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**STRATEGY PLANNING AND MANAGEMENT FOR  
LOGISTICS COMPANIES WITH BSC AND GF-AHP**

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**ABSTRACT**

*Traditional performance assessment is mainly based on financial aspects, but the significance of non-financial aspects such as customer satisfaction or innovation becomes important factors for business success especially in service areas. The aim of this paper is to investigate the appropriate strategy and performance measurement in logistics companies by using the Balanced Scorecard (BSC) method with fuzzy AHP (FAHP) approach to ensure comprehensive performance analysis of both financial and non-financial aspects. Since the major customer of logistics companies are traders and manufactures, they provide a series of transportation solution or other logistics activities. In this paper, the relative algorithm is proposed to measure each dimension of BSC. According to their significance level, all dimensions are ranked to pay attention respectively for the selection of the strategy of the logistic companies. The weight of each technical criterion which is important for the strategy of logistics companies is found to calculate the relative weight of each dimension of BSC. The most important measures of each BSC dimension are return on investment, safety and reliability, administrative performance, employee satisfaction.*

**Keywords:** Strategy selection, logistics companies, balance scorecard, fuzzy AHP.

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## BSC VE GF-AHP İLE LOJİSTİK İRİETLER İÇİN STRATEJİ PLANLAMA VE YÖNETİM

### ÖZET

*Klasik performans değerlendirilmesi çoklu olarak finansal beklentiler üzerine kuruludur, fakat finansal olmayan faktörler, örneğin tüketici memnuniyeti veya yenilikçilik, şirketlerin başarılarında özellikle servis alanlarında önemli olmaya başladı. Bu çalışmanın amacı Dengeli Sonuç Kartı (Balanced Scorecard-BSC) ve bulanık analitik hiyerarşi süreci metodları kullanılarak lojistik şirketleri için finansal ve finansal olmayan faktörler göz önünde bulundurularak uygun strateji ve performans ölçümünü araştırmaktır. Başlıca lojistik şirketlerinin müşterileri, alıcı ve üreticilerle ilişkilerinden dolayı, lojistik şirketleri farklı ulaşım yolları ve çözümleri sunarlar. Bu makalede, BSC'nin her bir boyutunun ölçülmesi için göreceli algoritma önerildi. Her bir boyut için elde edilen önem derecelerine göre, boyutların hepsi derecelendirilerek lojistik şirketleri için strateji seçimi belirlenmeye çalışıldı. Lojistik şirketlerinin strateji seçimi için önemli olan her bir teknik kriterin ağırlıkları hesaplanarak BSC'nin boyutları için göreceli ağırlıklar bulundu. Stratejik öneme sahip kriterler sırasıyla yatırım getirisi, emniyet ve güvenilirlik, idari performans, çalışan memnuniyetidir.*

**Anahtar Kelimeler:** Strateji seçimi, lojistik şirketleri, dengeli sonuç kartı (Balance Scorecard), bulanık analitik hiyerarşi süreci

### 1. INTRODUCTION

In today's highly competitive global marketplace, the increasing focus on core competencies brings many business opportunities as well as challenges for the logistics industry at the same time. For adopting highly competitive business environment and strengthening their competitive position, service quality and performance measurement is becoming increasingly important for the logistics companies. Logistics has traditionally been considered a link between production and consumption. On the other hand, the logistics industry today developed into a typical service-based industry is based on the underlying market changes. According to Mollenkopf, global competition pressure forces the logistics companies to find out the way to create customer value and provide excellent service, while customer requirements are getting demanding and critical to the service providers (Mollenkopf and Dapiran, 2005). Customer satisfaction and loyalty can be achieved through high-quality services providing value for the consumers that are essential for long-term survival and success (Robledo, 2001). The importance of service quality led some scholars to identify the service quality factors in logistics industry. Silan and Tuna (2002) explored the service quality issue for logistics transport in Turkish shipping company and it has

been found reliability and competency are the most important service factors. Duru *et al.* (2011) applied multi-layer QFD to improve the service quality for both major customer and service provider. Huang *et al.* (2012) empirically investigated the quality requirements of a Logistics Company and they found that developing new business processes and getting an ISO certificate is an important measure.

