CUSTOMS BONDED TRUCK SERVICE PROVIDER SELECTION IN AIR TRANSPORTATION CASE STUDY: LAO PDR

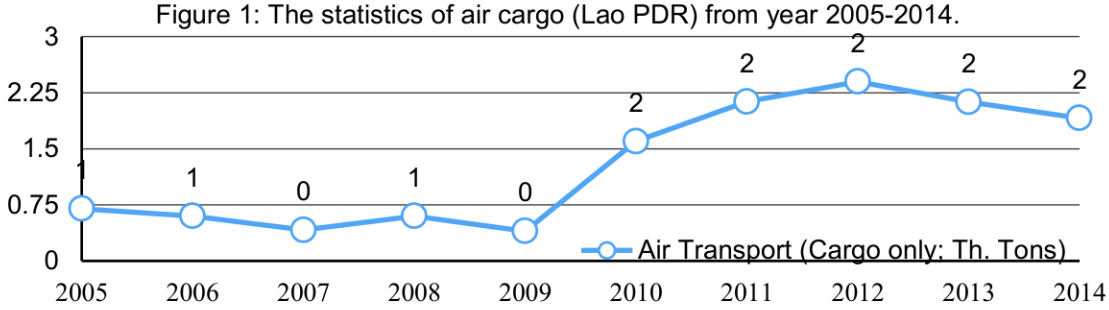
Tipavinee Suwanwong, Apichat Sopadang*

Excellence center in Logistics and Supply Chain Management, Chiang Mai University

Introduction

Theoretically, geography can impact economic development of the country in many ways, especially, the country with landlocked area. Land-locked area refers to the geographical situation of a country without direct access to the sea (Glassner, 1970). According to the world bank data, there are 44 landlocked countries in the world (as 2014). Lao PDR is the only land-locked country in the Southeast Asian region. Being a land-locked country with poor infrastructure has put the limitation to the economic development of Lao People's Democratic Republic (Lao PDR) (Oraboune S, 2008). Figure 1 also show the number of air cargo statistics from year 2005-2014. The data show that from year 2010, even some year dropped because of economic crisis, the number of air cargo increased year by year. The situation of the transportation infrastructure in the landlocked developing countries is updating very slowly, therefore the logistics company needs alternative solutions to ensure the movement of the freight in and out of the country (Kovacs and Spens, 2006). Multi-modal transportation will take part in the logistics system in this kind of situation. The situation that customer's demand is now getting higher and the growth of the speed-to-market product delivery is taking into account. Efficiency related to logistics services that are measured by the logistics service provider's potential in providing timeliness, cost effective, accurate in terms of low levels of losses and risk of damage to the specific location demanded by the shipper and consignees (Nordas and Piermatini, 2004).

Figure 1: The statistics of air cargo (Lao PDR) from year 2005-2014.



Air transportation (Cargo only): As cargo commodities are worth to deliver in timely basis while all airlines have very limited cargo space. There is only narrow-body aircrafts could operate. Thereby, an alternative to expand air cargo carriage by road feeder service will enhance such limited cargo space. In case of Lao PDR, Table 1, according to Lao Japan Airport Operator, show the number of airline operated by narrow body aircrafts and major cargo commodities. According to ICAO (2004), *Narrow bode aircraft* is an aircraft having only one aisle in the cabin with passenger seating divided into two axial groups and capable of carrying bulk cargo only. As mentioned above, this will lead to the other alternative for the transportation which is Air-to-truck transportation.

Number of Airline (all narrow body aircrafts)	Air Asia-AK/A320 , Thai Airways-TG/B737-400, T'way Airlines-TW/B737-800, China Eastern Airlines-MU/B737-700, Bangkok Airways-PG/A319, Vietnam Airlines-VN/A321
Major cargo commodities in general	Electronics, Machineries, Spare parts, Vaccineries

Table 1: Airline operated by narrow body aircrafts and major cargo commodities.

