



## A STUDY ON INTERNATIONAL TRADE RISKS OF OCEAN FREIGHT FORWARDERS

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Tsung-Yu Chou

Key words: ocean freight forwarders, trade risks, analytic hierarchy process, fuzzy set.

## ABSTRACT

Ocean freight forwarders play a critical role in the economic development of Taiwan and import/export services are their most important business line. As an integral element of the marine transportation industry, forwarders find themselves exposed to greater risks due to the homogeneity of their services in a highly competitive and changeable marketplace. It is hence essential to develop a model to evaluate trade risks so as to prevent and mitigate such risks, enhance competitive edge and operational sustainability. This paper examines the trade risks undertaken by the ocean freight forwarding industry in Taiwan and applies the algorithms of fuzzy multi-criteria decision making (FMCDM) to construct a model to assess such risks for the industry in an empirical study. By combining the fuzzy set theory with the analytic hierarchy process (AHP) technique, this paper finds that the most important dimension of the import/export risks undertaken by ocean freight forwarders are partnership risks, followed by freight operational risks and warehousing operational risks. The top three risk items are the unfamiliarity with overseas customs regulations and procedures, insufficient capability in warehousing operations and insufficient capability in container loading/unloading.

## I. INTRODUCTION

The ocean freight forwarding industry has adopted a proactive attitude towards confronting the cost pressure in a highly competitive market and the risks associated with the marine transportation system. For example, the US Government has implemented a series of container safety measures, such as 24-Hour Rules, the Container Security Initiative (CSI), the Customs-Trade Partnership against Terrorism (C-TPAT) and so on, also highlighting the importance of marine freight risk management. Meanwhile, the global nature of freight for-

warding means homogeneity and easy substitution of services. This, combined with an extensive service menu in a highly competitive market, produces the increasing risks faced by freight forwarders. However, very few players have set up an internal risk management function. The understanding, prevention and mitigation of risks should therefore be an important issue for ocean freight forwarders.

There are a large number of participants in the marine transportation industry. In addition to carriers, ocean freight forwarders play an integral role in the whole logistics chain. In fact, a high percentage of forwarders around the world also provide multimodal transport services. By leveraging their core business in forwarding, they integrate capabilities to cover services from exporters to import destinations, such as factory-to-port transport arrangements, container leasing, cargo consolidation and loading, customs procedures and consultation. The important role assumed by ocean freight forwarders in multimodal transport is accompanied by corresponding risks in the shipping process.

To manage the various forms of risk that supply chains are exposed to companies are increasingly investing in risk management tools such as mitigation practices and contingency planning (Ellis et al., 2011; Wiengarten et al., 2016). Tang and Musa's (2011) academic study on supply chain risk management advocated the concept of active management (i.e., prevention) of risks. If ocean freight forwarders can systematically analyze their risk profiles in the import/export workflows, they will be able to mitigate the risks proactively. Therefore, this paper seeks to segment, classify and establish a tree-like hierarchy for a complex set of issues associated with the import/export procedures of ocean freight forwarders by combining a systematic risk analysis and the analytic hierarchy process (AHP) method. The purpose is to present a clear picture of risk criteria and sub-criteria to assist managers in decision making. Meanwhile, the uncertainty associated with the scenario information for individual decision making and the fuzziness of human thinking, reasoning and perceptions mean the application of multiple criteria in the process. In other words, the fuzziness of environmental changes and human thinking should be described and presented in a fuzzy manner. The use of natural language can allow the appraisers to express their ideas freely with words and articulate the fuzziness in the decision-making process. This approach also empowers the assessment

model with objectivity. Therefore, this paper posits that fuzzy AHP is the ideal method to develop a multi-criteria decision-making model for the import/export risk profile of ocean freight forwarders. This paper seeks to establish a feasible framework for risk evaluation and management and sets out the following research purposes: (1) to analyze the risk types for the ocean freight forwarding industry; (2) to construct the risk items for the import/export process for the ocean freight forwarding industry; (3) to develop a multi-criteria *decision-making* model for the import/export risks faced by ocean freight forwarders; and (4) to synthesize effective risk management strategies for the ocean freight forwarding industry. This paper consists of five sections. Following this section, the second section presents a literature review, the third section the research methodology, the fourth section the empirical analysis and the fifth section the conclusions.

## II. LITERATURE REVIEW

### 1. Risk and Risk Management

Risk, in general, refers to the possibility of adverse impacts of an event or action on a given organization (Hutchins, 2003). Risk management is a systematic process to minimize the losses to an organization incurred as a result. It is also a process to assess the cause and effect of adverse impacts on a product or a system (Yang, 2011). Most of the academic studies (Link and Marxt, 2004; Yang, 2011) on risk management draw conclusions from the perspective of risk mitigation and argue that risk management strives to minimize the likelihood of risks with a series of systematic measures for risk identification, measurement, handling and control. This paper defines risk as the possibility of adverse outcomes for an organization due to resource uncertainties by referring to the risk concept proposed by Hutchins (2003) and Tang and Musa (2011). For ocean freight forwarders, this refers to any negative results concerning any element of the import/export process as a result of any significant uncertainties and factors.