The performance measurement should be also considered in business practice. Evanset *et al.* (1996) stated that performance evaluation is an important activity of management control and investigated whether resources are allocated efficiently. It is applied for the purpose of operational control to achieve a goal adjustment in the short-term, and for strategy management and planning in the long run. 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 organisations. According to Bourne and Neely (2003), traditional accounting based performance measures have been characterised by financial side, internally focused, backward looking and more concerned with local departmental performance than with the overall health or performance of the business. The traditional approach to performance measurement is an efficiency-based performance measurement system and it focuses on minimizing costs and maximizing functional operating efficiency (Dumond, 1994). By the early 1980s, the shortcomings of traditional measurement systems have triggered a revolution in the field of performance management (Eccles, 1991; Neely, 1999). Bruns (1998) stated that profit remains the overriding goal, but it is considered an insufficient performance measure since measures should reflect what organisations have to manage in order to profit.

Many 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. In recent, BSC is widely used to measure the performance to generate different strategy for the organizations. It provides an integrated look of an organization's overall performance of traditional financial measures as well as non-financial measures. It is now used by over 65% of Global Fortune companies, and is increasingly being adopted by government and non-

profit organizations worldwide (Howard and Dan, 2011). Since the increasing attention to non-financial measures of performance measurement, some studies have discussed the application of BSC in logistics industry. Ackermann compared the characteristics of traditional and modern performance measurement system and illustrated that traditional performance measurement systems do not sufficiently support the boundary-spanning approach of supply chain management (Ackermann, 2002). Based on the BSC, he discussed the non-financial measures in supply chain performance measurement. Bhagwat and Sharma (2007) considered the use of a BSC framework to measure and evaluate supply chain management in small and medium sized enterprises in India. The specific metrics are considered for each of the perspective, such as on-time delivery, inventory, lead-time, cash flow, range of services, responsiveness to urgent deliveries and so on. Brewer and Speh (2000) introduced the designed framework of BSC to the supply chain performance measurement, four dimensions of the performance measurement system are proposed based on supply chain management goal. They are financial revenue, supply chain management, management goal and customer profitability. Leem *et al.* (2007) used the dimensions of the BSC to allow the managers to look at the business from four important perspectives to measure the performance on logistics centres. The evaluation criteria are defined 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. Although they utilize the BSC in supply chain management, few studies have discussed to define the criteria and their priority to rank and select the significant strategy for the logistics companies. In this study, the criteria based on four dimensions of BSC method are defined to ensure a comprehensive analysis of financial and non-financial aspects. The weight of each criterion is computed by fuzzy analytic hierarchy process (FAHP) method. The relative weight calculation is used to reveal the most important dimension of BSC to take into account for the strategy planning and management for the logistics companies.

This paper is organized in five additional sections. Section 2 states the definition of the strategy and criteria for logistics companies. Section 3, Section 4 and Section 5 describes the methodology, balanced scored card (BSC), generic fuzzy analytic hierarchy process (GF-AHP) and the relative weight calculation used in our study to reveal the most important dimension of BSC method.

The application and results are found in section 6 and Section 7 concludes the study and suggests further research areas.

## **2. THE DEFINITION OF THE STRATEGY AND CRITERIA FOR LOGISTICS COMPANIES**

To face the competition and 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). In 2012, experts of the high level groups on logistics by EU transport commission gathered together in Brussels to discuss the strategy to improve logistics performance since logistics business provide 11 millions of jobs and contribute 4.9% economy added value for the EU. Their discussion is focused on the issues and bottlenecks such as administrative efficiency solution, customer service, and revenue growth and employee education. Also, according to 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. On the other hand, Nils Anderson, the executive of APM stressed the Daily Maersk service provides the reliability to customer because the industry as a whole could not get more business simply by cutting the rates since only 50% of containerized cargo is on time delivery (Lloyd's Fairplay, July-2012). After Daily Maersk's aggressive strategy, many firms began to form alliances or partnership to defend their own market. Therefore, providing appropriate strategies would significantly improve the performance of logistics firms. In this paper, the empirical work consists of five strategy selection tasks as shown in Table 1. The several criteria and strategies for the logistics companies are firstly defined from scientific studies and reports in the existing literature. After that, the pre-survey method is applied to practitioners and experts from logistics business to obtain their consensus on the criteria and strategies considered in the study. The selected criteria and their brief descriptions are shown in Table 2.