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Literature review

There are many studies about the landlocked countries and their economics. According to Banomyong (2010), the study highlighted the key issues that are affecting the integration of four countries (Cambodia, Lao PDR, Myanmar and Vietnam) from a logistics point of view and used Lao PDR as a case study of limited logistics connectivity. Be a land-locked country, there are number of limitations such as infrastructure — poor transportation. In case of transportation, Air transportation is the one option. In Lao PDR, logistics service providers are involved in the activities. Many studies have analysed the extent of the logistics service provider involvement in various logistics activities (La Londe and Cooper, 1989). Mode and carriers selection are the one of decision-making process in transportation that includes identifying relevant transportation performance variable, selecting mode of transport and carrier, negotiating rates and service levels, and evaluating carrier performance (Monczka et al., 2005).

The decision for the determination and selection of strategic partners creates a multiple criteria problem that changes from time to time (Ding and Liang, 2005). The goal of the multiple criteria decision-making (MCDM) method is to support decision makers in merging objective measurements with the valuable assessment that are based not only on individual opinions but on collective group ideas (Belton and Stewart, 2002), in order to choose the best alternative, that is, the one with the highest degree of satisfaction (Jacanbarg et al, 2012). Methods such as the weighted point method (Timmerman, 1986) or the matrix approach (Gregory, 1986) are applied to evaluate the qualification of the service providers. There are many different studies associated with service provider selection or supplier selection in any mode of transportation either sea or air or even location selection that have been commonly carried out by using MCDM techniques. AHP, was first developed by Saaty (1980), integrates specialists' opinions and evaluation scores into a simple hierarchy system. Yahoo and Kingsman (1999), applied AHP for rating the vendor for entrepreneur development programme. Tsaur at al., (2002) applied the fuzzy MCDM in order to evaluate the airline service quality.

Fuzzy Analytic Hierarchy Process (FAHP) applied fuzzy logic to basic AHP. Kahraman et al. (2003) used fuzzy AHP to select the best supplier from for the white good manufacturer. Zakir et al. (2009) also use the method the to select the third party logistic service providers. Golam, (2012) used fuzzy AHP and TOPSIS method to select the third party logistics service provider. Ding and Liang, (2005) also used fuzzy MCDM to select partners for strategic alliance for liner shipping. For the location selection such as selecting a site for a logistical centre on factor and methods (Chen and Liu, 2006), logistic centre selection with fuzzy-AHP and Electre Method (Ghoseiri and Lessan, 2008) and multi-modal hub location (Ashayeri and Kampstra, 2002). In 2013, Ayhan also used Fuzzy AHP for supplier selection. These methods can provide a better outcome in using complex, multi-dimensional data to solve decision making problems for selecting service provider. In this study, there are many criteria that are unclear, therefore, Fuzzy-AHP under Multiple Criteria Decision-Making (MCDM) theory will provide the comprehensiveness and reasonableness strengthen of the decision making process.

Research Methodology

This section will apply Fuzzy-AHP to evaluate the criteria and find the optimal solution. Assess to the data in the country is very difficult (Banomyong, 2000). In order to collect the data in this manuscript, this was assisted through the support from Lao Japan Airport Operator and Cargo space management and load planning department at Thai Airways International Public Company limited. Because of the time limited, the questions were distributed by emailing the person who are in charge of the activities. The question format is divided into two parts;

*Part one f*or *Lao Japan Airport Operator:* The question was utilized to get more entire picture of the current situation of air transportation in Lao PDR, especially, the general data that are not available in public.

Part two for Cargo space management and load planning department at Thai Airways International Public Company limited : The question was focused on the truck service provider criteria, how the current selection criteria being used, and the criteria weighted. The question was generated to five divisions which are Network Planning and Support division, Europe and Australia Division, Transpacific and North Asia division, Regional and Domestic division, and Alliance and Interlines division.

Criteria evaluation

The multiple criteria evaluation problem focuses on a set of feasible alternatives and considers more than one criterion to determine a priority ranking for alternative implementation (Tsaur et al.,2002). Three general criteria - time, cost, and risk - are emphasised by nearly all the studies as the most important criteria for selecting an agent (McGinnis er al., 1981; Mentzer et al., 1989; Cakravastia and Takahasiy, 2004). Table 2 show the evaluation criteria of truck service provider in air cargo transportation.

