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Full Length Research Paper

Transport risks analysis of temperature-controlled cargoes for airfreight forwarders in Taiwan: Case study of the orchids

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The main purpose of this paper is to evaluate the transport risks of temperature-controlled cargoes of orchids for airfreight forwarders in Taiwan. At first, we use a risk assessment method as the research method in this paper. Secondly, four dimensions and eighteen risk factors are derived to proceed the empirically study via questionnaires. The empirically results show that: (1) the top factor of perceived risk is 'delayed shipments caused by climate factors' (2) the top factor of risk frequency is 'insufficient air cargo space on aircraft' (3) the top factor of risk severity is 'delays or cancellation of flights' (4) thirteen risk factors place on the low-risk area; five risk factors place on the medium-risk area; and there are no risk factor places on the high-risk area. Furthermore, three risk strategies are suggested to be adopted by different risk factors.

Key words: Transport risk, orchid, temperature-controlled cargo.

INTRODUCTION

Temperature-controlled cargoes (e.g. fruits, vegetables, frozen aquatic products, frozen poultry meat, drugs, and flowers, and so on) are easy to be damaged by collisions, and therefore they cannot endure long transport time. Besides, it is very easy for them to go bad due to improper temperature or humidity control. All these risks may cause the loss of their economic values when they arrive in their destinations. As a result, airfreight forwarders (hereinafter referred to as AFFs) are assuming a great risk when they are transporting temperature-controlled cargoes. In light of this, the AFFs need to first identify all possible risks in the course of cargo transport and implement proper risk management measures to reduce the risk of cargo damages. The orchids (Lee, 2011; Liu, 2010) are one of the very important export economic crops to Taiwan. The production values of all kinds of the orchids, the phalaenopsis (butterfly orchid) undoubtedly is the highest one in Taiwan.

Due to the fact that the planting area of phalaenopsis orchid is about 200 ha, accounting for only one third of the total orchid planting area in Taiwan. Agricultural statistics in 2008 showed that among all orchid varieties, the phalaenopsis orchid has the highest price per unit area and makes up for two thirds of total orchid export values. The phalaenopsis orchid was selected as one of top four Taiwanese agricultural products in 2004. It further

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became the third export agricultural product in Taiwan in 2008. In addition to boosting the nation's export momentum, the orchid also plays an important role in improving Taiwan's international image. The orchid industry in Taiwan enjoys two advantages - genetic sources with high quality and the largest number of species in the world. Moreover, it also has other strengths such as superior breeding, tissue culture technologies, standardized facilities, culture and management skills, suitable climate and environment, and professional labor division in up, mid and downstream, and so on. These advantages enable Taiwan to export the phalaenopsis orchids to major countries (Feng, 2009; Wang, 2009; Wu, 2006) such as Japan, the US, China, and European countries as well as lead the whole world in terms of export volumes.

The orchid is a flower species of high economic value. To shorten transport time and ensure the freshness of flowers, most AFFs adopt refrigerated air containers for the consignment. However, it is very easy for orchid to be damaged in the transport process due to risk factors such as temperature, humidity, packaging, and transportation time, and so on. According to the geographical locations of destination countries and the varieties of orchids, the consigners would indicate temperature requirements on bill of lading (B/L) to ensure the freshness, qualities, and economic value of orchid flowers. They would normally require a temperature range between 18 to 24°C and exposure to sunlight absolutely less than 30 min. As orchid flowers are very typical cargos that require temperature control, they were chosen as the subject of this study. We attempt to identify, evaluate, and analyze the transport risks involved in temperature-controlled cargo for the AFFs, and further to come up with appropriate risk strategies in this paper.

