

The Impacts of Kunming-Bangkok expressway: Logistics Channel Analysis

Poon Thiengburanathum
Dept. of Civil Engineering, Chiang Mai University

Ruth Banomyong
Faculty of Commerce & Accountancy, Thammasat University

Apichat Sopadang
Dept. of Industrial Engineering, Chiang Mai University

Abstract

The Kunming-Bangkok expressway is expected as an important infrastructure in this region. This logistics infrastructure functions as a land bridge between China and the ASEAN countries, particularly in Thailand. Once the project is fully functional, significant impacts can be anticipated, such as shifts of transportation mode, short and long term of economic and cultural changes. A schematic model is presented in this paper as a schematic decision making tools for evaluating transportation mode and route selection. This model is grounded on Stochastic and Analytical Heretical Process (AHP) techniques. The dimensions of cost, time, and reliability of service are integrated as key performance indices of the logistics system. Each business type has different kinds of requirements. The results show this expressway will be a major logistics channel between Thailand and the Southern part of China.

Introduction

Historically, the flows between Kunming and Bangkok have been recognized. However, traveling on the Mekong river was very rare at that time. People rather connect one and other by sea or air travels. The highland geology and political differences are the main obstructions (Berman, 1989). Improving the logistics infrastructure between these two cities has been a dream of many people in this region for a longtime. The Kunming-Bangkok expressway is expected to be the first importance jigsaw of logistics breakthrough.



Figure 1: Overall Asian Highway routes (United Nation, 2001)

The Kunming-Bangkok expressway involves four countries, such as the People's Republic of China, Lao People's Democratic Republic, Myanmar, Thailand. It stretches south from Kunming to Jinghong and traverse the border at Jinghong into Laos. It crosses through highlands in southern Yunnan and Laos before entering Thailand, in which it continues southward until it reaches Bangkok.

This expressway is a part of Asian Highway project (initiated in 1959, that has a main goal for the integrated Asian Land) (United Nation, 2001). Asian Development Bank (ADB) plays a main role in initiating and supporting this project in several forms (e.g. loan offering and cross-border transport agreement coordinating).

It is expected to open in year 2008. The significant impacts can be anticipated, particularly in transportation mode and route. Therefore, this expressway is a part of whole scheme of globalization. This study reviews the basic characteristics of these infrastructures and also develops a schematic model to approximate behaviors of goods flows via different perspectives of demand types. "The Kunming-Bangkok expressway will create major change in this region in both economic and social paradigms" is set as a hypothesis of this study.

