Fuzzy AHP Signifies Criteria Influencing Third Party Logistics Selection in Outsourcing Decisions of Freight Forwarding Company

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Abstract

Outsourcing decisions for logistics activities are a multi-criteria problem, composed of qualitative and quantitative factors. Most decision support models in logistics outsourcing or known as third party logistics (3PL) are popularly adopting the multi-criteria decision making (MCDM) methods used in manufacturing or import/export business. However, most factors in outsourcing are identified as human judgments which are challenging in term of objectively measuring. Freight forwarding is one of major businesses that frequently utilizes 3PL. Yet, few studies of outsourcing logistics for freight forwarding business were investigated. Purpose of this study is to examine and propose critical criteria to be used in decisions to choose 3PL road transportation provider for freight forwarding companies in Thailand. Responses from experts in the industry was calculated using fuzzy analytic hierarchy process (Fuzzy AHP) procedure to obtain weight and rank of criteria. The result reveals that top 3 criteria for freight forwarding company to use in evaluating road transportation provider are quality of service, cost of service, and delivery performance respectively.

Keywords
Criteria, Multi-Criteria Decision Making, Third Party Logistics, Fuzzy AHP and Freight Forwarding.

1. Introduction

In the present, 3PL providers are classified into asset-based and non-asset-based professional service providers. Majority of survey identified freight forwarding business as a non-asset-based provider to manage international transport amid shippers, consignee, and carriers for both personal and business because freight forwarders do not own any transport assets (Markides and Holweg 2006). Large freight forwarding companies have a subsidiary company that coordinates shipment and gains more profit from consolidation. In contrast, small freight forwarding companies have partners to support their business (Saeed 2013). Traditional service of freight forwarding business is preparing documentation, booking air/vessel space, and tracking shipment. (Markides and Holweg 2006). However, valued added services have become competitive advantages and response to customer needs such as packaging and warehousing using 3PL provider.

Using 3PL providers can help firm to reduce investment budget, improve and focus on their core business (Vasiliauskas and Jakubauskas 2007). Moreover, 3PL providers are used for value-added services. Selecting 3PL is an essential process. If process of 3PL selection is ineffective, it might have a negative effect on firm's reputation (Razzaque and Sheng 1998).

Traditional methods for selecting a third party are applying static model to support a simple evaluation and, an auxiliary decision support system based on rule-based reasoning. Both methods could not reflect complexity of human decision-making. Selecting the third party is related to various criteria and a complex process considers both tangible and intangible criteria, called as a multi-criteria problem (Hwang et al. 2016). According to literature, the MCDM methods are widely adopted to support 3PL selection process. Benefits of this method are ability to quickly handle both qualitative and quantitative criteria and gather human judgments to make the process to more realistic (Velasquez and Hester 2013). However, before creating evaluating criteria and selecting 3PL, firms must set aims for using

outsourcing. The selection process of 3PL starts with detailed research to collect data regarding the customer needs, demands, and scope of a framework to select criteria (Qureshi et al. 2008).

Apart from the manufacturers or firms, freight forwarders also use logistics outsourcing that serves broker, transportation service, packaging, and others to customer. Numerous papers proposed criteria on 3PL selection in manufacturers or firms, but outsourcing logistics selection in freight forwarding business in literature is quite limit. Nevertheless, selecting 3PL in freight forwarding business is a stimulating problem, as well as finding evaluating criteria and prioritizing them. Officers or practitioners in freight forwarding firm must consider various factors according to literature reviews. The study of modeling supports and solution methodology for 3PL selection is reviewed in order to propose a systematic knowledge-based and reliable synthesis for finding the important criteria.

The remainder of this paper proceeds as follows; next section is a literature review. Section 3 describes research methodology while section 4 deliberates data collection. The results and discussion are given in section 5. Finally, the conclusion presents in section 6.

1.1 Objectives

In this light, this study reviews existing literature of 3PL selection models. Additionally, analysis of evaluating criteria to solve 3PL – road transportation – selection problems especially for small and medium freight forwarding business is done. The objective of the study is to explore present criteria and methodologies to propose modeling procedure to determine important criteria for 3PL selection for freight forwarding industry in Thailand.