### 2. Risk Profile of Ocean Freight Forwarders

Air and marine transport are currently the options for cross-border cargo shipment, in response to the advancement of information technology and the demand from consignors for “timely” services. Lin and Chang (2014) stated that freight forwarding comprises air and marine cargo forwarding. Meanwhile, forwarders without a fleet of ships are classified as non-vessel-operating common carriers (NVOCCs). This paper aims to examine the risk criteria associated with the imports/exports of NVOCCs.

#### 1) Risk Criteria

The common risks involved in the process of international trade include credit risk, political risk, currency risk, transport risk, price risk and product liability risk (Cherunilam, 2010; Feenstra, 2016). Credit risk is the risk of default on a debt that may arise from a borrower failing to make required payments.

Currency risk is a financial risk that exists when a financial transaction is denominated in a currency other than that of the base currency of the company. Transport risk means the improper disposal cause cargo damage or loss in the process of transport. Price risk resulting from the possibility that the price of a security or physical commodity may decline. Product liability risk refers to the risk causing damage to a person or to other property. These risks can be summarized as three main criteria, namely partnership risk, transportation operational risk and external information and financing risk.

Lin and Chang (2014) indicated that marine bills of lading provide three functions in international trade, namely the definition of rights and obligations for carriers and cargo owners, the receipt for the cargo and the certificate for cargo ownership. The commonly seen risks are anti-datedness and advancing, cargo release without the presentation of bills, letter of indemnity for bills of lading, forgery of bills of lading, risks in connection with charter parties and house bills of lading. Chang and Kan (2014) classified the marine transport risks into cargo risk, ship risk, freight fee risk and liability risk according to the marine insurance categories of the underlying assets. Forwarders and consignors are partners in a corporation relationship, but such a relationship extends beyond risk sharing and uncertainty mitigation. In fact, this cooperation creates an additional risk, that is, implicit risk known as cooperation risk (Link and Marxt, 2004). Das and Teng (2001) suggested that cooperation risk is the amalgamation of partnership relation risk and partner performance risk, two mutually independent risk factors. Link (2001) argued that cooperation risk mostly stems from the cultural differences between companies and hence such a risk should be classified into information, communication and value risk. Meanwhile, Chen (2012) investigated the import/export warehousing operations of marine operators and categorized warehousing risks into equipment risk, storage risk and operational risk. However, freight forwarders are confronted with the additional risk of cargo consolidation, port selection risk and risk in relation to the choice of wording in import/export terminology (Jose, 2009; Adams and Thomas, 2012; Chow, 2013).

#### 2) Risk Sub-Criteria

The following is a description of the assessment contents of the above-mentioned respective risk sub-criteria.

##### 1. Risk sub-criteria under the criteria of partnership risk

Scholars have proposed a list of four sub-criteria for the risks associated with the cooperation process. These risk sub-criteria are a passive attitude towards contract execution; selfish and speculative behavior; a lack of communication or information sharing; and insufficient capabilities of partners (Das and Teng, 2001). They are described as follows:

##### (1) Passive attitude in contract execution

If the cooperation partners do not actively honor the contract terms and conditions and cause any disruptions in

multimodal transport services, ocean freight forwarders have to assume losses.

(2) Selfish and speculative behavior

If the cooperation partners maliciously conceal or poach information or engage in selfish behavior such as deceit and dishonesty, it is detrimental to the partnership, causing the collaboration to fall apart or resulting in losses beyond the risk-taking capacity of ocean freight forwarders.

(3) Lack of communication or information sharing

Ocean freight forwarders work with partners to achieve a common goal and mutual benefits by communicating and sharing information. For example, marine shipping companies are expected to start new routes to save transportation costs for the forwarders in the alliance. However, insufficient communication or information sharing between shipping companies and forwarders damages the mutual trust and undermines the efficiency of decision making. This could come at the expense of orders from consigners to forwarders.

(4) Insufficient capabilities of partners

The selection of partners with severely insufficient capabilities will cause adverse effects on the organizational performance of ocean freight forwarders. For example, a forwarder specializing in international business working with a company lacking in experience in ocean shipping may suffer from insufficient transportation due to the incompetence of the partner shipping company.

2. Risk sub-criteria under the criteria of transportation operational risk

Ocean freight forwarders are responsible for cargo transportation in the import/export process. Goods may be damaged as a result of operators' negligence in the warehouse before shipment, cargo collisions in the transportation process or unforeseen circumstances on marine routes. The ocean freight forwarding industry is confronted with a large number of risks throughout the cargo import/export workflows. Therefore, scholars have proposed a list of three risk sub-criteria for the risks associated with transportation operation. These sub-criteria are uncertainty in the overall transportation process; insufficient capability in cargo loading/unloading; and insufficient capability in warehousing operations (Yang et al., 2010). They are described as follows:

(1) Uncertainty in the overall transportation process

The main sources of transportation uncertainties are access to container space, customs clearance and unexpected situations in the marine environment. For example, a consignor places a rush order with a forwarder but the forwarder fails to deliver the cargo on time due to poor communication to secure container space or the inability to clear the customs. The uncertainties associated with the transportation process may cause attrition, impairment or complete loss.