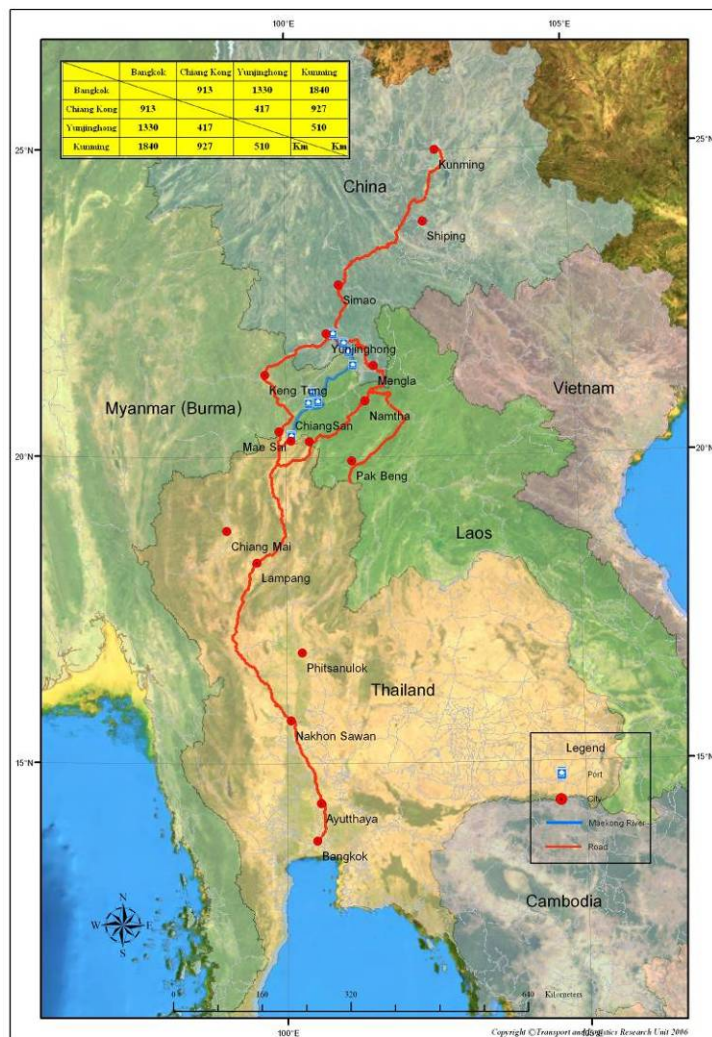


Figure 2: The Kunming-Bangkok expressway

The Kunming-Bangkok Routes

To connect Kunming and Bangkok within the continent, the Kunming-Bangkok routes are necessary. The Kunming-Bangkok expressway is referred as the last of the three routes that enables this integration. There are the follows: (Figure 2 and 3)

- 1) Bangkok- Chiang Rai-Mai Sai-Keng Tung-Mong La-Mengghi-Yunjinghong-Kunming
- 2) Bangkok- Chiang Rai-Chiang San-Mekong River-Yunjinghong/Kuanlei-Kunming
- 3) Bangkok- Chiang Rai-Chiang Khong-Luang Namtha-Boten-Mohan-Kunming



Figure 3: Alternatives Routes between Thai and China

The Bangkok-R3W-Kunming Route

The first Kunming-Bangkok route starts from Bangkok to Chiang Rai, running on the 830 km. four lane highway, which is the main north-south highway of Thailand. Then, it goes from Chiang Rai to a Thai's border town, named Mai Sai, on the 60 km. four lanes highway. After that, it passes a border bridge to a Myanmar's border town, named Tachilek, which is the starting point of a major highway named R3W(R3B).

This first part of R3W locates in Myanmar. This section is two-lane two-way 253 km, starting from Tachilek to Keng Tung, and to Mong La. Although, the construction work is completed, the quality is still under the standard of international highway. However, small to medium trucks are capable of transporting via this route (see Figure 4). This route is on the Wa state in Myanmar. There are several fee stations for collecting transit taxes along this route. Especially on the section of Tachilek to Keng Tung, most taxes belong to the company that built the road.



Figure 4: Road Condition and Typical Transportation in the Myanmar R3W highway (Banomyong et al., 2006)

The last section of R3W is Mong La to Yunjinghong, 140 km two-lane two-way highway. The road is still under improvement. Figure 5 shows the road condition of the China's two-lane two-way highway, which illustrates the China readiness.



Figure 5: the road condition of the R3W China's Two-Lane Two-Way highway near Yunjinghong (Banomyong et al., 2006)

Then, the last section of the Bangkok-R3W-Kunming route is the route 540 km R3 highway, which links Yunjinghong and Kunming. From Yunjinghong to Xuxi the highway is four-lane two-way and from Xuxi to Kunming is six-lane two-way. Figure 6 illustrates the road condition of Yunjinghong to Xuxi. Within the year 2007, China aims to finish the improvement of this highway by making it better and shorter.



Figure 6: the road condition of the R3 highway, Four-Lane Two-Way highway near Yunjinghong (Banomyong et al., 2006)

Although the construction of this route has been significantly completed a few years ago, most merchants and logistic service providers are reluctant to use this route. The major barriers are located in Myanmar, which are 1) Myanmar political issues. 2) Policies of transit fee, and 3) Quality of the highway. The minor barriers are

international logistics collaborations, which have been on the process of improvement (e.g. Cross-Border Transport Agreement).