2. Literature Review

2.1 Review methodology

Literature review presents a review based on articles relevant to 3PL provider selection within international journals in third party logistics (3PL) selection domain. Aim of this section is to review criteria affecting 3PL selection problems. The literature was gathered from multiple journal papers and conference proceedings written in the English language. The articles published were chosen from ScienceDirect, ResearchGate, Emeraldinsight, Inderscience Publishers, and Google Scholar using keywords, “3PL selection”, “third party logistics selection”, “logistics outsourcing”, “3PL provider selection”, and “third party logistics service provider.” This review found 14 criteria for selecting of 3PL and displayed the application of tools and methods for modeling. In order to deduce relevant criteria according to the goals of this paper, the criteria of all papers were reviewed and screened based on road transportation selection problems. Critical evaluation of each article demonstrates the modeling procedures and the important criteria for 3PL selection in a different industry.

The main contribution of review can be concluded in the following:

Papers on models and approaches of 3PL selection decision support in various industries were examined. According to research framework, literature review consists of work regarding 3PL decision support model and relevant criteria to year 2020. This research presented a structure of research framework present and identifies various criteria affecting the 3PL providers. This research focuses on the identified criteria influencing performance of road transportation service providers, criteria would be used in final step of 3PL selection. Various modeling methods are considered to identify the weight and rank the importance of criteria in 3PL selection problems. For this research, criteria from literature are analyzed, shortlisted, and hierarchized using fuzzy AHP to find the most important factors. Moreover, this framework helps guide officers or practitioners in freight forwarding businesses who choose outsourcing providers. Lastly, the paper proposes important recommendations for future research in the field of freight forwarding company.

2.2 Overview of criteria on third party logistics selection

From survey, both quantitative and qualitative criteria affecting the 3PL selection are displayed. Each study presents different crucial criteria under different industries. Kabir (2012) proposed results of sample indicates that financial is

the most important factor for selecting 3PL provider for a medium-sized company in fast-moving-consumer-goods (FMCG) business. This paper reviewed factors, but criteria are restricted only six criteria; quality management, operational performance, flexibility, reputation, compatibility, and financial stability, according to requirements of decision-makers of the case study. Kumar and Singh (2012) presented criteria to evaluate global 3PL service provider's performance to ensure effective supply chain management. A total of nine criteria were considered with respect to cost to be the most important criteria to rate performance of 3PL. Additionally, other criteria are information, range of service provided, financial performance, on-time delivery, compatibility, service quality, geographical coverage, and consignment tracking capability. Bansal and Kumar (2013) suggested a hybrid model in order to give new factors to the vital managerial decision for 3PL selection in manufacture. Logistics cost was ranked as the most significant factor among nine criteria; compatibility, environmental sustainability, number of value-added services, cost, quality of service, delivery performance, the geographic range of service, trust factor, and information technology capability. Daim et al. (2013) illustrated a paper that purposed a comparison of logistics/trade experts and exporters to give the chief criteria for selection of 3PL providers in a case of international business. The result indicates that statistically between two groups of decision-makers under six criteria included global capabilities, service, local presence, information technology, cost, and industry experience. The most important criterion is identified as service from experts and export opinion, then the top two criteria are service level performance/quality and cost of service at the same rank. While global capabilities and IT capabilities are ranked the opposite. The logistics and trade experts found information technology to be more important than comprehensive global capabilities. Gurcan et al. (2016) identified four criteria for selecting among 3PL providers for a firm in Istanbul in order to determine the best alternative by experts' review. The four keys factors proposed are compatibility, financial, reputation, and long-term relationship. Finding is compatibility to rank as the most crucial factor. Jovcic et al. (2019) presented five main criteria technology level, price, social responsibility, safety, and delivery for decision making tool to support selecting the 3PL provider. The highest importance score was the price. Pamucar et al. (2019) proposed computing the priority weights of criteria for ranking 3PL providers in multinational companies (MNCs) among five main criteria including intangible, service, geographical location, logistics cost, and information system. Cost was chosen to the most important criterion. Bamatov et al. (2020) suggested the long-term relationships, reputation of the logistics operator, financial performance, cost of service, and operational performance to select 3PL provider in the cold chain of pharmaceutical products. The key criterion of this study was operational performance. Liu et al. (2020) considered the total assets to be the first priority criterion that was used to select the potential 3PL provider in a Chinese airport company amid five criteria including total assets, transport cost, customer satisfaction, personalized service, and technology level.