(2) Insufficient capability in cargo loading/unloading

Improper loading/unloading may cause cargo damage or

container overturns. For instance, the operators may ignore the specific conditions of the cargo or may simply be inexperienced in loading/unloading. This may cause cargo loss or container tilts.

(3) Insufficient capability in warehousing operations

Warehousing environments, operational procedures and equipment yields are all factors to be taken into consideration for warehousing arrangements. Operators should fully understand the characteristics of the cargo in question. Insufficient competence or experience of warehousing operators or any force majeure events may cause cargo damage and operational disruption for the forwarding industry.

3. Risk sub-criteria under the criteria of external information and financing risk

Access to external information, fluctuations in exchange rates and the reasonability of freight tariffs are all important issues to the ocean freight forwarding industry. Therefore, scholars have suggested that external information and financing risks should be accompanied by three risk sub-criteria, specifically unfamiliarity with overseas customs regulations and operational procedures; currency losses due to exchange rate fluctuations; and unreasonable levels of freight charges (Chen and Hwang, 1997; Lun, 2011). They are described as follows:

(1) Unfamiliarity with overseas customs regulations and operational procedures

Customs regulations differ from one country to another. In fact, these regulations often change in response to international affairs. Unfamiliarity with customs requirements and operational procedures may cause delays in cargo shipments or even a breach of local laws and the need to seek legal assistance.

(2) Currency losses due to exchange rate fluctuations

The import/export business of oceanic freight forwarders is highly sensitive to changes in exchange rates, interest rates and commodity prices. These factors expose the forwarders to the risk of cargo value loss. Ocean freight forwarders may end up with lower-than-expected fee incomes if they overlook the currency impact.

(3) Unreasonable levels of freight charges

Ocean freight forwarders are fully responsible for the cargo shipments in the import/export business. Therefore, they should select the marine operators or shipping companies that charge a reasonable level of transport fees to maintain the trust from their importer/exporter customers. This will also avoid a loss associated with freight income due to craft loss.

3) The Maps of Risks for Ocean Freight Forwarders

This paper explores the risks faced by the ocean freight forwarding industry in the import/export business. Fig. 1 maps the connection between the procedures and the risks of ocean freight forwarders in the import and export business. A total of three risk assessment criteria are established based on a

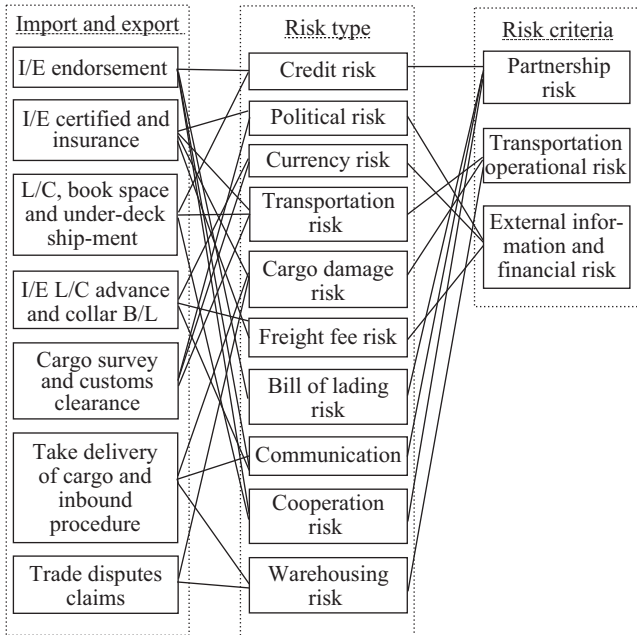


Fig. 1. The maps risks of ocean freight forwarders.

literature review and in-depth interviews with industry professionals and scholars in Taiwan. These risk criteria are partnership risk, transportation operational risk and external information and financing risk. The resulting list of risk assessment sub-criteria are: R1. a passive attitude towards contract execution (credit risk); R2. selfish and speculative behavior (bills of lading risk); R3. a lack of communication or information sharing (communication risk); R4. insufficient capabilities of partners (cooperation risk); R5. uncertainty in the overall transportation process (transportation risk); R6. insufficient capability in cargo loading/unloading (cargo damage risk); R7. insufficient capability in warehousing operations (warehousing risk); R8. unfamiliarity with overseas customs regulations and operational procedures (political risk); R9. currency losses due to exchange rate fluctuations (currency risk); and R10. unreasonable levels of freight charges (freight fee risk).

