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CONTENTS

Papers

- 3 Performance assessment for liner shipping industry: a multi-attribute analysis by the balanced scorecard (BSC)
Zi-Yi Gao, Okan Duru, Emrah Bulut and Shigeru Yoshida
- 29 Comparative Analysis of Methodologies to Evaluate Air Cargo Carriers' Service Quality: Focusing on SERVQUAL and SERVPERF
Park, A Rim and Hun-Koo Ha
- 47 The Effect of Customer Service on Firm Performance: Developing Scales for Performance Measurement of Customs Clearance Firms
Hee-sung BAE , Woo-young LEE and Yang-kee LEE
- 71 Impact of Market Openness on Growth and Stability in Korea
Wonchang Jang
- 87 The Effects of FTA on Trade under Different Degree of Product Substitution and Imports Market Struct
Koo Woong Park

Performance assessment for liner shipping industry: a multi-attribute analysis by the balanced scorecard (BSC)*

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Abstract

This paper investigates the performance assessment of liner shipping industry and presents a multi-dimensional evaluation framework to ensure both financial and non-financial monitoring. The traditional performance assessment approach is based on the financial indicators such as ratio analysis, but it is limited to the fiscal perspective. The meaning of performance has dramatically changed and non-financial (and intangible) assets increased their importance in recent years. Under these circumstances, the multi-attribute performance assessment methods play a critical role to combine many aspects of the business. Balanced Scorecard (BSC) is originally developed for the multi-attribute performance assessment and its philosophy on business process evaluation pioneered the importance of key performance indicators and the quality management issues including the internal customer. Service quality and the business performance assessment are some of the hot issues in the liner shipping industry and the long term competitiveness is a critical concern in the recent liner shipping business. The BSC method is utilized to ensure a cumulative analysis of the short/long and tangible/intangible indicators of performance and computes the weight of each criterion by using Fuzzy-AHP method in the liner shipping industry.

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1. Introduction

The measurement of performance is essential in business practice because it assists managers to evaluate the achievement of business goals, points out problems and adjusts direction of possible improvement actions. Kassem [1] indicated that operational performance is a representation of overall target achievement, and, thus, companies constantly aim to improve their operational performance. Measurement provides the basis for an organization to assess how well it is progressing towards its predetermined objectives. It also helps to identify strength and weakness areas for decisions on future initiatives with the goal of improving organizational performance.

The importance of performance measurement has been widely recognized in recent years. Accounting-based ratios or measures of performance have been the traditional mainstay of quantitative approaches to organised performance measurement [2]. According to Van Horne [3], the firm's purpose is not only internal control but also better understanding of what capital suppliers seek in financial condition and performance from it. Analysis and interpretation of various ratios should give analysts a better understanding of the financial condition and performance of the firm than they would otherwise obtain from analysis of the financial data alone. Different financial ratio such as liquidity ratios, asset management ratios, profitability ratios, market value ratios, and debt management ratios are widely used to evaluate the performance of any companies. In order to make effective use of financial ratios, it is necessary to classify the large number of possible ratios into meaningful groups.

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 [4-6]. In the last few decades, top managers have been motivated with valued financial performance and undervalued long term performance indicators such as customer satisfaction, loyalty, learning organization, innovation etc. However, the traditional cost management systems are not so comprehensive to cope with all those competitive criteria. Most of them fail to capture the real costs that occur as a result of customer compliance requirements [7].

By the lessons learnt in the 20th century, the meaning of performance has dramatically changed and the importance of non-financial (and intangible) assets has increased. Under these circumstances, many of the studies investigate the non-financial measures for the performance assessment, and multi-attribute performance assessment methods play an increasingly critical role to combine many aspects of the business [8-12].

Service quality and the business performance assessment are some of the hot issues in the liner shipping industry [13-15]. Worldwide competition in the liner shipping market

intensified with economic globalization and some traditional liner shipping companies went bankrupt [16]. Therefore, long term competitiveness has recently become a critical concern in liner shipping business. Varvate [14] investigates the shipping companies' financial performance measurement using industry key performance indicators in the highly volatile period of 2007-2010. The results indicate that the combined effect of industry benchmarking and risk management in companies' performance is efficiency, effectiveness and high growth prospects. In addition to the utilizing measures of financial performance, utilizing measures of non-financial performance has attracted more attention in shipping industry because the shipping is a service industry and its quality has increased considerably in recent years [15]. In order to gain higher loyalty from customers and improve the reputation and market share of the business, it is essential for shipping companies to deliver high quality service.

