Publishing*, New York.

Porter, M.E., 1980, Competitive Strategy, *Free Press*, New York, 1980.

Saaty, T. L., 1977, A scaling method for priorities in hierarchical structures, *Journal of Mathematical Psychology*, 15, 234-281.

Siakas, K. V., Prigkou, A. A. and Draganidis, S., 2005, Enhancing Organisational Effectiveness, Achieving Excellence and Competitive Advantage in Higher Education by Balanced ScoreCard, 2nd, ICESAcc.

Tuna, O.and Silan, M., 2002, Freight transportation selection criteria: An empirical investigation of Turkish liner shipping, *proceeding of IAME 2002 conference*, Panama.

Van Horne, J.C., 2009, Financial management and policy. Pearson Education.

Varvate, M., 2010, Shipping Companies' Financial Performance Measurement using Industry Key Performance Indicators. SNAME.

Wall, A., 2003, The future of the balanced scorecard. An interview with ProfessorRobert Kaplan, *Measuring Business Excellence*, 17(1), 30-36.

Wu, H.Y., 2012, Constructing a strategy map for banking institutions with key performance indicators of the balanced scorecard, *Evaluation and Program Planning*, 35(3), 303–320.

Yang, Ching-Chiao, Marlow, Peter B, Lu, Chin-Shan, 2008, Evaluating Key Logistics Service Capabilities for Taiwanese Liner Shipping Firms. *International Forum on Shipping, Ports and Airports (IFSPA 2008)-Trade-Based Global Supply Chain and Transport Logistics Hubs: Trends and Future Development*, 122-136

Zolfani, S. H. and Radfar, I., 2011, A Research on Hybrid Models of Balanced Scorecard and MADM Methods for Selecting the Best Hybrid Model, *American Journal of Scientific Research*, 36, 83-89.

Chapter 4

Conclusions

The demand for maritime transport is derived primarily from the need of industrial processes. The boom and bust in shipping market are typically motivated by the global economic situation. Economic activity, as measured by the global Gross Domestic Product (GDP), increased by an average 4.1 % per year in 2000-2008, while world trade increased by 6.1% annum during 2000-2008. Worldwide container shipping volumes grew at an average annual growth rate of 9.6% in the same period, which closely related to the increase of the economic and trade activity. After the global financial crisis hit in 2008, in tandem with the world economy decelerated and reduced trade, the buoyant growth in shipping market ended. World GDP in 2012 rose by 3.3%, down from the growth of 5.1% in 2010. Although global container traffic continued to grow in 2012, the growth rate slipped 5.5 % in 2012 from 2010. Under such an unpredictable and uncertain circumstance, for striving for a competitive position in market, improving performance to achieve competitive advantage is very significant to liner shipping companies. Therefore, the status quo of liner shipping industry and performance measurement of liner shipping company are analysed in this study. This chapter review the research result of this study, as well as discuss directions for future study.

4.1 Conclusions

This study investigates the development trends and status quo of liner shipping industry over the past several decades in order to select explicit strategies and measure performance better. Liner shipping market is in a constant state of flux with economic development. Five main trends in liner shipping industry are discussed in chapter 2. They are bigger container ships, strategic alliance, mergers and acquisitions of global carriers, e-commerce and logistics service. Generally, concentration, widespread use of IT and providing logistics services are development features of liner shipping market. In addition, liner shipping industrial structure are analysed by Porter's five forces analysis. Competitive rivalry and bargaining power of buyers show a relatively strong force in liner shipping industry by the five forces analysis of industrial structure. For striving for a competitive position in market, liner shipping companies have to take into account of these critical forces in its strategic planning. In such a constantly changing environment and violent competition, the financial status of liner shipping companies is investigated. The result shows that the profit margin deficits are presented in the most of major liner shipping companies in 2011. Liner shipping companies are taking series of positive measures to make it recently. However, they are still facing high pressure because of global political and economic instability.

Performance measurement is studied as an effective means of improving liner shipping companies' performances and competitive advantages in chapter 3. This study measures performance of liner shipping companies based on a multidimensional framework that includes financial, customer, internal business process, and learning and growth perspectives. The subject of measurement is traditional liner shipping companies

as well as liner shipping companies as logistics service providers in order to provide a more comprehensive performance measurement system. Since more and more liner shipping companies consider providing logistics services as an important development strategy.

The study defines the priority weight of strategies and the degree of relationship between every single strategy and the performance measure for traditional liner shipping companies. The measurement result shows that profitable growth is the major requirement for traditional liner shipping companies. The second important strategy is the improved service coverage and increased customer satisfaction, reduction of costs, improved internal business process, improving convenience and IT based interfaces and increased satisfaction of internal customers are following indicators, respectively. Market share, customer satisfaction, cargo missing / damage rate and No. of employed researchers is the important performance indicator for financial, customer, internal business process and learning and growth perspectives, respectively.

Different strategies and measures are set when liner shipping companies are acting as logistics service providers. This section puts particular emphasis on priority weights of technical measures, the result shows that the return on investment, cost saving measure, safety and reliability, increased market share, and on time delivery are most important indicators. Return on investment, safety and reliability, administrative performance, and employee satisfaction play the most significant role for each perspective of BSC, respectively.

Results show that liner shipping companies should pay attention on financial and customer perspective because priority weights of two perspectives are found superior than others in both traditional liner shipping companies and logistics service providers.

However, other two perspectives, internal business process and learning and growth perspective cannot be neglected either in development of liner shipping companies. Since the performance of nonfinancial indicators will directly affect the financial performance. In addition, liner shipping companies also require attention to the important indicators that affect logistics service providers, thereby offering a more comprehensive performance measurement system to improve companies' performances.

4.2 Limitations and future study

Few limitations of this study along with questions for future research should be noted. This study sets strategies and technical measures by analysing development trends and status quo of liner shipping industry, reviewing the related literature and interviews with business practitioners who are working in liner shipping companies, logistics companies and freight forwarder companies in China, Korea, Turkey and Japan. Although strategies and technical measures selected are based on a comprehensive analysis, it has still a high subjective content. This study assumes that the selected data is reliable and uses them to measure performance of liner shipping company. However, the measurement result could change by reviewing different literature or interviews with different practitioners. This problem is not within the scope of this study.

In chapter 3, the performance of liner shipping company is measured based on four perspectives of BSC method by FAHP. Expert survey questionnaire is designed in order to calculation of related weight by FAHP. The subject of survey focuses on 4 Asian countries because of limited resources. Therefore, this limitation of data source should be considered in practice.

This study contributes to providing analysis of liner shipping industry and a performance measurement framework of liner shipping companies. However, there are some improvements that can still be made. The following points are some interesting research topics which are worth investigating further:

1. The performance measurement for liner shipping companies using other MADM methods. This study uses FAHP and BSC to investigate performance measurement of liner shipping companies. The methodology can be changed to other one. It was worth discussing if the research result changed.
2. Specific liner shipping companies are selected as case study for performance measurement of liner shipping companies. This study is based on a world-wide liner shipping company perspective to measure performance. In future study, the performance of specific liner shipping companies is expected to measure and make more specific or detailed suggestion in practice.