The brief explanations of proposed strategies show us their managerial meanings and make clear if they fit to the expectations of logistics firms. First of all, the strategy of profit growth reflected the revenue, profitability of logistics companies and consideration of financial investment. The logistics companies have clear strategy to expand market share and reduce cost, especially fuel and labour 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 companies 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 1.** Strategies for Logistics Companies

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

**Table 2.** Goal Setting and Technical Measures

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

### **3. BALANCED SCORECARD**

The balanced scorecard (BSC) was first introduced as a performance measurement system by Kaplan and Norton in 1992 at the Harvard Business School. They (1992) indicated that many executives do not rely on one set of measures to the exclusion of the other; they want a balanced presentation of both financial and operational measures. Since they understand that traditional financial accounting measures can give misleading signals for continuous improvement and innovation-activities today's competitive environment demands. Based on their research project with 12 companies at the leading edge of performance measurement, they devised a "balanced scorecard" that gives executives a fast but comprehensive view of an organization's overall performance: it complements the traditional financial performance measures and performance indicators in three non-financial perspectives that are customer, internal business process, and learning and growth. The four perspectives are explained briefly as follows:

**Financial perspective:** As the traditional performance measures, financial performance measures indicate whether the company's strategy, implementation, and execution are contributing to bottom-line improvement. A well-designed financial control system can actually enhance rather than inhibit an organization's total quality management program (Kaplan and Norton, 1992). However, financial performance is impacted by three other perspectives: internal business processes, customer, and learning and growth.

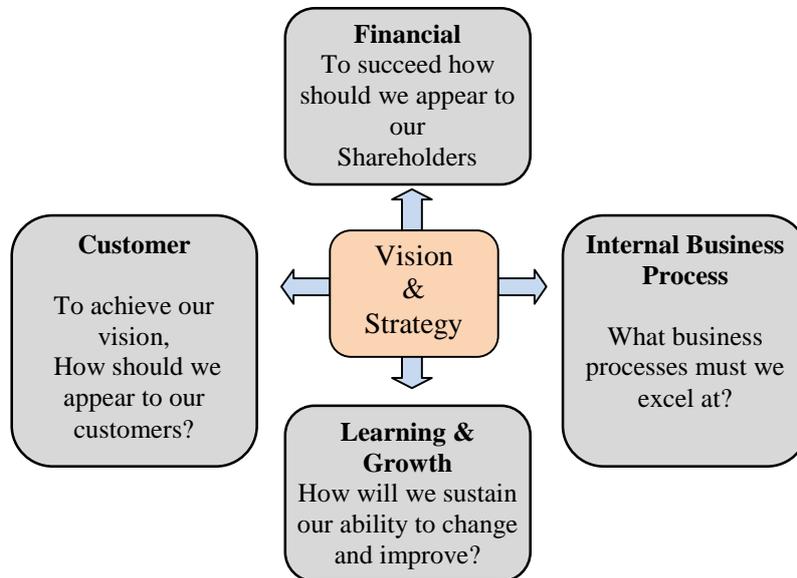
**Customer perspective:** In this dimension, organisations have focused on the customer in order to ensure growth and improve market share. Improving customer satisfaction with products and services and increasing customer loyalty are the main strategic objectives of customer perspective. It defines how the organization will differentiate itself from competitors to attract, retain, and deepen relationships with customers (Kaplan and Norton, 2000).

**Internal business processes perspective:** The internal business processes are the critical step because they have the greatest impact on customer satisfaction and meeting shareholder expectations regarding financial returns. These are the processes in which the firm must concentrate its efforts to excel.

**Learning and growth perspective:** The objectives of Learning and Growth establish long-term growth and improvement of business infrastructure and drive for achieving the objectives of the

other three perspectives. Along with the intense competition and technology advancement, continuously enhancing employees' capabilities and improving information technology are increasingly crucial.

The BSC is not a static list of measures, but rather a logical framework for implementing and aligning complex programs of change, and, indeed, for managing strategy-focused organizations (Abran and Buglione, 2003). Figure 1 provides a graphical representation of how values-focused strategy drives the four perspectives.