Executives understand that traditional financial accounting measures like return-on-investment and earnings-per-share can give misleading signals for continuous improvement and innovation-activities of today's competitive environment demands. Kaplan and Norton [16] revealed that the traditional financial performance measures worked well for the industrial era, but their performance is out of step with the 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 assessment and its philosophy on business process evaluation pioneered the importance of key performance indicators and the quality management issues including the internal customer. However, the BSC framework does not provide the quantitative and qualitative indicators how much each perspective contributes, even on the relative importance weight for each perspective and its sub-indicators [17]. 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 [18-21]. According to Zolfani et al. [17], 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. [20] conducted a performance analysis on three banks using a FMCDM approach based on the BSC perspectives. 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, we can get more realistic results from BSC by combining MCDM method; it has also been 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 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. 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.

2. Methodology

The performance assessment process for a liner shipping company is designed in seven steps:

Step 1: Preliminary consultation for strategy assignment

Strategy assignment is a significant stage of the entire process. Panayides and Cullinane [22] addressed the importance of competitive advantages and presented 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 [23] illustrates these two major directions under the fiscal considerations by revising the Return on Investment (ROI) indicator. Figure 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 1.

Porter (1980)'s approach on strategic management.

In this study, seven strategies are selected as an illustration by reviewing the related literature and interviews with business practitioners (table 1).

Table 1.

Strategies for liner shipping companies.

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

Step 2: Compromised performance assessment and Goal setting by utilising BSC framework.

This step consists of goal setting according to the four perspectives: Finance, Customer, Internal Business Process and Learning Organization.

Step 3: Assignment of Performance indicators and their measurement procedure (e.g. units, 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.

Step 4: Priority assignment for strategies by utilising the pairwise comparison under the fuzzy environment (i.e. Fuzzy AHP).

Among the strategies, the liner shipping companies should define the level of priority for them in order to design the strategic policy. The priority degree will contribute to the disclosure of where to begin and how to distribute the existing resources. Without a priority scale, companies may focus on several issues at the same time and spend their power and time without strategic control.

Since this paper integrates the relationship matrix with the BSC framework, priority degrees also define the priority of a single performance indicator for the entire strategic

plan. The priority degrees are estimated by utilising the pairwise comparisons with the linguistic representatives (See section 2.2).

Step 5: Consultation for the relationship matrix between performance indicators and strategies (priority assignment for performance indicators)

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 (See section 2.3).

Step 6: Cause-and-Effect assessment and process mapping for business practice.

The results of the assessment can be illustrated by a cause-and-effect diagram and the process flow for final outcome is visualised by this tool. Its diagram is particularly useful for the improvement follow-up and the dashboard design based on performance control for practical implementation. These diagrams may support to select key performance indicators and their corresponding interactions. If a contradiction is detected between a cause and an effect, then the strategic policy and process can be redesigned. For exposing such disparities, the strategies and goals should be integrated with their corresponding process connections. For example, an increasing number of customers are expected to raise additional revenues with at least the average rate of return. Otherwise, the cost of services would be higher than the previous level of sales and it would have been necessary to be investigated in depth.

Step 7: Policy development for implementation and corrective actions.

Finally, the proposed method suggests the control tools and the most contributing technical measures for improvement and strategy implementation. 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 organizational culture.

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 later 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 organization's strategy' in 1996 [10]. Wall [24] suggested that the BSC is the most successful tool in the field of performance management and it is used by a half of the Global 1000 companies.

Kaplan and Norton argued that the traditional financial measures can only tell the story of past events, but they are incapable to provide guidance on how to navigate the future. Therefore, the BSC considers the financial indicators and the non-financial ones in determining the corporate performance level. The BSC brings a balance between financial and the non-financial measures, short-term and the long-term objectives, internal and external performance, and leading and lagging indicators [10]. It is not only a performance measurement tool but also a performance management system that enables organizations to clarify their vision and strategy. Figure 2 [25] provides a graphical representation on how the mission and values-focused strategy drives four perspectives.

Figure2.
The Balanced Scorecard Model [23]

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 [16]. It shows how these measures are interrelated and effect one another, enabling an organization's past, present, and potential performance to be tracked and managed (Airport Cooperative Research programme Report).

Financial perspective

Financial indicators based on financial data show execution of financial performance of an organization. But not all long-term strategies can get a quick profit improvement of non-financial indicators such as quality, time of production, productivity and new product, etc. that are means for achieving a purpose. The financial perspective addresses the question of how shareholders view the firm and which financial goals are desired from the shareholder's perspective [26].