After searching the relevant literature, the themes of risk assessment (Blackhurst et al., 2008; Giovanna and Lorenzo, 2011; Lichtenberg, 2010; Misra et al., 2007; Shang and Tseng, 2010; Sheehan, 2010; Sunil and ManMohan, 2004; Tsai and Su, 2005; Tummala and Schoenherr, 2011; Yang, 2010) are very important; however, the evaluation issue of transport risk of temperature-controlled cargo was found very few in this field. Hence, the future development of temperature-controlled cargos of avoiding cargos damages as well as adopting various improvement strategies of transport risk would be an urgent task for the AFFs. In summary, the main purpose of this study is to evaluate and analyze the transport risks of temperature-controlled cargoes for the AFFs in Taiwan. Beside, we take the orchid flowers of temperature-controlled cargo as a case study to evaluate this issue.

MATERIALS AND METHODS

We use three risk steps (Shang and Tseng, 2010; Tseng and Li, 2011; Yang, 2010) as the assessment of the research method in this paper, including risk identification, risk analysis and evaluation, and risk strategies, respectively.

Risk identification

In this study, risk identification is mainly done by literature review (Feng, 2009; Lee et al., 2008; Lee, 2011; Liu, 2010; Shang and Tseng, 2010; Wang, 2009; Wu, 2006) and interviews with experts to find the risk factors of temperature-controlled cargoes in the transport process for orchids. Hence, four dimensions and eighteen preliminarily risk factors for temperature-controlled cargoes of orchids are suggested; and their codes are shown in parentheses as follows:

(1) Operators risk: This dimension includes six risk factors, that is, 'cargo damages caused by car accidents when truck drivers are carrying the goods (R_1),' 'improper operations by forklift truck operators (R_2),' 'improper ways in which warehouse workers move or stack cargoes (e.g. heaping heavy goods on light ones) (R_3),' 'false customs declarations by customs brokers (R_4),' 'negligence by AFFs' operator (OP) personnel in B/L-related work (R_5),' and 'mistakes made by AFFs' OP personnel in their reservation of cargo space (R_6),' respectively.
(2) Hardware risk: This dimension includes five risk factors, that is, 'improper temperature control causing cargoes to spoil (R_7),' 'improper humidity control causing cargoes to spoil (R_8),' 'insufficient warehouse space (R_9)', 'trucks with improper temperature control equipment (R_{10}),' and 'insufficient air cargo space on aircraft (R_{11}),' respectively.
(3) Consignors risk: This dimension includes three risk factors, that is, 'insufficient strength or poor quality of packaging materials (R_{12}),' 'disputes caused by consignors' false on customs declarations (R_{13}),' and 'cargo damages caused by incomplete documents supplied by consignors (e.g. certificate of origin and documents related to quarantine, tests, and so on) (R_{14}),' respectively.
(4) Time risk: This dimension includes four risk factors, that is, 'delayed shipments caused by climate factors (R_{15}),' 'delays or cancellation of flights (R_{16}),' 'delayed transport by truck companies (R_{17}),' and 'delays caused by B/Ls filed by AFFs (R_{18}),' respectively.

Risk analysis and evaluation

With regards to risk analysis and evaluation, a number of studies (Manuele, 2010; Peltier, 2004; Shang and Tseng, 2010; Yang, 2011) have applied the 'risk matrix model (RMM)' to assess placement of risk levels. A RMM can help risk managers to develop highly efficient risk management strategies through different zones of risk levels in accordance with various risk factors; hence, in attempt to lower loss occurrence rates and to reduce financial impacts for corporations. The Australian/New Zealand Standard (that is AS/NZS 4360: 2004) is a common risk management standard model. The AS/NZS 4360 model is used in the second procedure of the risk assessment in this paper. The AS/NZS 4360 proposes the concept of risk assessment level matrix, dividing the major factors of risk analysis into two dimensions, that is, risk frequency and risk severity. Regarding the former dimension - the risk frequency - refers to a specific risk within a certain period of time. The number of times for a specific risk incident to occur in a risk unit (probability) is divided into five levels. With regard to the latter one - the risk severity - refers to the severity of loss caused from a specific risk occurring within a certain period of time, which is also divided into five levels. The measurements of the risk frequency and risk severity are shown in Table 1. After completing the estimation of the risk frequency and risk severity, this study defines risk value as the value after the multiplatinum of risk frequency and risk severity. Finally, the risk value was divided into three risk areas in this study according to Shang and Tseng's (2010)

Table 1. The measurements of risk frequency and risk severity.