Fig. 1 shows a total of three risk criteria and ten risk type for import/export trades. Partnership risk consists of four risk types, specifically credit risk, bills of lading risk, information/communication risk in cooperation and value risk in cooperation. Transportation operational risk contains three risk types, namely transportation risk, cargo damage risk and the risk of insufficient capabilities in warehousing operations. External information and financing risks are comprised of political risk, currency risk and freight fee risk.

III. RESEARCH METHOD

The procedures that this paper follows to analyze the import/export risks borne by the ocean freight forwarding industry are as follows: (1) the formation of the analytical hierarchical framework for import/export risks; (2) the description of risk

Table 1. The hierarchical structure of risk.

Perspectives	Factors	Criteria
Risks of ocean freight forwarder	Partnership risk	R1. Passive attitude in contract execution
		R2. Selfish and speculative behavior
		R3. Lack of communication or information sharing
		R4. Insufficient capabilities of partners
	Transportation operational risk	R5. Uncertainty in overall transportation process
		R6. Insufficient capability in cargo loading/unloading
		R7. Insufficient capability in warehousing operations
	External information and financial risk	R8. Unfamiliarity with overseas customs regulations and operational procedures
		R9. Currency losses due to exchange rate fluctuations
		R10. Unreasonable levels of freight charges

assessment criteria and sub-criteria for different levels; (3) the design of a questionnaire on the relative importance of sub-criteria for analysis; (4) the issue of the survey questionnaire; (5) the establishment of a pairwise matrix; (6) the consistency test on risk assessment sub-criteria; and (7) the standardization of fuzzy weights in the fuzzy AHP method.

1. Construction and Explanation of the Analytical Hierarchy of Risks

This paper intends to analyze the risks to ocean freight forwarders in the import/export business and provides a benchmark for their risk management decision-making process. A list of key risk criteria recognized by most scholars is established on the basis of the literature review provided in the second section (Chen and Hwang, 1997; Das and Teng, 2001; Yang et al., 2010; Lun, 2011). A hierarchical structure for the analysis of the import/export risks borne by the ocean freight forwarding industry is constructed (Table 1) and a questionnaire on the relevant importance of these factors is designed accordingly. The hierarchical framework consists of three main criteria, namely partnership risk, transportation operational risk and external information and financing risk, and ten corresponding risk sub-criteria. Below are the definitions and explanations of the individual risk criteria.

Saaty (1980) suggested that the maximum number of assessment indicators should be limited to seven per level in the hierarchical structure for the AHP method. In fact, four or

five indicators are suggested for most empirical studies. This paper refers to the literature review in the analysis of the possible risks faced by the ocean freight forwarding industry. A total of three major risk criteria are generalized, that is, partnership risk, transportation operational risk and external information and financing risk.

**2. Methodology**

Intrinsically speaking, the thinking process or cognition regarding the surrounding environment is often vague and uncertain. Consequently, ocean freight forwarders risk making judgments based on the traditional analytic methods that offered crisp value results but often failed to accommodate real-life scenarios, which are often indefinite and uncertain. Therefore, this paper proposes the fuzzy AHP method to characterize vague and ambiguous data expression and transmission effectively.

*1) Fuzzy Analytic Hierarchy Process*

Herein, the analytic hierarchy process (AHP) (Saaty, 1980) is used to solve multiple-criteria decision problems. By means of a systematic hierarchical structure, complex estimation criteria can be presented clearly and distinctly. Ratio scales are utilized to make reciprocal comparisons for each element and layer. After completing the reciprocal matrix, the comparative weights for each element can be obtained. The AHP is widely used for tackling multi-criteria decision-making problems in real situations. In spite of its popularity and simplicity as a concept, this method is often criticized for its inability to handle adequately the inherent uncertainty and imprecision associated with the mapping of the decision maker’s perception into crisp values. In the traditional formulation of the AHP, human judgments are represented as crisp values. However, in many practical cases, the human preference model is uncertain and decision makers might be reluctant or unable to assign crisp values to the comparison judgments (Chan and Kumar, 2007; Chou et al., 2008).

The use of fuzzy set theory allows decision makers to incorporate unquantifiable information, incomplete information, non-obtainable information and partially unknown facts into a decision model (Kroemer et al., 1999). Although fuzzy AHP requires tedious computations, it is capable of capturing a human’s appraisal of ambiguity when complex multi-criteria decision-making problems are considered (Erensal et al., 2006).

*2) Fuzzy Set*

In a universe of discourse  $X$ , a fuzzy subset  $A$  of  $X$  is defined by a membership function  $f_A(x)$ , which maps each element  $x$  in  $A$  to a real number in the interval  $[0, 1]$ . The function value  $f_A(x)$  represents the grade of membership of  $x$  in  $A$ . The larger the  $f_A(x)$ , the stronger is the grade of membership of  $x$  in  $A$ .