Main Criteria	Attribute	Measurement	Alternative 1	Alternative 2
Financial term	freight rate from BKK-VTE 6 wheels	value	6 wheels: 72,000	6 wheels: 60,703
Service performance	Fleet *	Number of trucks	10	6
	Schedule (Frequency)	Number of freight	Tue, Fri	M,Tue, Wed, Thrs
	Track and Trace system	scale 1-10 (10 is the best)	GPS	GPS
Trade restriction	Custom formalities	Value	8000	7000
Quality assurance	Damage and loss	No. of claim (2 year history)	4	2
	Insurance coverage	value	Limited of liability THB 10,000,000	Limited of liability THB 10,000,000

Table 2: the evaluation criteria of truck service provider

Fuzzy Analytic hierarchy Process (FAHP)

The AHP is accepted to be a powerful and flexible method for ranking decision alternatives and selecting the best ones when decision maker has multiple criteria. In FAHP, the pairwise comparisons of both criteria and alternatives are performed through the linguistics variables, which are represented by triangular numbers (Ayhan, 2013). The scope of this study, Buckley's method (1985) and Ayhan (2013) is applied to determine the weights for the attribute and alternatives.

Stage 1: As specialist's response, the selection of the attributes will be compared. Table 3 show the triangular fuzzy conversion scale and Table 4 show the pair-wise comparison matrix of the specialist evaluation in attribute level. Track and Trace system (A4) and Insurance coverage (A7) are eliminated because both alternatives have the same level.

Saaty scale (1980)	Linguistic Scale	Fuzzy Triangular Scale
1	Equally important	(1,1,1)
3	Weakly important	(2,3,4)
5	Fairly important	(4,5,6)
7	Strongly important	(6,7,8)
9	Absolutely important	(9,9,9)
2,4,6,8 : The intermittent values between two adjacent scales		

Table 3: The triangular fuzzy conversion scale

The pair wise matrix equation: where; d_{ij}^{k} indicate that k is the decision maker's preference of i criterion over j criterion.

$$\tilde{A}^{K}=\begin{bmatrix} \tilde{d}_{11}^{k} & \tilde{d}_{12}^{k} & \cdots & \tilde{d}_{1n}^{k} \\ \tilde{d}_{21}^{k} & \cdots & \cdots & \tilde{d}_{2n}^{k} \\ \cdots & \cdots & \cdots & \cdots \\ \tilde{d}_{n^1}^{k} & \tilde{d}_{n^2}^{k} & \cdots & \tilde{d}_{nn}^{k} \end{bmatrix} \quad (1)$$

If there are more than one decision maker, preference of each decision maker are average.

$$\tilde{d}_{ij}=\frac{\sum_{k=1}^{k}\tilde{d}_{ij}}{K} \quad (2)$$

	Freight rate	Fleet	Schedule	Tariff	Damage
Freight rate	(1,1,1)	(4,5,6)	(6,7,8)	(1,1,1)	(4,5,6)
Fleet	(1/6,1/5,1/4)	(1,1,1)	(6,7,8)	(2,3,4)	(4,5,6)
Schedule	(1/8,1/7,1/6)	(1/8,1/7,1/6)	(1,1,1)	(1/6,1/5,1/4)	(1,1,1)
Custom formalities	(1,1,1)	(1/4,1/3,1/2)	(4,5,6)	(1,1,1)	(6,7,8)
Damage	(1/6,1/5,1/4)	(1/6,1/5,1/4)	(1,1,1)	(1/8,1/7,1/6)	(1,1,1)

Table 4: The pair-wise comparison matrix of the specialist evaluation in attribute level.