In all the above-mentioned studies, the selection of 3PL is a multi-objective decision because there are decision makings among several criteria such as cost, information technology, reputation, and compatibility.

2.3 Overview of modeling procedures on third party logistics selection

Numerous studies have applied the MCDM methods to assist making 3PL selection decision with various criteria. Kabir (2012) used AHP method to rate the importance weight of each criterion for 3PL service provider selection in a medium-sized of FMCG firm. Kumar and Singh (2012) suggested the important criteria of global 3PL providers by fuzzy AHP in the supply chain. Bansal and Kumar (2013) adopt AHP to proposed new dimension for support 3PL selection in manufacturing. Daim et al. (2013) illustrated AHP to handle decision-making of logistics/trade experts and exporters in order to rank each criterion. Gurcan et al. (2016) utilized AHP to evaluate criteria by decision-makers rating.

From reviews, AHP is one of the most popular methods to use for solving MCDM problems because this method can formulate problem to a hierarchic structure of pairwise comparison matrix and handle both qualitative data and quantitative data (Bayazit and Karpak 2013). Some studies developed the AHP with fuzzy theory to reflect human thinking among vagueness of criteria (Wang et al. 2009).

3. Methods

Research methodology and framework consist of six stages, as shown in Figure 1. Those six stages are as follows: setting research goal and literature review, identifying criteria, determining criteria weights using a fuzzy scale, checking the consistency ratio, computing the fuzzy weight matrix, and ranking and conclusion.

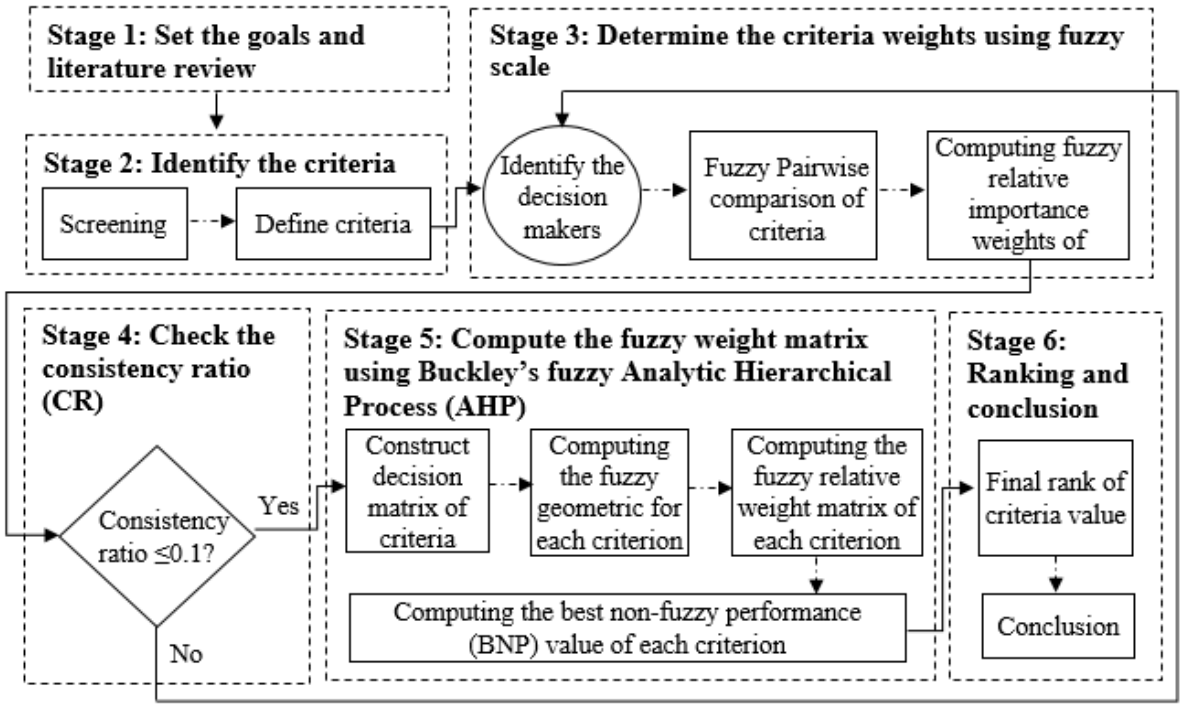

Figure 1. Research framework to signify criteria for third party logistics selection

Stage 1: Set the goals and literature review for this review.