Parameter	Levels		Descriptions
Risk severity	1	lighter	Under New Taiwan Dollars (NTD) 5,000
	2	light	NTD 5,000 -10,000
	3	acceptable	NTD 10,000 - 50,000
	4	severe	NTD 50,000 -100,000
	5	extremely severe	Over NTD 100,000
Risk frequency	1	impossible	Over 12 months
	2	not often	6 - 12 months
	3	passable	3 - 6 months
	4	sometimes	1 - 3 months
	5	often	Under 1 month

advices including:

(1) The risk belongs to low-risk area when the risk value is between grades 1 to 4;
(2) The risk belongs to medium-risk area when the risk value is between grades 5 to 10;
(3) The risk belongs to high-risk area when the risk value is between grades 11 to 25.

Risk strategies

Risk management strategies are often divided into categories of riskcontrol and risk financing (Smeltzer and Siferd, 1998; Sunil and ManMohan, 2004; Uher and Toakley, 1999). The former refers to the strategies or measures made towards lowering risk occurrence rate and loss frequency. The purpose aims to prevent and reduce loss. Common risk control strategies or measures include risk avoidance, risk transfer, loss prevention, and loss reduction. The later refers to financial planning, including finance funding as rapid restoration to situation prior to risk occurrences. Commons risks financing strategies or measures include reserve contribution, credit financing, and insurance, respectively.

EMPIRICAL STUDY

Questionnaire and data collection

The data of four dimensions and eighteen risk factors were collected to design the questionnaires, which were divided into three parts. Part I is related to the basic data; meanwhile Part II measures the perceived risks of eighteen factors, which were based on a Likert 5-point scale, ranging from '1' for 'strongly disagreed' to '5' for 'strongly agreed.' The Part III is to measure risk frequency and severity by Likert 5-point scale. The measurements of risk frequency and risk severity are shown in Table 1. The questionnaires were filled in by the related participants of various communities in Taiwan, including AFFs and exporters of temperature-controlled cargoes of orchids. In addition, the surveys were completed through post-mails, e-mails, phone calls, and in-person interviews conducted by the authors. A total of 118 valid samples were collected from the 140 questionnaires, which represents 84.29% of the total questionnaires.

The reliability (Hair et al., 2010) of the article applies Cronbach's α to measure the consistency of all risk factors covered in each dimension. If the coefficient of Cronbach's α falls higher than 0.7, it is a high value of reliability. After conducing reliability analysis, the average value for each dimension can reach 0.943, and it is therefore a high reliability value. Due to the fact that the questionnaire of this paper introduces questionnaires with related literature or practical verifications collected by related experts, and hence this paper contains reasonable content validity (Hair et al., 2010). The basic statistics information in the questionnaire survey are summed up as follows:

(1) Male and female respondents each accounted for half of the valid samples, and most of them were aged between 31 and 40, suggesting that the majority of the interviewees in this survey belonged to young and middle-aged groups.
(2) Most of those surveyed had been working in this field for less than 10 years, and 42% of them were working as OP personnel for the AFFs, most of which had been established for over 20 years and were running on capital of more than NTD 16 million with 200 employees. This also indicates that most of those polled were working for large forwarders.