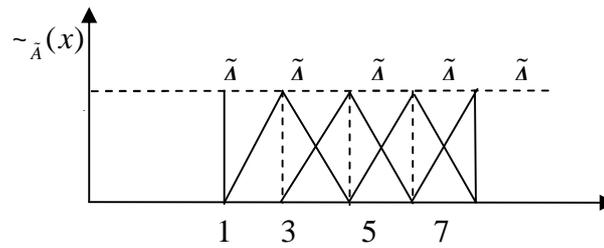


**Figure 1.** The Balanced Scorecard Model.  
Source: Kaplan and Norton (1996)

#### 4. FUZZY AHP METHOD

Since the deficiency of the fuzziness of analytic hierarchy process (AHP) during decision making, Laarhoven and Pedrycz (1983) proposed the fuzzy approach for the AHP method by using the triangular fuzzy number of the fuzzy set theory. In the many decades, many studies extend the AHP method by using different fuzzy algorithm (Buckley, 1985, Chang, 1996, Da deviren and Yüksel, 2008). Many approaches for FAHP method are also criticized because of ignoring consistency control. In this paper, therefore, GF-AHP method (Bulut *et al.*, 2012, Duru *et al.*, 2012) is applied to calculate the weight of each criteria. The reason behind the chosen of GF-AHP is two-fold. First, GF-AHP is capable of subjective data such as

responses given for strategy planning and management of the logistics companies. Second, it overcomes drawbacks of uncontrolled reliability (survey validity debate) and unrated expertise (expert validity debate). The five triangular fuzzy numbers are defined with corresponding fuzzy linguistic variables as presented in Figure 2 and Table 3.



**Figure 2.** Fuzzy Number of Linguistic Variable Set.

**Table 3.** Membership function for the TFNs.

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

The algorithm of the Chang’s approach is as follows;

Let  $X = \{ x_1, x_2, \dots, x_n \}$  be an object set and  $U = \{ u_1, u_2, \dots, u_m \}$  be a goal set. According to the method of extent analysis, each object is taken and extent analysis for each goal is performed, respectively (Chang ,1996). Therefore,  $m$  extent analysis values for each object can be obtained, with the following signs:

$$M_{g_i}^1, M_{g_i}^2, \dots, M_{g_i}^m, i=1, 2, \dots, n, \tag{eq. 1}$$

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

The steps of Chang's extent analysis can be given as in the following:

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

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

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:

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

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:

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

and then the inverse of the vector in Eq. (5) is computed, such as:

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

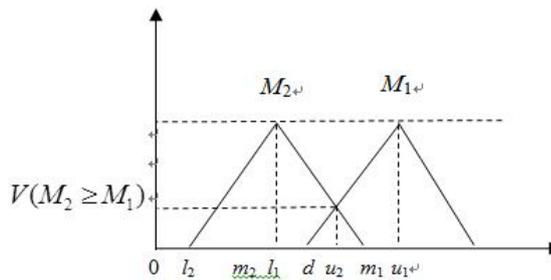
**Step 2:** The degree of possibility of  $M_2 = (l_2, m_2, u_2)$   $M_1 = (l_1, m_1, u_1)$  is defined as

$$V(M_2 \geq M_1) = \sup_{y \geq x} [\min(\tilde{M}_1(x), \tilde{M}_2(y))] \tag{eq. 6}$$

and can be expressed as follows:

$$V(M_2 \geq M_1) = \begin{cases} 1, & \text{if } m_2 \geq m_1, \\ 0, & \text{if } l_1 \geq u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & \text{otherwise.} \end{cases} \tag{eq. 7}$$

Figure 3 illustrates Eq. 7 where d is the ordinate of the highest intersection point D between  $\tilde{M}_1$  and  $\tilde{M}_2$ . 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 3.** 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  $M_i$  ( $i=1,2,\dots,k$ ) numbers can be defined by

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_k)] \tag{eq. 8}$$

$$= \min V(M \geq M_i), i=1,2,3,\dots,k.$$

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

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

(eq. 9)

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

**Step 4:** Via normalization, the normalized weight vectors are

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

(eq. 10)

where  $W$  is a non-fuzzy number.