Selecting of 3PL should be structured goal; (1) identify evaluating criteria affecting the 3PL (road transportation) in freight forwarding company and (2) find the most important criteria in freight forwarding company's 3PL selection (road transportation). Resulting from the review, perspective of decision-makers in various industries regarding important criteria suggests 14 decision criteria for 3PL selection.

Stage 2: Identify the criteria.

The criteria from the literature review which are the cost of service, quality of service, compatibility, information technology, delivery performance, information systems, geographical coverage, flexibility, environmental sustainability, trust, reputation, financial performance are screened. The irrelevant criteria for road transportation service are taken out. Detailed and potential impact of each criterion is described as follows:

C01 Cost of service: Most firms used 3PL providers to operate in order to cost reduction and the cost of carrying. Moreover, using 3PL can help the firm to higher rates of revenue growth and performance. Thus, it is an important criterion for evaluating 3PL providers (Rajesh et al. 2011). This criterion aims to help freight forwarding firms to get more profit margin and add sales opportunities with customers when the firms can reduce transportation costs.

C02 Quality of service: The quality is key for adding value to provide product differentiation (Qureshi et al. 2008). Quality improvement of 3PL providers can provide support for responding to customer's requests. This criterion aims to measure the 3PL provider's level of care that operates to customer order without any damage.

C03 Compatibility: The relationship between user and outsourcing needs to have for effective teamwork. The key to attaining growth and success of partnership can build from the compatibility of culture and values between organizations that will become a long-term relationship (Bowersox and Daugherty 1990). This criterion aims to displays the strong relationship between freight forwarding companies and 3PL providers to complete tasks.

C04 Information technology: Outsourcing that develops their information technology to operate vehicle real-time visibility can give strong information and have become to be user's needs (Vaidyanathan 2005). This criterion aims to establish the facility for tracking the shipment from origin to destination at any time.

C05 Delivery performance: Most users requested on-time delivery to be one of the abilities of 3PL providers (Menon et al. 1998). The high delivery performance of 3PL providers can increase customer satisfaction (Stock et al. 1998). This criterion aims to expresses the delivery time of shipment when 3PL providers respond to the customer's order.

C06 Flexibility: The 3PL provider who able to provide operational and delivery flexibility can increase customer volume (Stock et al. 1998). Also, they may support rapidly the customer requirement (Qureshi et al. 2008). This criterion aims to imply the flexibility of third-party logistics providing diversified value-added services to respond to the customer requirement.

C07 Trust: The 3PL provider has to operate with honesty, reliability, and long-sightedness (Huo et al. 2015). Thus, trust is one of the key criteria for success in outsourcing selection. This criterion aims to measure the confidence of the freight forwarding firm to the 3PL firms when they choose.

C08 Reputation: The reputation of 3PL may assure that have good health financially (Lieb and Randall 1996). This criterion aims to receive the opinions of practitioners in freight forwarding companies that have about a 3PL brand.

Stage 3: Determine the criteria weights using a fuzzy scale.

The weight of each criterion is obtained from decision-makers who have at least ten years of experience in a freight forwarding firm and working in at least a supervisory position. According to the literature review, each paper collects a different number of decision-makers in MCDM methods such as Daim et al. (2013) used 10 persons to create decision making in AHP, Sultana et al. (2015) obtained the opinion from 4 experts using integrated fuzzy Delphi, fuzzy AHP and fuzzy TOPSIS method, and Seo et al. (2018) received judgments from 10 persons. In this research, the weight relative importance of criteria was obtained from 12 experienced decision-makers based on a pairwise comparison matrix. Table 1 shows the scale of criteria weight.