Suppose that there is a fuzzy number  $A$ ; its membership function will be expressed as  $f_A : \Re \rightarrow [0, 1]$ . As shown by Eq. (1), the fuzzy number  $A$  can be defined as a triangular fuzzy number.

$$f_A(x) = \begin{cases} (x-c)/(a-c), & c \leq x \leq a \\ 1, & a = b \\ (x-b)/(a-b), & a \leq x \leq b \\ 0, & o.w. \end{cases}$$

In this formula,  $-\infty < c \leq a \leq b < \infty$ , the triangular fuzzy number  $A$  is presented by  $(c, a, b)$ , so  $A = (c, a, b)$ .

According to the extension principle (Zadeh, 1965), the extended algebraic operations of any two triangular fuzzy numbers  $A_1 = (c_1, a_1, b_1)$  and  $A_2 = (c_2, a_2, b_2)$  can be expressed as follows:

(1) Addition:

$$A_1 \oplus A_2 = (c_1 + c_2, a_1 + a_2, b_1 + b_2)$$

(2) Multiplication:

$$k \otimes A = (kc, ka, kb), k \geq 0, k \in R$$

$$A_1 \otimes A_2 \cong (c_1c_2, b_1b_2, c_1c_2), c_1 \geq 0, c_2 \geq 0$$

(3) Subtraction:

$$(A_1)^{-1} = (c_1, a_1, b_1)^{-1} \cong (1/b_1, 1/a_1, 1/c_1); c_1 > 0$$

$$A_1 \oslash A_2 \cong (c_1/c_2, b_1/b_2, c_1/c_2), c_1 \geq 0, c_2 > 0$$

*3) Linguistic Values*

The concept of linguistic values (Zadeh, 1975, 1976) is useful in handling situations that are too complex or ill-defined to be described reasonably in conventional quantitative expressions. In this paper, the linguistic values characterized by triangular fuzzy numbers defined in  $[0, 1]$  are utilized to convey the suitability evaluation of alternatives versus criteria.

The weights of the criteria and sub-criteria are determined using pairwise comparison matrices. The fuzzy scale showing the relative importance to measure the relative weights is given in Table 2. This scale is proposed by Kahraman et al. (2006) and is used for solving fuzzy decision-making problems.

*4) Ranking of Triangular Fuzzy Numbers*

Because the graded mean integration representation (Chen and Hsieh, 2000) not only improves some of the drawbacks of the existing ranking methods, but also possesses the advantages of easy implementation and powerfulness of problem solving, it is adopted in this study to find the rank of risk criteria and sub-criteria. Based on the graded mean integration representation method, we can obtain the presented and ranking value of triangular fuzzy number  $A_i = (c_i, a_i, b_i)$  as

$$R(A_i) = \frac{c_i + 4a_i + b_i}{6}$$

**Table 2. Linguistic scales for importance.**

Linguistic scale for importance	Triangular fuzzy scale	Triangular fuzzy reciprocal scale
Just equal	(1, 1, 1)	(1, 1, 1)
Equally important	(1/2, 1, 3/2)	(2/3, 1, 2)
Weakly more important	(1, 3/2, 2)	(1/2, 2/3, 1)
Strongly more important	(3/2, 2, 5/2)	(2/5, 1/2, 2/3)
Very strongly more important	(2, 5/2, 3)	(1/3, 2/5, 1/2)
Absolutely more important	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)

Using  $R(A_i)$ ,  $i = 1, 2, \dots, n$ , we can rank the  $n$  triangular fuzzy numbers,  $A_1, A_2, \dots, A_n$ . Let  $A_i$  and  $A_j$  be two fuzzy numbers and define:

$$A_i > A_j \Leftrightarrow R(A_i) > R(A_j);$$

$$A_i = A_j \Leftrightarrow R(A_i) = R(A_j); \text{ and}$$

$$A_i < A_j \Leftrightarrow R(A_i) < R(A_j).$$

**3. The Process of FAHP**

The procedure for the evaluation is described briefly as follows.

*Step1: Build the Hierarchical Structure of the Criteria*

The systemic hierarchical structure of criteria is adopted to present the risk of ocean freight forwarders. The first level reveals the objective of this study and the second level describes the three risk criteria. The third level illustrates the sub-criteria determined for each perspective. The details are presented in Table 2.

*Step2: Calculate the Fuzzy Weights of the Criteria*

This study is based on the concept of Kahraman et al. (2006) to measure the relative weights scale of each criterion or sub-criterion. Then, the method presented by Buckley (1985) is applied to use the geometric mean method to calculate the fuzzy weights for each fuzzy matrix.

Let  $A = [\tilde{A}_{ij}^{L+1}]$  be a fuzzy positive reciprocal matrix (given criterion  $i$  to criterion  $j$ ) of criteria layer  $L+1$ ,  $A = [\tilde{A}_{ij}^{L+1}]$ . First, compute the geometric mean of each row as  $\tilde{Z}_i^{L+1} \cong (\tilde{A}_{i1}^{L+1} \otimes \tilde{A}_{i2}^{L+1} \otimes \dots \otimes \tilde{A}_{ik}^{L+1})^{2/k}$ ,  $\forall i = 1, 2, \dots, k$ .