RESULTS

Applying the three risk steps aforementioned, the results of the mean, the standard deviation (S.D.), and the rank of the perceived risk, risk frequency, and risk severity can be shown in Table 2. The results of Table 2 can be summarized as follows:

(1) The means of the top three factors of perceived risks are 'delayed shipments caused by climate factors (R_{15}),' 'cargo damages caused by car accidents when truck drivers are carrying the goods (R_1),' and 'delays or cancellation of flights (R_{16}),' respectively. Contrarily, the means of the latter three ones are 'false customs declarations by customs brokers (R_4),' 'insufficient warehouse space (R_9),' and 'delays caused by B/Ls filed by AFFs (R_{18}),' respectively.
(2) The means of the top three factors of risk frequency are 'insufficient air cargo space on aircraft (R_{11}),' 'perceived risks are delayed shipments caused by climate factors (R_{15}),' and 'risk severity are delays or cancellation

Table 2. The results of the perceived risk, risk frequency, and risk severity.

Risk factors		Perceived risk			Risk frequency			Risk severity		
		Mean	S.D.	Rank	Mean	S.D.	Rank	Mean	S.D.	Rank
R_1	Cargo damages caused by car accidents when truck drivers are carrying the goods	3.64	0.872	2	2.59	1.449	1	2.37	1.067	11
R_2	Improper operations by forklift truck operators	3.44	1.009	6	2.15	1.062	11	2.39	1.242	10
R_3	Improper ways in which warehouse workers move or stack cargoes	3.53	1.182	4	2.37	0.993	7	2.32	1.213	12
R_4	False customs declarations by customs brokers	3.26	1.058	16	1.95	0.706	15	2.12	1.029	17
R_5	Negligence by AFFs' OP personnel in B/L-related work	3.34	1.023	9	2.41	1.161	5	1.95	0.973	18
R_6	Mistakes made by AFFs' OP personnel in their reservation of cargo space	3.27	1.083	15	2.44	1.226	4	2.15	1.062	16
R_7	Improper temperature control causing cargoes to spoil	3.47	1.196	5	1.90	0.767	16	2.41	1.396	9
R_8	Improper humidity control causing cargoes to spoil	3.32	1.183	12	1.76	0.799	18	2.32	1.404	12
R_9	Insufficient warehouse space	3.14	1.045	17	1.88	0.927	17	2.29	1.309	15
R_{10}	Trucks with improper temperature control equipment	3.32	1.101	12	2.00	0.922	14	2.32	1.213	12
R_{11}	Insufficient air cargo space on aircraft	3.41	1.080	8	2.41	0.974	5	2.49	1.468	4
R_{12}	Insufficient strength or poor quality of packaging materials	3.42	1.015	7	2.29	1.031	8	2.61	1.284	2
R_{13}	Disputes caused by consignors' false on customs declarations	3.29	0.979	14	2.05	1.023	13	2.41	1.284	7
R_{14}	Cargo damages caused by incomplete documents supplied by consignors	3.39	1.046	10	2.20	0.980	10	2.44	1.119	7
R_{15}	Delayed shipments caused by climate factors	3.73	0.823	1	2.56	1.141	2	2.46	1.286	5
R_{16}	Delays or cancellation of flights	3.60	0.962	3	2.56	1.184	2	2.70	1.346	1
R_{17}	Delayed transport by truck companies	3.33	1.110	11	2.24	1.019	9	2.59	1.303	3
R_{18}	Delays caused by B/Ls filed by AFFs	3.06	1.072	18	2.07	0.959	12	2.46	1.286	5

of flights (R16),' respectively. Contrarily, the means of latter three ones are 'improper temperature control causing cargoes to spoil (R7),' 'insufficient warehouse space (R9),' and 'improper humidity control causing cargoes to spoil (R8),' respectively.
(3) The means of the top three factors of risk severity are 'delays or cancellation of flights (R16),' 'insufficient strength or poor quality of packaging materials (R12),' and 'delayed transport by truck companies (R17),' respectively. Contrarily, the means of latter three ones are 'mistakes made by forwarders' OP personnel in their reservation of cargo space (R6),' 'false customs declarations by customs brokers (R4),' and 'negligence by AFFs' OP personnel in B/L-related work (R_5),' respectively.
(4) According to the risk frequency and risk severity in Table 2, the risk matrix for temperature-controlled cargoes of orchids can be drawn as shown in Figure 1. In order to facilitate the identification of relative importance of each risk item, the risk levels are divided into three areas according to Shang and Tseng's advices (2010). They are low-risk area, medium-risk area, and high-risk area, respectively. Finally, the position of each risk factor item can be shown in Figure 1.
(5) In summary, (i) thirteen risk factors, that is R_2-R_{11}, R_{13}, R_{14}, and R_{18}, place on the low-risk area; (ii) five risk factors, that is R_1, R_{12}, and R_{15}-R_{17}, place on the medium-risk area; and (iii) there are no risk factor places on the high-risk area.