Table 1. Scale of Criteria Weight

Fuzzy number	Linguistic variable	Triangular fuzzy number (TFN)
9	Perfect	(8, 9, 10)
8	Absolute	(7, 8, 9)
7	Very good	(6, 7, 8)
6	Fairy good	(5, 6, 7)
5	Good	(4, 5, 6)
4	Preferable	(3, 4, 5)
3	Not bad	(2, 3, 4)
2	Weak advantage	(1, 2, 3)
1	Equal	(1, 1, 1)

Source: Gumus, 2009

Stage 4: Check the consistency ratio (CR).

After decision-makers identified the level of important each criterion using 1 to 9 scale, the pairwise comparison matrix was computed as the average of their eigenvalues (λmax). The average was then calculated to obtain consistency index (CI) following equation (1). Next, Consistency ratio (CR) from equation (2) was calculated by

dividing CI with a random index (RI) from Table 2. RI is chosen by using number that relevant to size of the matrix (n) for decision-maker samples (Saaty, 1980).

The equation of consistency index (CI) is as follows.

$$CI = \frac{\lambda max - n}{n-1} \tag{1}$$

The equation of consistency ratio (CR) is as follows.

$$CR = \frac{CI}{RI} \tag{2}$$

Table 2. Random Index (RI)

Matrix size (n)	1	2	3	4	5	6	7	8	9	10
Random index (RI)	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Source: Saaty, 1994

According to Saaty's (1994), the consistency ratio (CR) should be equal to 0 or less than 0.1 to be acceptable. If the opinions matrices do not fall under the condition, the decision-makers have to revise.

Stage 5: Compute the fuzzy weight matrix using Buckley's fuzzy AHP.

This review has applied process of Buckley's fuzzy Analytic Hierarchical Process (AHP) as follows (Buckley, 1985).

Step 5.1: Construct decision matrix of criteria.

The pairwise comparison matrices of criteria are built from linguistic variables to be pairwise comparisons by giving the importance scale between 2 criteria. The equation is shown below.

$$\tilde{A} = \begin{pmatrix} 1 & \tilde{a}_{1n} & \cdots & \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & 1 \end{pmatrix} = \begin{pmatrix} 1 & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ 1/\tilde{a}_{21} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & 1 \end{pmatrix} \tag{3}$$

$$\text{Where } \tilde{a}_{ij} = \begin{cases} \left(\frac{1}{u_i}, \frac{1}{m_i}, \frac{1}{l_i}\right); & \text{For } \forall i<j \\ (1, 1, 1); & \text{For } \forall i=j \\ (l_i, m_i, u_i); & \text{For } \forall i>j \end{cases}$$

Step 5.2: Computing the fuzzy geometric for each criterion

The geometric mean is applied to each row $\tilde{A}$ for computing to be the fuzzy geometric as equation (4).

$$\tilde{r}_i = \left(\tilde{a}_{i1} \otimes \cdots \otimes \tilde{a}_{ij} \otimes \cdots \tilde{a}_{in}\right)^{\frac{1}{n}} \tag{4}$$

Step 5.3: Computing the fuzzy relative weight matrix of each criterion.

Next, the fuzzy relative weight matrix calculation is applied the below equation.

$$\tilde{w}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \cdots \oplus \tilde{r}_i \oplus \cdots \tilde{r}_n)^{-1} \tag{5}$$

Step 5.4: Computing the best non-fuzzy performance (BNP) value of each criterion.

This step is the best non-fuzzy performance calculation, the center of area method is used in equation (6).

$$\text{BNP } \tilde{w}_i = [(uw_i - lw_i) + (mw_i - lw_i)] / 3 + lw_i \quad (6)$$

Stage 6: Ranking and conclusion.

The crisp number or the BNP value of each criterion is ranked from the maximum to minimum, during the maximum value is the most important criteria for 3PL.

4. Data Collection

The data collection began by reviewing criteria and methods of 3PL selection in numerous industries. The eight criteria were selected for evaluating relevance to road transportation. Then, judgments obtained via questionnaire collected from 12 freight forwarding experts to consider the importance of criteria. The importance weight of each criterion is rated by comparing of the relative importance of all criteria pairs based on AHP method, under 1 to 9 scale of Saaty's (1994) suggestion. The linguistic variable is used to describe the meaning of fuzzy number (Zadech, 1975), the value of importance criteria is identified in Table 1. Then, rating scores gathered from the responses in questionnaire are assessed the consistency ratio before constructing the corresponding pairwise comparison judgment in matrices form to determine the weights, as explained in section 3.