Then, the fuzzy weight of the  $i^{th}$  criterion can be denoted by

$$\tilde{W}_i^{L+1} = (w_{ic}, w_{ia}, w_{ib}) = \tilde{Z}_i^{L+1} \oslash (\tilde{Z}_1^{L+1} \oplus \dots \oplus \tilde{Z}_k^{L+1}).$$

*Step3: Defuzzify the Fuzzy Weights into Crisp Weights*

Based on the graded mean integration representation method, we can obtain all crisp weights by defuzzifying these fuzzy weights  $\tilde{W}_i^{L+1} = (w_{ic}, w_{ia}, w_{ib})$  as follows:

$$W_i^{L+1} = \frac{w_{ic} + w_{ia} + w_{ib}}{6}, \forall i = 1, 2, \dots, k$$

*Step 4: Normalize the Crisp Weights and Calculate the Integrated Weights*

For ease of comparison of the relative importance between each layer, these criteria weights are normalized by the following formula:

$$NW_i^{L+1} = \frac{W_i^{L+1}}{\sum_{i=1}^k W_i^{L+1}}, \forall i = 1, 2, \dots, k$$

Furthermore, let  $NW_u^{L+2}$  be the normalized weight of the  $u^{th}$  sub-criterion (on the sub-criteria layer  $L+2$ ) under the  $i^{th}$  criterion. Then, the integrated weight of the  $u^{th}$  sub-criterion under the  $i^{th}$  criterion can be obtained as follows:

$$HW_u^{L+2} = NW_i^{L+1} \times NW_u^{L+2}, \forall u = 1, 2, \dots, p.$$

where  $p$  is the number of sub-criteria under the  $i^{th}$  criterion.

$$HW_u^{L+2} = NW_i^{L+1} \times NW_u^{L+2},$$

$$\forall u = 1, \dots, p, \forall i = 1, \dots, q, \forall u = 1, \dots, r$$

**IV. EMPIRICAL STUDY**

This paper generalizes a list of risk criteria and sub-criteria on the basis of a literature review. A questionnaire for industry experts is designed accordingly to determine the list factors associated with the import/export business of ocean freight forwarders. The survey and research findings are reported in three sections concerning the analysis of the sample structure, the hierarchical framework for import/export risks and the AHP analysis of import/export risks.

**1. Analysis of the Sample Structure**

The questionnaire consists of three parts. Part 1 provides the instructions for the survey participants and explains the risk assessment criteria and sub-criteria. Part 2 summarizes the pairwise comparisons of factors on different hierarchical levels and requires the respondents to tick the three criteria and ten sub-criteria. Part 3 gathers basic information on the survey participants. The survey was conducted in February 2015 with members listed in the directory published by the International Ocean Freight Forwarders and Logistics Association, Taiwan. A total of 15 questionnaires were distributed. After the elimi-



**Table 3. The weights of all criteria and integrated weights of all sub-criteria.**

Criteria	Weight (a)	Sub-criteria	Weight (b)	Integrated weight (c = a*b)	Rank
C1. Partnership risk (C.I. = 0.0053) (C.R. = 0.0059)	0.2807	R1	0.2539	0.0713	7
		R2	0.2393	0.0672	9
		R3	0.2494	0.07	8
		R4	0.2574	0.0724	6
C2. Transportation operational risk (C.I. = 0.0410) (C.R. = 0.0707)	0.2513	R5	0.2403	0.0604	4
		<b>R6</b>	<b>0.2513</b>	<b>0.0632</b>	<b>3</b>
		<b>R7</b>	<b>0.2584</b>	<b>0.0649</b>	<b>2</b>
C3. External information and financing risk (C.I. = 0.0050) (C.R. = 0.0087)	0.218	<b>R8</b>	<b>0.3143</b>	<b>0.0685</b>	<b>1</b>
		R9	0.172	0.0375	10
		R10	0.2637	0.0575	5

nation of an incomplete response and an invalid questionnaire that failed the consistency test, this paper collected 13 effective questionnaires, achieving an effective response rate of 86.67%.

To summarize the sample structure on the basis of the effective questionnaires, among the respondents, 30.76% were mid-level managers or senior executives and 53.85% had tenures of over six years (mostly 11~15 years).

This paper achieved a total of 13 effective questionnaires, in compliance with the suggestion by Robinson (1994) that 5 or 7 experts are optimal for group decision making. It is hence safe to infer that the survey results and analysis are, to a certain degree, representative.

## 2. Hierarchical Framework for Import/Export Risks

The risk criteria and sub-criteria for import/export risks in this paper are largely based on the review of domestic and overseas literature described in the second section. This paper generalizes three risk criteria and ten sub-criteria as the hierarchical structure of import/export risk assessments for ocean freight forwarders by consulting with industry experts.