Stage 2: At the second stage, the geometric mean of the fuzzy comparison values of each attribute (3) and the fuzzy weight of attribute (4) is calculated. Also the the averaged and normalized relative weights of attribute

Equation	Example of "Freight rate"
(3) $\tilde{r}_i=\left(\prod_{j=1}^{n}\tilde{d}_{ij}\right)^{1/n}$	=[1×4×6×1×4]$^{1/5}$; [1×5×7×1×5]$^{1/5}$; [1×8×8×1×6]$^{1/5}$ =[2.491,2.809,3.1036]
(4) $\widetilde{w}_i=\tilde{r}_i\otimes(\tilde{r}_1\oplus\tilde{r}_2\oplus\ldots\oplus\tilde{r}_n)^{-1}$ $=\left(lw_{i,}\, mw_{i,}\, uw_i\right)$	=[(2.491×0.126);(2.809×0.143);(3.103×0.164)] =[0.313,0.401,0.508]
(5) $M_i=\frac{lw_i+mw_i+uw_i}{3}$	=(0.313+0.401+0.508)/3 =0.407
(6) $N_i=\frac{M_i}{\sum_{i=1}^{n}M_i}$	=0.407/1.213 =0.335

Therefore, the Geometric means of fuzzy comparison value, Relative fuzzy weights of each attribute, and the averaged and normalised relative weights of attribute are given in Table 5;

Attribute	$\tilde{r}_i$			$\tilde{w}_i$			M_i	N_i
Freight rate	2.491	2.809	3.103	0.313	0.401	0.050	0.407	0.335
Fleet	1.515	1.838	2.168	0.190	0.262	0.355	0.269	0.221
Schedule	0.304	0.332	0.370	0.038	0.047	0.060	0.048	0.039
Custom formalities	1.430	1.634	1.888	0.180	0.233	0.309	0.240	0.197
Damage	0.322	0.355	0.401	0.040	0.050	0.657	0.249	0.205
Reverse	0.164	0.143	0.126					
Increasing order	0.126	0.143	0.164					

Table 5: the Geometric means of fuzzy comparison value, Relative fuzzy weights of each attribute, and the averaged and normalised relative weights of attribute

Stage 3: At this stage, the alternatives should be pair wise again compared with each attribute particularly. Meaning, the analysis will repeat five more time for each attribute. The processes are the same, it will start back again from the beginning. Therefore, the normalized non-fuzzy relative weights of each alternative for each attribute are given in Table 6;

Alternative	Freight rate	Fleet	Schedule	Custom formalities	Damage
A1	0.126	0.831	0.168	0.126	0.545
A2	0.875	0.168	0.831	0.875	0.456

Table 6: The normalised non-fuzzy relative weights of each alternative for each attribute

Using Table 5 and 6 together, each attribute will present the individual score as shown in Table 7;

Criteria	Attribute	Weights	Scored of Alternatives	
			Alternative 1	Alternative 2
Financial term	freight rate from BKK-VTE : 6 wheels	0.335	0.126	0.875
Service performance	Fleet	0.221	0.831	0.168
	Schedule (Frequency)	0.039	0.168	0.831
Trade restriction	Custom formalities	0.197	0.126	0.875

Quality assurance	Damage and loss	0.205	0.545	0.456
Total			0.361	**0.627**

Table 7: Aggregated results for each alternative

According to the results, Alternative 2 is with the best score, therefore, it is recommended as the suitable truck service provider among two of them.

Conclusion

According to various criteria, service provider is the significant task for the firms. Because of the huge budget and customer satisfaction are involved, the firms need to find the best way to evaluate those fuzzy criteria. Therefore, the techniques are developed for this goal. AHP technique is used to delegate the fuzzy logic. The studied have demonstrated a methodology for evaluating the truck service provider for airline, in order to transfer the product to the land-locked country — Lao PDR by using Fuzzy AHP model. The above analysis shows that the model employ to solve the truck service provider problem in the airline company. There are 7 criteria, namely, freight rate, Fleet, Schedule (Frequency), Track and Trace system, Custom formalities, Damage and loss, and Insurance coverage. As mentioned, no need to evaluate the criteria; Track and Trace system and Insurance coverage because there both have the same level. As the result of the case study, the alternative 2 surpass the other one.

Using this formulation, the airline can easily test a number of what-if scenarios. For future research, it would be worth wide to implement the FAHP model with an airline decision makers. The airline with have a reliable tool to select truck service provider in order to expand its network to offline station.

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