#### 4.1. The Consistency Control for Pairwise Matrices

The consistency control plays a significant role whether acceptance of each pairwise matrices. In the existing literature, consistency control, however, has not been considered to control the consistency of matrices by using the FAHP method. Duru *et al.* proposed the centric consistency index CCI to control the consistency of each matrix (Duru *et al.*, 2012). The CCI method is based on row geometric mean method (RGMM) proposed by Crawford and Williams (1985) and Aguarón and Jimenez (2003). The algorithm of CCI is stated 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

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

(eq. 11)

where  $n$  is the number of criteria.

When  $CCI(A)=0$ , we consider  $A$  fully consistent. The thresholds of GCI Aguarón *et al.* 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  $n > 4$  (Aguarón and Moreno-Jiménez, 2003).

#### 4.2. The Prioritization of Decision Maker

Since the value of CCI might be considered as an indicator of the experience and knowledge of practitioners, it is used to define the weight of decision makers (Duru *et al.*, 2012). The calculation of the weight of each decision makers is as follows:

Let  $D = \{d_1, d_2, \dots, d_m\}$  be the set of decision makers, and  $w_k = \{w_{k1}, w_{k2}, \dots, w_{km}\}$  be the weight of decision makers. The weight of decision makers ( $w_k$ ) is the normalized  $I_k$  for the group of experts which is calculated as follows:

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

where  $I_k$  is the inverse of the CCI,

$$w_k = \frac{I_k}{\sum_{k=1}^m I_k} \quad (\text{eq.13})$$

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

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

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

The aggregation of individual priorities is defined by

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

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

## 5. THE RELATIVE WEIGHT CALCULATION

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 logistics 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:

$$w_b = \frac{\sum_{d=1}^g w_d}{\sum_{n=1}^s w_n} \quad (\text{eq. 16})$$

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.

## 6. APPLICATION AND RESULTS

The first step for the strategy assessment technique is based on defining requirements and their priority weights. The aggregated fuzzy judgment matrix (AFJM) for the criterion of all dimensions of BSC is calculated from the individual fuzzy judgment matrix of decision makers by using FAHP method as shown in Table 4. The CCI of AFJM is found consistent, 0.02, since it is less than the threshold value of 0.37. The contribution of the return on investment, cost saving measure, safety and reliability, increased market share, and on time delivery criteria is calculated as 0.13, 0.11, 0.11, 0.09, 0.08, respectively (Table 5). The priority weight of the safety and reliability criterion is one of the significant criteria for the customer satisfaction, it has the same degree as cost saving measure and which found superior than increased market share criterion for the financial dimension of BSC.

In this paper, each dimension of BSC has its criteria. The logistics companies could not be expected to consider all these criteria with the same degree. The priority weight determines the most

significant criterion for each dimension of BSC and the strategy for the logistics company is based on these important criteria. The relative weight is used to define which dimension of BSC is important to pay attention respectively for the logistic companies. 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 ( $C_{13}$ ) for the learning and growth perspective play the most significant role for each dimension of BSC, respectively.

The financial perspective addresses the question of how shareholders view the firm and which financial goals are desired from the shareholder's perspective (Kaplan and Norton, 1992). The goal to increase wealth is prior to all others for the owners of a company. ROI provides information about financial health of company. It is the most commonly used management indicator of company profit performance. ROI can give more highlight than measuring the company performance. It can also be used to analyse and forecast a company's future investments and investment returns for the budgetary management, can assist in management goals setting. On the other hand, the customer perspective 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). There are many factors that have impact on customer's views and customer satisfaction. One of the most important criterions is found to be the safety and reliability of service criterion in logistics industry. There is no doubt that supply chains are complex, and this complexity creates a high degree of scientific uncertainty and risk. In addition, internal business process objectives address the question of which processes are the most critical for satisfying customers and shareholders (Kaplan and Norton, 1992). Improving administrative ability and efficiency is a crucial part in internal business process. It has a direct impact on an overall business process; meanwhile, the effect involves customer service quality. A worse administrative performance can easily lead to customer complaints, even customer loss. This is a well-known fact in management practices; however, it is often ignored by employers, especially in time of recession. Employees would produce superior quality performance in optimal time and would lead to growing profits if they are satisfied. Satisfied employees are also more likely to be creative and innovative who help company grow, upgrade competitiveness and face challenge positively in an unceasingly changing logistics market environment.