Customer perspective

Based on the target customers and market segment, firm/organization 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 organization 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 are considered.

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 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.
The Cause and Effect relationships among the four perspectives.

2.2. Fuzzy analytic hierarchy process

Laarhoven and Pedryc [27] proposed the Fuzzy Analytic Hierarchy Process (FAHP) method to overcome the decision making problem and evaluate multiple alternatives by using pairwise comparison matrix and by using the triangular fuzzy numbers. After that, many scholars proposed a new approach to improve and simplify the calculation by using a different algorithm [28-33]. In this study, the Chang's method is first applied as a FAHP method and second Bulut et al.'s approach [29] is used to compute the weight of each criterion by using six different fuzzy numbers (table 2 and figure 4).

Figure 4.

Fuzzy number of linguistic variable set.

Table 2.

Transformation for TFNs membership functions

Fuzzy number	Linguistic scales	Membership function	Reciprocal
$\tilde{A}_1$	Equally important	(1,1,1)	(1,1,1)
$\tilde{A}_2$	Slightly important	(1,1,3)	(1/3,1,1)
$\tilde{A}_3$	Moderately important	(1,3,5)	(1/5,1/3,1)
$\tilde{A}_4$	More important	(3,5,7)	(1/7,1/5,1/3)
$\tilde{A}_5$	More important	(5,7,9)	(1/9,1/7,1/5)
$\tilde{A}_6$	Extremely important	(7,9,9)	(1/9,1/9,1/7)

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 companies.

The Chang approach for the FAHP method is stated 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:

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

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

$$S_i = \sum_{j=1}^m M_{g_i}^j \otimes \left[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j \right]^{-1} \quad (2)$$

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:

$$\sum_{j=1}^m M_{g_i}^j = \left(\sum_{j=1}^m l_j, \sum_{j=1}^m m_j, \sum_{j=1}^m u_j \right) \quad (3)$$

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:

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

and then the inverse of the vector in equation 5 is computed such as:

$$\left[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \right) \quad (5)$$

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

$$V(M_2 \geq M_1) = \sup_{y \geq x} \left[\min(\mu_{M_1}(x), \mu_{M_2}(y)) \right] \quad (6)$$

and can be expressed as follows:

$$\begin{aligned} V(M_2 \geq M_1) &= hgt(M_1 \cap M_2) \\ &= \mu_{M_2}(d) = \begin{cases} 1, & \text{if } m_2 \geq m_1 \\ 0, & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & \text{otherwise} \end{cases} \end{aligned} \quad (7)$$

Figure 5 illustrates equation 7 where d is the ordinate of the highest intersection point D between μ_{M_1} and μ_{M_2} . To compare M_1 and M_2 , we need both the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$

Figure 5.

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 $M_1 (i = 1, 2, \dots, k)$ numbers can be defined by

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_k)] \\ = \min V(M \geq M_i), i = 1, 2, 3, \dots, k. \quad (8)$$

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

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad (9)$$

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

Step 4: Via normalization, the normalized weight vectors are

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T \quad (10)$$

where W is a non-fuzzy number.

2.2.1. The consistency calculation for the FAHP method

The acceptance of pairwise matrix is based on the value of consistency. Bulut et al. [29] proposed the centric consistency index (CCI) for the FAHP method that is based on the geometric consistency index (GCI) [31,34] to calculate the consistency of each pairwise matrix. The thresholds of CCI and its scale are as $\overline{GCI} = 0.31$ for $n=3$; $\overline{GCI} = 0.35$ for $n=4$ and $\overline{GCI} = 0.37$ for $n>4$.

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 $w = [(w_{L1}, w_{M1}, w_{U1}), (w_{L2}, w_{M2}, w_{U2}), \dots, (w_{Ln}, w_{Mn}, w_{Un})]^T$ be the priority vector derived from A using the RGMM. The centric consistency index (CCI) is computed by

$$CCI(A) = \frac{2}{(n-1)(n-2)} \sum_{i < j} \left(\log\left(\frac{a_{Lij} + a_{Mij} + a_{Uij}}{3}\right) - \log\left(\frac{w_{Li} + w_{Mi} + w_{Ui}}{3}\right) + \log\left(\frac{w_{Lj} + w_{Mj} + w_{Uj}}{3}\right) \right)^2 \quad (11)$$

where n is the number of elements. When $CCI(A)=0$, we consider A fully consistent.