5. Results and Discussion

5.1 Numerical result

Results from this decision support model could be utilized by people are applying weighting of criteria for selecting 3PL. Table 3 shows part of results of pairwise comparisons obtained from decision-makers in fuzzy form.

Table 3. Sample of Pairwise Comparisons

	C01	C02	C03	C04	C05	C06	C07	C08
C01	1	1	5	5	1	5	1/6	5
C02		1	5	5	1	5	1/6	5
C03			1	1	1/8	1	1/9	1
C04				1	1/8	1	1/9	1
C05					1	5	1/6	5
C06						1	1/9	1
C07							1	9
C08								1

Note: Consistency Index (CI) = 0.05; Average Random Index (RI) = 1.40; Consistency Raito (CR) = 0.04

The weight of each criterion value was weighted depended on the decision maker's judgment and may differ due to the requirement of the organization and corporate identity. The analysis of important criteria regarding 3PL selection in Table 4, which is the overall pairwise comparison of decision-makers.

Table 4. The Overall Pairwise Comparison of Decision Makers

	C01	C02	C03	C04
C01	1, 1, 1	0.935, 1.019, 1.161	2.592, 3.250, 3.973	4.146, 5.253, 6.306
C02	0.742, 0.858, 0.953	1, 1, 1	2.310, 3.149, 3.879	3.681, 4.762, 5.814
C03	0.253, 0.308, 0.386	0.258, 0.318, 0.433	1, 1, 1	1.264, 1.633, 2.040
C04	0.159, 0.190, 0.241	0.172, 0.210, 0.272	0.498, 0.624, 0.810	1, 1, 1
C05	0.861, 0.926, 0.976	0.913, 1, 1.196	2.406, 3.091, 3.830	3.879, 4.941, 5.980
C06	0.267, 0.333, 0.423	0.233, 0.278, 0.343	1.205, 1.463, 1.699	0.891, 1.139, 1.482
C07	0.713, 0.913, 1.134	0.556, 0.702, 0.902	1.720, 2.264, 2.949	2.339, 3.185, 4.165
C08	0.249, 0.292, 0.347	0.199, 0.229, 0.273	0.753, 0.951, 1.253	0.882, 1.137, 1.442
	C05	C05	C07	C08
C01	1.024, 1.079, 1.161	2.362, 2.999, 3.739	0.882, 1.096, 1.402	3.422, 4.118, 4.772
C02	1, 1.059, 1.096	2.915, 3.595, 4.283	1.108, 1.425, 1.799	3.658, 4.360, 5.017
C03	0.228, 0.288, 0.379	0.614, 0.724, 0.910	0.339, 0.442, 0.581	0.845, 1.098, 1.373
C04	0.167, 0.202, 0.258	0.675, 0.878, 1.122	0.240, 0.314,0.427	0.693, 0.880, 1.134
C05	1, 1, 1	2.721, 3.571, 4.484	0.842, 1.067, 1.436	2.460, 3.263, 3.975
C06	0.223, 0.280, 0.368	1, 1, 1	0.354, 0.468, 0.622	0.833, 1.175, 1.608
C07	0.696, 0.937, 1.188	1.608, 2.137, 2.826	1, 1, 1	2.375, 3.040, 3.764
C08	0.252, 0.306, 0.406	0.645, 0.864, 1.223	0.266, 0.329, 0.421	1, 1, 1

The Fuzzy geometric mean value ($\tilde{r}_i$) and fuzzy relative weight matrix ($\tilde{w}_i$) of each criterion are computed as shown in Table 5.

Table 5. Fuzzy Geometrics Mean Value and Fuzzy Relative Weight Matrix

Code	**Fuzzy geometrics mean value ($\tilde{r}_i$)**	**Fuzzy weight matrix ($\tilde{w}_i$)**
C01	(1.711, 1.998, 2.322)	(0.149, 0.207, 0.290)
C02	(1.714, 2.044, 2.344)	(0.149, 0.212, 0.293)
C03	(0.490, 0.597, 0.744)	(0.043, 0.062, 0.093)
C04	(0.355, 0.432, 0.542)	(0.031, 0.045, 0.068)
C05	(1.592, 1.909, 2.237)	(0.138, 0.198, 0.279)
C06	(0.508, 0.627, 0.778)	(0.044, 0.065, 0.097)
C07	(1.198, 1.517, 1.884)	(0.104, 0.157, 0.235)
C08	(0.441, 0.531, 0.660)	(0.038, 0.055, 0.082)

After obtained the fuzzy weight of each criterion, this value is computed to be the BNP using the center of the area. The importance weight of each criterion and its rank are included in Table 6.