Table 5 displayed the result of the relative weights of each dimension of BSC and the financial and customer perspectives are

found superior than others. Logistics companies are no exception since the ultimate goal of any company is making profits. The financial performance is a lag indicator and it can reflect if the company's strategies contribute to the bottom-line improvement of the company. In a sense, the financial performance also acts as targets for objectives and measures in the three other perspectives of BSC. Therefore, the importance of financial perspective in logistics companies is self-evident. For another thing, customer satisfaction nowadays is fast becoming a hot issue in all industries since the competition grew. In particular, logistics industry is itself a service industry. 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. After all, no business would be making money without customers. Good service can keep your customer coming back and buying again while poor service can lead to customers find other suppliers that will meet their needs. The performance from this 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.

## **7. CONCLUSION**

The strategy analysis and performance assessment is one of the critical issues to growth and develop for the logistics companies. There are many criteria and factors that influence strategy analysis and performance assessment and they also depend on type of industry. For the logistics companies, profit growth, enhancement of customer satisfaction, reliable alliance partner, excellent staff and intelligence, and streamline business process and efficiency excellence are defined as a strategy and all these strategies are related not only financial but also non-financial dimension. The dimensions related with financial and customer perspectives are found superiority than other two dimensions. The financial indicator plays a significant role for the logistics companies since it can reflect if the company's strategies contribute to the bottom-line improvement of the company. In a sense, the financial performance also acts as targets for objectives and measures in the three other perspectives of BSC.

The BSC is widely used for the performance measurement of companies and it consists of four different dimensions. Firstly, the technical criteria related logistics companies for the BSC are defined by using pre-survey among the practitioners from the logistics

business and related studies in literature. After that, the FAHP method is applied to find the weight of each criterion. The most important criteria of each dimension of BSC are revealed as return on investment, safety and reliability, administrative performance and employee satisfaction, respectively. In this paper, the relative weight method is proposed to define the most important dimension of BSC for the logistics companies to take into account for the strategy selection.