2.2.2. The prioritization of the 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.* [29] proposed that reverse CCI ratio can be used as a prioritization of decision maker by using the following algorithm;

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:

$$I_k = \frac{1}{CCI_k} \quad (12)$$

where I_k is the inverse of the CCI,

$$\lambda_k = \frac{I_k}{\sum_{k=1}^m I_k} \quad (13)$$

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

$$w_i^{(k)} = \frac{(\prod_{j=1}^n a_{ij}^{(k)})^{1/n}}{\sum_{i=1}^n (\prod_{j=1}^n a_{ij}^{(k)})^{1/n}} \quad (14)$$

The aggregation of individual priorities is defined by

$$w_i^{(w)} = \frac{\prod_{k=1}^m (w_i^{(k)})^{\lambda_k}}{\sum_{i=1}^n \prod_{k=1}^m (w_i^{(k)})^{\lambda_k}} \quad (15)$$

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

3. Performance assessment in liner shipping industry

3.1. Strategies for liner shipping companies

Strategy can be defined as ‘the plans and activities developed by an organization in pursuit of its goals and objectives, particularly in regard to positioning itself to meet external environmental demands relative to its competition’ [35]. 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 organization. For example, it can help employees make concerted efforts toward common goals, so as to concentrate and conserve valuable resources and increase work efficiency.

In this study, strategy is also a critical step for a multi-dimensional evaluation framework. Table 1 presents the strategies for liner shipping companies, it is the centre of liner shipping companies’ efforts to implement performance-based management, and involves setting long-term goals, translating those goals into plans, as well as implementing programmes, monitoring performance, and measurement.

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 companies, figure 6 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 [36] stated that innovation from creative people provides the only assured source of long-term success and competitiveness, because every other aspect of an organization can be duplicated by others. 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 6.
Cause and effect relationships between the strategic objectives.

3.3. Goal setting and technical measures

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 a 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 presents the Goals and technical measures for liner shipping assessment based on strategies. As in table 4, the main focus of liner shipping companies 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 two of 24 performance measures represent financial measures. 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.
Goal setting and technical measures.

Perspective	Goal	Measure	Unit	Description
Financial	Profitable Growth	Turnover	USD	Turnover per year
		Market Share	%	Market share of company in the industry
	Profitability	Cargo volume growth	%	Cargo volume percentage change on previous year
		Net Profit	%	Net profit rate per year
Customer	Increased customer Satisfaction	Return on net assets	%	A comparison of net income with the net assets of liner shipping company
		Customer satisfaction index	Survey	Index of customer satisfaction according Index of customer satisfaction according
		Complaint number	No.	Number of complaints received
		Complaint quota	No.	Number of complaints divided by number of orders
		Customized service	%	The number of customized service divided by the

Perspective	Goal	Measure	Unit	Description
	Higher customer Loyalty	Top ten customer volume Customer give-up rate	mton %	number of all service Top 10 customer volume of shipping company 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	%	Confirmed customer delivery date divided by actual
		Cargo missing / damage rate	%	The number of the missing/damage cargo divided by the total number of cargo
		Extending service coverage	No.	The number of increased routes
	Process improvement	Share of web-based orders	%	Share of web-based orders per month
		Accuracy of invoices	%	The number of line items invoiced correctly divided by the total number of line items invoiced
		Order process cycle time	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	Survey	Index of employee satisfaction according to questionnaire
		Training hours of employee	Hours	Hours of training a year for every employee
	Improving the intellectual level of company	MSc degree in senior staff	%	The number of MSc degree in senior staff divided by the number of all staff
		PhD degree in managers & consultants	%	The number of PhD degree in managers & consultants divided by the number of all staff
		Participation to industrial conferences, seminars	No.	The number of Participation to industrial conferences, seminars etc by senior

Perspective	Goal	Measure	Unit	Description
	Improving the innovation processes	Workshop organization No. of employed researcher	days No.	officers, managers divided by the number of all senior officers, managers The number of days for workshop organization per year The number of employed researcher

Table 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

Technical Measure	Financial/ Non-financial	Lead/Lag	External/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

3.4. Empirical results and discussion

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 maker. Table 5 displays the result of weight for each strategy requirement and CCI is found less than the critical value of 0.37. Profitable growth is found the major requirement of the customers. 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 indicators, respectively.

Table 6 indicates the numerical results for the relationship matrix and the priority degrees of technical measures. In respect to this study, a group of recommendations are found critical to ensure business sustainability and increasing competitiveness in the liner shipping market. Increasing market share and cargo volume has become the keystone for profitable growth. 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 84% as of July 2011. 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 15.4% market share; Mediterranean Shipping Company, 12.9%; and CMA CGM, 8.3%. United Arab Shipping Company, ranked at 20, has a 1.5% market share (Ports forwarding & maritime forum, 2011).