## 3. Consistency Tests

The AHP method refers to consistency ratios as the criterion for pairwise matrix consistency. This paper conducts consistency tests on the three risk criteria and ten risk sub-criteria in the pairwise matrix. The C.I. values and C.R. values are shown in Table 3. Saaty (1980) stated that a C.I. value of 0.1 indicates satisfactory consistency of the pairwise matrix. Meanwhile, a C.R. value of 0.1 indicates that the pairwise matrix is within the consistency range and the decision making can continue. The results of this paper indicate that all the C.I. values and C.R. values of the respective risk criteria and sub-criteria are smaller than 0.1. This suggests that the hierarchical framework and the pairwise matrix constructed with the effective questionnaire responses are highly consistent.

## 4. AHP Analysis of Import/Export Risks

This section details the steps of the fuzzy AHP method described in Section 3.3 and the derived weights of individual risk criteria and sub-criteria. The calculation results are provided below.

### 1) Analysis of the Assessment Factors of the Major Criteria

On the major criteria level (Table 3), the assessment criteria are C1 (partnership risk), C2 (transportation operational risk) and C3 (external information and financing risk). Table 3 indicates that the respondents think that the most important import/export risk dimension is C1 (partnership risk) with a weighting of 0.2807, followed by C2 (transportation operational risk) with a weighting of 0.2513 and finally C3 (external information and financing risk) with a weighting of 0.2180. The weighting assigned to C1 is significantly higher than those assigned to C2 and C3. This highlights the importance of partnership risk management for the import/export business of ocean freight forwarders from the viewpoint of the survey respondents.

### 2) Analysis of the Assessment Factors of the Sub-Criteria

The sub-criteria consist of ten risk assessment items (R1~R10) under the three risk criteria (C1~C3). Based on the results, the top five risk sub-criteria, in order of weightings, for the import/export business of the ocean freight forwarding industry are R8 (unfamiliarity with overseas customs regulations and operational procedures), R7 (insufficient capability in warehousing operations), R6 (insufficient capability in cargo loading/unloading), R5 (uncertainty in the overall transportation process) and R10 (unreasonable levels of freight charges). Below is a brief description of the causes of the top three risks identified.

Firstly, import/export traders deal with issues in at least two countries. If one country changes its laws and regulations, the trader in the counterparty country may be exposed to political risks associated with contract breaches. This is why familiarity with overseas customs regulations and operational procedures is critical to ocean freight forwarders to ensure the honoring of contractual obligations. In fact, on the extensive menu of import/export services offered by overseas freight forwarders, customs clearance is often the political factor that is the most difficult to control. There are variances in customs clearance requirements from one country to another. A lack of familiarity with local customs regulations may cause delays in customs clearance and cargo shipments. A solid understanding of the customs rules and trade laws of different countries can enhance the customs clearance efficiency and shorten the cargo delivery timeframe. This is why familiarity with customs regulations is considered to be the most important element of risk management in the import/export business of ocean freight forwarders.

Secondly, cargo is stored in warehouses before shipment. Insufficient competence of warehousing operators, accidents or force majeure events may damage cargo to the detriment of the business of ocean freight forwarders. Stored goods may

deteriorate if packages are poor or the facilities are improperly maintained or incorrectly operated. Data transcription errors or an unsafe operational environment may also cause unexpected warehousing risk. The ocean freight forwarding industry is advised to monitor the equipment and facilities for cargo storage and supervise on-site operators to mitigate and prevent warehousing risk and ensure cargo integrity. This will boost the level of customer satisfaction with the import/export services provided by ocean freight forwarders.

The third important risk sub-criterion is R6 (insufficient capability in cargo loading/ unloading). Incapable operators may not load/unload cargo properly and, as a result, the transportation costs may rise due to cargo attribute or container overturns. Cargo loss and delayed delivery may deprive the ocean freight forwarders of future business opportunities. This is why sufficient capability of operators in cargo loading/ unloading is considered a key risk factor. The ocean freight forwarding industry is advised to reduce the likelihood of operational hiccups by establishing a powerful network of industry contacts and a seamless process with shipping companies and consignors to control the risk associated with import/export services.

## V. CONCLUSION

This research results are summarized below and suggestions are provided for the ocean freight forwards. The three risk assessment criteria and ten risk sub-criteria are established for the import/export services offered by ocean freight forwarders. The three criteria are “Partnership risk”, “Transportation operational risk” and “External information and financing risk”. Furthermore, by the fuzzy AHP technique to obtain the four important risk sub-criteria. Such as Unfamiliarity with overseas customs regulations and operational procedures, Insufficient capability in warehousing operations, Insufficient capability in cargo loading/unloading, and Uncertainty in the overall transportation process. In the four most important risk awareness items, there are three belong to transportation operational risk criterion (transportation risk, cargo damage risk, warehousing risk). Another belongs to the external information and financial risks (political risk).