DISCUSSION

While considering the actual situations with occurrences in the process that AFFs delivering temperature-controlled cargoes of orchids at different risk attribute in this paper, the risk strategies for various risk items are obtained by related literature (Baranoff, 2004; Chen, 2007; Shang and Tseng, 2010; Vaughan and Vaughan, 2007; Yang, 2010) and then interviewed and discussed with experts of AFFs and scholars in Taiwan. We conclude that when the risk severity of loss is high; however, the risk retention is not realistic in the practice. On the other hand, when the high probability of loss occurred in a specific incident, the insurance is a costly expense. Some

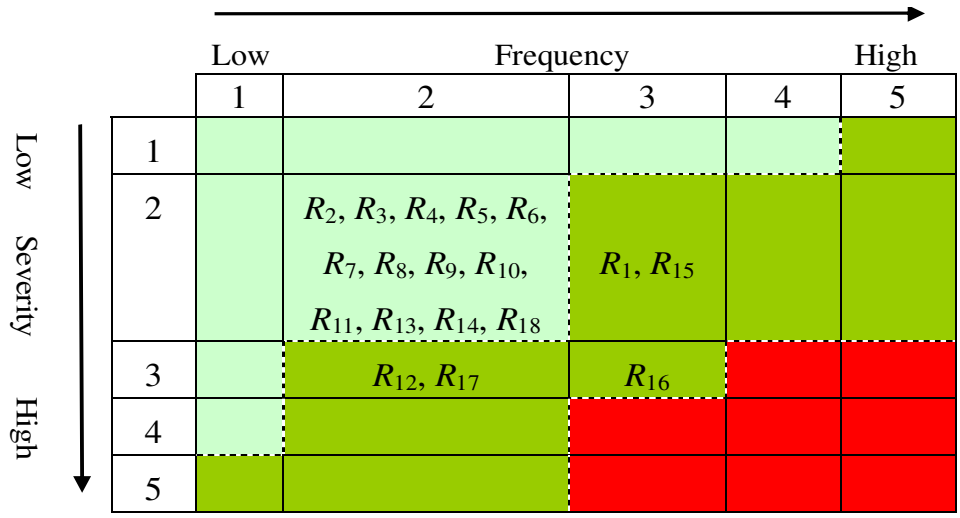

Figure 1. The risk matrix.

techniques of risk solutions are necessary for risk strategies. At first, those risk strategies characterized by high frequency and low severity are most appropriately dealt with risk prevention to lower the potential probability.

Secondly, these ones with low frequency and high severity are most properly used in risk reduction to minimize the aggregate amount of losses that must be borne. Meanwhile, those ones we can cope with risk transfer to shift risks to the third party, e.g. insurance contract or disclaimer agreement. In short, the principle of risk strategies can be divided into three categories of risk prevention, risk reduction, and risk transfer as described below:

1) Risk prevention. The attempt of risk countermeasures to reduce the possibility of loss which is the strategy before the occurrence of an accident. For example, the strengthening of on-the-job training, the thorough implementation of SOP, and so on.
2) Risk reduction. The attempt of risk countermeasures to reduce the impact after the loss occurrence which can be applied before or after the accident occurrence. For example, the maintenance of temperature-controlled equipment, the intensification of packaging, and so forth.
3) Risk transfer. To undertake the risk of loss. The risk countermeasures of risk transferring to others through insurance contracts or otherwise before the accident. For example, risk transfer through insurance contracts, the addition of disclaimer agreement in transport contracts, etc.