Table 5.

The aggregated fuzzy judgment matrix.

	S1	S2	S3	S4
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)
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)
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)
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)
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)
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)
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)
	S5	S6	S7	Weight
S1	(1.00,3.00,5.00)	(1.00,1.68,3.82)	(1.00,1.84,3.98)	0.22
S2	(1.00,1.00,1.56)	(1.00,1.00,1.56)	(1.00,1.00,1.92)	0.15
S3	(1.00,1.00,1.00)	(1.00,1.00,1.00)	(1.00,1.00,1.79)	0.13
S4	(1.00,1.00,3.00)	(1.00,1.00,3.00)	(1.00,1.00,1.27)	0.16
S5	(1.00,1.00,1.00)	(1.00,1.00,1.79)	(1.00,1.00,1.00)	0.12
S6	(0.56,1.00,1.00)	(1.00,1.00,1.00)	(0.61,1.00,1.00)	0.11
S7	(1.00,1.00,1.00)	(1.00,1.00,1.63)	(1.00,1.00,1.00)	0.12
CCI=0.02				

Table 6.
Strategy-to-measure transformation matrix

Max. value in row	Relative weight		Financial					Customer					Internal Business Process					Learning							
			Turnover	Market share	Cargo volume growth	Net profit	Return on net assets	Customer satisfaction index	Complaint number	Complaint quota	Customized service	Top ten customer volume	Customer give-up rate	On time delivery	Cargo missing/damage rate	Extending service coverage	Share of web-based orders	Accuracy of invoices	Order process cycle time	Employee satisfaction	Training hours of employee	MSc degree in senior staff	PhD degree in managers & consultants	Partipation to industrial conferences	Workshop organization
9	0.22	S1	■*	▲	▲	■	■				▲	▲	■	■	■	■	■	■	■	■	■	■	■	■	researcher
9	0.15	S2					■	■		▲	■	▲	■	■		▲	■								(days)
9	0.13	S3		■	■				▲				▲	■	●	●	●			▲		▲			No. of employed
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	9	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.

In such a competitive environment, liner shipping companies unavoidably face the strategy to choose. The following suggestions may help to improve the capacity of profitability and service coverage of the liner shipping companies: expanding the scope of cooperation, improving the ability to integrate resources while maintaining market competitiveness of the domestic routes, continuing to focus on the development of overseas regional routes; expanding the proportion of long-term customers and increasing the volume of return cargo to raise the utilization rate, and lastly, digging up the potential of cost savings.

Herein, increase the customer satisfaction which shows the close relationship with profitable growth. For the customer, nothing is as important as good service and low price. On-time delivery and cargo missing/damage rate reduction in internal processes are key factors in increasing the customer satisfaction. For shipping, the punctuality rate is an important performance measure of its performance. The new service provides customers with Cut-off every day, every container arriving on time. The companies offer to pay compensation if the containers do not arrive on time. Keeping the promise is very important to liner shipping companies.

In addition, the customer of liner shipping service tends to purchase a complete transport service including other logistics services. Rather than a single seaborne transport, a liner shipping company is expected to serve additional tasks such as management of the entire transportation business, computer aided follow-up and door-to-door services. In case of lack of inter-modality and complete logistic support, customers need to hire these services separately and transaction costs are rising. Essentially, the economies of scale and one-contact-whole-service benefits are required for business development.

As mentioned earlier, the people are the foundation for strategic success. The quality of employees and their development through training and education are 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 translates 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.

4. Conclusion

In recent years, the meaning of performance assessment has dramatically changed and not only traditional performance assessment which is based on financial indicators has started to become investigated but also non-financial assets have found a place in literature for performance assessment of companies. Shipping is a service industry and importance of its quality has significantly increased for the overall competitiveness of the companies. The business performance (financial), service quality (non-financial) and the long term competitiveness (financial and non-financial) play a significant role in the liner shipping companies. Therefore, the performance assessment of liner shipping industry should be investigated by using multidimensional methods. In this study, the balanced scorecard is proposed for the multi-attribute performance assessment for the liner shipping companies, and the multi-layer quality function deployment is used for the relationship matrix to compare for all performance indicators with the strategy to reveal the strength and weakness sides of liner shipping companies. For this purpose, seven strategies are chosen by reviewing the related studies and interviews with business practitioners and their weight is computed by using FAHP method.

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