Table 6. The Important Weight on Criteria for Third Party Logistics Selection

Code	**Criteria**	**Weight (BNP)**	**Rank**
C01	Cost of service	0.215	2
C02	Quality of service	0.218	1
C03	Compatibility	0.066	6
C04	Information technology	0.048	8
C05	Delivery performance	0.205	3
C06	Flexibility	0.069	5
C07	Trust	0.165	4
C08	Reputation	0.059	7

5.2 Discussion

Previously, criteria on 3PL selection in freight forwarding business has not been proposed. Since key criteria for 3PL evaluation may be different from one industry to another, research to determine appropriate factors to use as criteria for selecting 3PL for freight forwarding company was set out. As a result, quality of service is the most significant criterion to evaluate and select 3PL provider for freight forwarding industry. Interestingly, the quality of service was also suggested by Daim et al. (2013) as the most important factor for selecting the 3PL providers for international business. Additionally, when assessing quality of service, evaluator should also focus on level of delivery performance; specifically, on-time, accuracy, and reliability. On the other hand, Bansal and Kumar (2013) proposed the cost to be the most important criteria for selecting the 3PL for manufacturers. That means management would focus on saving costs and taking advantage of economies of scale especially when outsourcing.

Freight forwarding company is indeed acting as service providers for other businesses, therefore quality of service of would also play very important role in their reputation. They also often use road transportation 3PL, performance of such 3PL would directly affect the freight forwarder's reputation. Moreover, there will also occur extra charges in case of cargo damage during transportation by 3PL provider. Resulting from analyzing responses from freight forwarding experts by Fuzzy AHP, the quality of outsourcing's service is as the first priority with BNP of 0.218. Secondly, cost of service is unsurprisingly the next important criterion with crisp number 0.215. Cost is one of the primary reasons business including freight forwarding business decides to outsource. Core business of freight forwarding company is cargo delivery by air and vessel, therefore 3PL provider is used to operate other logistics activities to response to customer's need and increase revenue. Staff in many companies especially small and medium business would focus only on cost, they would think hiring the cheapest 3PL provider would allow the company to get more profit. However, that is not always the case, as seen in research finding, other factors are also as important i.e. service quality and delivery performance. The delivery performance is third importance criterion according to our finding with BNP score of 0.205. When freight forwarding company arranges the vessel or flight schedule to ship cargoes out of a country; they have to consider a cut-off time for loading cargo at port and terminal, and truck for picking up goods imported shipment from oversea. Truck transportation should be able to deliver shipment at the right time, at both origin and destination. If the truck could not delivery within the vessel or airline cut-off time, late and wrong time; problems may occur such as material shortage, the extra cost for waiting in port/ terminal, damage relationship of customer and carrier.

6. Conclusion

In general, 3PL evaluation has many criteria depend on objective, goals, and needs of each business. This paper illustrates data collecting and modeling procedure to discover level of importance of factors influencing third party logistics selection in outsourcing decisions. Expert in freight forwarding industry's opinions were collected via carefully designed questionnaire to pairwise compare eight relevant factors. Responses were analyzed using Fuzzy AHP. The benefit of using fuzzy AHP is that it reflects human judgments using the AHP under the MCDM concept. The resulting weight shows that top three most important criteria for evaluating 3PL (road transportation) in freight forwarding industry are quality of service, cost of service, and delivery performance at 0.218, 0.215, and 0.205 BNP, respectively. All proposed weight criteria from the study could be used as important criteria in performance evaluation and supplier selection process for freight forwarding enterprise because they reflect requirements of the 3PL that lead to effective process and service.

As a result, criteria from this paper can be adopted to the freight forwarding business to select road transportation 3PL provider. Practitioners could apply the result to their organizations or follow the procedure to fit their organizational goals.

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