In summary, we used the aforementioned concepts, the principles of risk management strategies can be adopted by different risk factors, as shown in Table 3. It is suggested that these risk strategies can be applied to the AFFs when they are operating the temperature-controlled cargoes of orchids in the shipments of transport process in Taiwan. Nevertheless, these strategies of transport risk could be widely different among various industries.

Conclusions

Due to the fact that there were very few academic studies conducted in this field, how the AFFs can work out various improvement measures for the risks involved in the process of orchids' air transport has become an urgent task. Hence, the aim of this research is to evaluate the risks faced by AFFs in their transportation of temperature-controlled cargoes of orchids in Taiwan. At first, this paper offers description on three steps of risk assessment. With regards to risk identification, a total of four dimensions with eighteen preliminary risk factors are generated from literature and experts interviews. With regards to risk analysis and evaluation, a RMM using an AS/NZS 4360 model has been constructed through risk frequency and risk severity, in order to place risk degree. Finally, a survey is empirically studied. The results show that:

(1) The top factor of perceived risk is delayed shipments caused by climate factors. Contrarily, the last one is delays caused by bills of lading filed by forwarders;
(2) The top factor of risk frequency is insufficient air cargo space on aircraft. Contrarily, the last one is improper humidity control causing cargoes to spoil;
(3) The top factor of risk severity is delays or cancellation of flights. Contrarily, the last one is negligence by AFFs' OP personnel in B/L-related work (R_5); and
(4) In summary, thirteen risk factor places on the low-risk area; five risk factor places on the medium-risk area; and there is no risk factor place on the high-risk area.

In addition, recommended principles of risk management strategies according to the risk area of various risk factors' occurrence were given in this study. However, the evaluation of risk management costs and benefits was not

Table 3. The adopted strategies for risk factors.

Risk factors		Risk strategies		
		Risk prevention	Risk reduction	Risk transfer
R_1	Cargo damages caused by car accidents when truck drivers are carrying the goods	√		√
R_2	Improper operations by forklift truck operators	√		
R_3	Improper ways in which warehouse workers move or stack cargoes	√		
R_4	False customs declarations by customs brokers	√		
R_5	Negligence by AFFs' OP personnel in B/L-related work	√		
R_6	Mistakes made by AFFs' OP personnel in their reservation of cargo space	√		
R_7	Improper temperature control causing cargoes to spoil	√	√	
R_8	Improper humidity control causing cargoes to spoil	√	√	
R_9	Insufficient warehouse space	√		
R_{10}	Trucks with improper temperature control equipment	√		√
R_{11}	Insufficient air cargo space on aircraft	√		
R_{12}	Insufficient strength or poor quality of packaging materials		√	√
R_{13}	Disputes caused by consignors' false on customs declarations	√		√
R_{14}	Cargo damages caused by incomplete documents supplied by consignors	√		√
R_{15}	Delayed shipments caused by climate factors		√	
R_{16}	Delays or cancellation of flights	√	√	
R_{17}	Delayed transport by truck companies		√	√
R_{18}	Delays caused by B/Ls filed by AFFs	√		

done in this study. The discussion of the cost-benefit analysis would be worthwhile. Note that part of it would require some discussion on the damages caused by different risks. For example, some risks would destroy the entire shipment whereas others would only damage 10% of it. It would also require discussion of the costs of prevention. For example, worker training can be cheap compared to re-routing flights around poor weather.

Therefore, it is suggested for follow-up studies of risk cost-benefit analysis to focus on the risk reduction with effective risk management methods in a reasonable price. Moreover, this paper focused on the orchids, rather than on the frozen materials or the similar concerns. We think our paper can contribute to the transport risks of the orchids. If the readers are interested in similar cases in the future, they can apply the same procedures on risk management. Hence, the issues related to other products are not mentioned in this study, due to the fact that the research scope focuses on 'orchids.'

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