**Table 4.** The Aggregated Fuzzy Judgment Matrix.

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1 (1,1,1)	(1,00,126,334)	(1,00,171,385)	(2,19,258,512)	(1,71,385,589)	(2,19,258,512)	(1,42,167,281)	(2,38,357,586)	(1,63,308,537)	(1,40,278,498)	(2,38,357,586)	(1,63,388,598)	(1,63,308,537)	(2,78,498,704)	(3,57,466,715)
C2 (0,30,079,100)	(1,1,1)	(1,26,140,150)	(1,26,239,320)	(1,40,150,221)	(1,22,276,362)	(0,00,140,257)	(1,00,126,334)	(1,76,228,463)	(1,00,171,385)	(1,00,171,385)	(1,00,176,228)	(1,00,238,449)	(1,40,163,388)	(1,00,238,449)
C3 (0,26,059,100)	(0,67,071,079)	(1,1,1)	(1,22,219,325)	(1,00,126,239)	(0,72,171,276)	(0,72,171,276)	(1,00,215,428)	(1,40,350,554)	(1,00,215,428)	(1,71,219,453)	(1,00,100,300)	(1,00,171,385)	(1,40,350,554)	(2,38,449,653)
C4 (0,20,039,046)	(0,30,042,079)	(0,31,046,082)	(1,1,1)	(1,00,100,176)	(0,72,126,140)	(0,72,126,140)	(1,40,150,221)	(0,74,106,095)	(0,74,140,210)	(0,46,074,195)	(0,46,082,205)	(1,26,195,418)	(0,95,180,245)	(1,40,205,253)
C5 (0,17,026,059)	(0,45,067,071)	(0,42,079,100)	(0,57,100,100)	(1,1,1)	(0,72,100,126)	(0,54,083,126)	(1,00,126,195)	(0,64,120,253)	(0,46,059,126)	(0,59,100,176)	(0,46,074,195)	(0,59,100,176)	(1,00,140,205)	(1,00,100,174)
C6 (0,20,039,046)	(0,28,036,082)	(0,36,059,140)	(0,71,079,140)	(0,79,100,140)	(1,1,1)	(0,54,083,126)	(0,74,195,245)	(0,74,106,245)	(1,26,140,210)	(1,00,100,176)	(0,82,163,227)	(1,76,238,465)	(1,63,180,419)	(1,63,308,537)
C7 (0,36,060,071)	(0,39,071,111)	(0,36,059,140)	(0,71,079,140)	(0,79,121,184)	(0,79,121,184)	(1,1,1)	(1,40,205,432)	(1,63,308,537)	(1,00,126,334)	(1,00,238,449)	(1,40,163,388)	(2,05,432,641)	(1,63,308,537)	(2,78,395,633)
C8 (0,17,028,042)	(0,30,079,100)	(0,23,047,100)	(0,45,067,071)	(0,51,079,079)	(0,41,051,136)	(0,23,049,072)	(1,1,1)	(1,19,150,221)	(0,61,100,126)	(0,72,100,148)	(1,00,145,255)	(1,00,145,357)	(1,26,203,361)	(1,26,165,387)
C9 (0,19,032,061)	(0,22,044,057)	(0,18,029,072)	(1,05,095,134)	(0,40,083,157)	(0,41,095,134)	(0,19,032,061)	(0,45,067,084)	(1,1,1)	(0,52,072,126)	(0,61,072,126)	(0,72,145,255)	(0,72,182,284)	(0,72,171,276)	(0,72,171,276)
C10 (0,20,036,072)	(0,26,059,100)	(0,23,047,100)	(0,48,071,136)	(0,79,171,219)	(0,48,071,079)	(0,30,079,100)	(0,79,100,164)	(0,79,140,192)	(1,1,1)	(1,00,100,148)	(1,18,184,405)	(1,18,160,261)	(1,00,171,385)	(1,26,165,261)
C11 (0,17,028,042)	(0,26,059,100)	(0,22,046,059)	(0,51,136,219)	(0,57,100,171)	(0,57,100,100)	(0,22,042,100)	(0,87,100,140)	(0,79,140,163)	(0,87,100,100)	(1,1,1)	(1,18,184,405)	(1,40,177,281)	(1,00,118,324)	(0,54,085,174)
C12 (0,17,026,091)	(0,44,057,100)	(0,33,100,100)	(0,49,122,219)	(0,51,136,219)	(0,44,081,122)	(0,26,081,072)	(0,39,089,100)	(0,39,089,140)	(0,25,054,085)	(0,25,054,085)	(1,1,1)	(0,59,100,126)	(0,54,085,174)	(0,54,085,174)
C13 (0,19,032,061)	(0,22,042,100)	(0,26,059,100)	(0,24,051,079)	(0,57,100,171)	(0,22,044,057)	(0,41,432,205)	(0,28,069,100)	(0,35,055,140)	(0,38,062,085)	(0,36,056,071)	(0,79,100,171)	(1,1,1)	(0,85,100,255)	(1,00,100,124)
C14 (0,14,020,036)	(0,26,061,072)	(0,18,029,072)	(0,41,055,105)	(0,49,072,100)	(0,24,055,061)	(0,19,032,061)	(0,28,049,079)	(0,36,059,140)	(0,26,059,100)	(0,31,085,100)	(0,57,118,184)	(0,39,100,118)	(1,1,1)	(0,42,100,124)
C15 (0,14,021,029)	(0,22,042,100)	(0,15,022,042)	(0,40,049,072)	(0,57,100,100)	(0,19,032,061)	(0,16,025,036)	(0,26,061,079)	(0,26,059,140)	(0,27,061,079)	(0,57,110,184)	(0,57,110,184)	(0,79,100,100)	(0,79,100,230)	(1,1,1)

CCI = 0.02.

**Table 5.** Mean Aggregated Weight for Each Criteria and Relative Weight for Each Dimension of BSC.

	Financial			Customer				Internal Business Process					Learning and External		
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Mean aggregated weight <sup>+</sup>	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 <sup>+</sup>
Relative weight for each dimension <sup>+</sup>	0.34			0.30				0.23					0.13 <sup>+</sup>		

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