From this result, freight forwarders need to pay attention and set specifications for the operation of cargo transportation. For example, standardization of operating processes, audit and supervise truck companies of land transport, or container yard and warehousing company’s selection and supervision. These are the basic methods for risk prevention. In the political risks, handling the customs clearance operations by the agency is also a quick way to learn customs regulations and operational procedures.

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## REFERENCES

- Adams, B. S. and M. C. Thomas (2012). Choosing a port: an analysis of containerized imports into the US. *Transportation Research Part E* 48(4), 881-895.
- Chan, F. T. S. and N. Kumar (2007). Global supplier development considering risk factors using fuzzy extended AHP-based approach. *Omega* 35, 417-431.
- Chang, C. Y. and H. F. Kang (2014). *International Trade Practice*. Wunan, Taipei.
- Chen, K. K. and R. C. Hwang (1997). The study of finance risk management of Taiwan’s shipping industry. *Maritime Research Journal* 4, 89-99.
- Chen, S. H. and C. H. Hsieh (2000). Representation, ranking, distance, and similarity of L-R type fuzzy number and Application. *Australian Journal of Intelligent Processing System* 6(4), 217-229.
- Chen, Y. C. (2012). Risk Management of Warehousing Activity for Import and Export Operations. *Ship & Shipping Newsletter* 106, 1-2.
- Cherunilam, F. (2010). *International Trade and Export Management*, Himalaya Pub. House, Mumbai India.
- Chou, T. Y., C. L. Hsu and M. C. Chen (2008). A fuzzy multi-criteria decision model for international tourist hotels location selection. *International Journal of Hospitality Management* 27, 293-301.
- Chow, H. K. H., W. Siu, C. K. Chan and H. C. B. Chan (2013). An argumentation-oriented multi-agent system for automating the freight planning process. *Expert Systems with Applications: An International Journal* 40(10), 3858-3871.
- Das, T. K. and B. S. Teng (2001). A Risk Perception Model of Alliance Structuring. *Journal of International Management* 7, 1-29.
- Erensal, Y. C., T. Özcan and M. L. Demircan (2006). Determining key capabilities in technology management using fuzzy analytic hierarchy process: A case study of Turkey. *Information Sciences* 176, 2755-2770.
- Feenstra, R. C. (2016). *Advanced International Trade : Theory and Evidence*, Princeton: Princeton University Press.
- Hutchins, G. (2003). Risk management in the supply chain. *Quality Congress. ASQ's Annual Quality Congress Proceedings* 57, 49-58.
- Jose, L. (2009). Port choice and freight forwarders. *Transportation Research Part E*. 45, 186-195.
- Kahraman, C., T. Ertaş and G. Büyükoğuzkan (2006). A fuzzy optimization model for QFD planning process using analytic network approach. *European Journal of Operational Research* 171, 390-411.
- Kroemer, K., H. Kroemer and K. Kroemer-Elbert (1999). *Ergonomics*. Prentice-Hall, New Jersey.
- Lin, K. and C. C. Chang (2014). *Shipping Management*. Shipping Digit, Taipei.
- Link, P. (2001). *Risiko management in Innovation skoooperationen*, Doctoral Thesis, Nr. 14240 ETH Zurich, Zurich.
- Link, P. and C. Marxt (2004). Integration of risk and chance management in the co-operation process. *International Journal of Production Economics* 90(1), 71-78.
- Lun, Y. H. V., M. Browne, K. H. Lai, C. W. Y. Wong and T. C. E. Cheng, (2011). Examining the influence of firm performance on business risk-taking and the mediation effect of scale of operations in the container terminal industry. *Research in Transportation Economics* 32 (1), 64-70.
- Robbins, S. P. (1994). *Management*. McGraw-Hill, New York.
- Saaty, T. L. (1980). *The Analytic Hierarchy Process*, McGraw-Hill, New York.
- Tang, O. and S. N. Musa (2011). Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics* 133(1), 25-34.
- Uher, T. E. and A. R. Toakley (1999). Risk management in the conceptual phase of a project. *International Journal of Project Management* 17(3), 161-169.
- Wiengarten, F., P. Humphreys, C. Gimenez and R. McIvor (2016). Risk, risk management practices, and the success of supply chain integration, *International Journal of Production Economics* 171, 361-370.
- Yang, Y. C. (2011). Risk management of Taiwan’s maritime supply chain

- security. *Journal of Safety Science* 49(3), 382-393.
- Yang, Y. L., J. F. Ding and Y. T. Wang (2010). Analyzing cooperation risk of multi-modal shipments for ocean freight forwarders in Taiwan. *Maritime Quarterly* 19(1), 1-14.
- Zadeh, L. A. (1965). Fuzzy Sets. *Information and Control* 8(3), 338-353.
- Zadeh, L. A. (1975, 1976). The concept of a linguistic variable and its application to approximate reasoning. *Information Science* 8, 199-249, 301-357; 9, 43-80.