The Bangkok-Mekong-Kunming Route

The Bangkok-Mekong-Kunming route also uses the 830 km. Bangkok to Chiang Rai as the first section. Then, the second section is a local highway from Chiang Rai to Chiang San port, which is the Thai major port in the Mekong river. The length is about 60 km. Thai government has a plan to improve this section of highway into a 40 km route and to build the new port in the near-by location.

The third section is Mekong river. All the goods have to be relocated from trucks to ships. The length of this section is about 287 km from Chiang San to Kuwnlei or about 360 km from Chiang San to Yunjinghong. The Yunjinghong port, other than Kuwnlei, is planned for passenger accommodation, but not for commodity transportation. Since the Kuwnlei port is about 75-80 km far from Yunjinghong, the Kuwnlei port is positioned as a strategic port for the area.

After all of the goods pass through the customs process, they are reloaded into trucks or near-by warehouses. The method of loading and unloading between trucks and ships of the Mekong is still of primitive and man-power necessity. The crane and container system is still under the process of development. Then, the last section of this route is the R3 highway, as the same as the Bangkok-R3W-Kunming route. Figure 7 shows Typical China's Port and Cargo Ship in the Mekong River



Figure 7: Typical China's Port and Cargo Ship in the Mekong River (Kuwnlai Port)

Nowadays, this route plays a main part serving the Thai and Yunnan logistics demands, particularly in the bulk commodities. However, this is still not effective, particularly during the first six months (November to May), during which the water levels of the river are low and the transportation capacity of the ships decrease significantly. For the worst case, during the dry season, the river water volume may not be enough for the transportation. However, China succeeded in improving the transportation efficiency of the upper Mekong river from Yunjinghong to Chiang Khong (Upper Mekong Navigation Improvement project).

Risks of transportation in this river are relatively high, no insurance company officially guarantees the logistics services along this river, therefore the transportations normally do carry on during the daytime.

Typically, the travel time between Chiang San and Yunjinhong is about 1 day upstream and 3 days downstream. Most transportation fleets are owned by Chinese, Loa, and Myanmar, respectively. Only skillful captains can effectively manage the ships.

Due to the installation of several dams along the northern part of river, China can now control the transportation flows along this river. Practically, China has the advantages beyond other GMS countries in term of transportations. Furthermore, the issues of environmental impacts for these changes on the Mekong river are still questionable in terms of sustainability and fairness (Berman, 1998).

The most barriers of transportation for this route come from the natural and human factors. They can be summarized as 1) Volume of water during the dry season, 2) Risks due to the obstructions, 3) Environmental Impacts, 4) Political issues. Other barriers, such as infrastructure capability and logistics technologies can be feasibly improved step-by-step.

The Bangkok-R3E-Kunming Route

The last alternative route is R3E highway, which connects Thai and China through the highland of Loas. The first section also starts from the Asian highway, Bangkok-Chiang Rai. While the second section is the highway 1152 and 1020 from Chiang Rai to Chiang Khong. This section is about 110 km long. Chiang Klong, a border city, has no bridge crossing the Mekong river yet. All cars and trucks have to use ferry boats for river crossing. The Chiang Khong bridge is expected to start the construction in the next few years. The ferries reach another side of river at Huay Xay, a border city of Loas.

The third section starts from Huay Xay, Louangnamtha, to Boten. This section is 228 km long. This is the last section that is still under construction. The construction is divided into three parts responsibilitywise: Thai, Loas (supported by ADB), and China. According to the plan, the section will be finished in 2007 (see Figure 8). Boten is the end city of Loas. Another is called Mohan, a China border city. The last section, between Boten and Kunming is about 736 km. If China finish the upgrade and all construction along the section, the distance between Boten and Kunming can be shortened to 688 km.



Figure 8: The construction of R3E

The Bangkok-R3E-Kunming route is expected to be a major logistics route for road transportation (Kunming-Bangkok Expressway). During the R3E section, truck fleet can use this two-lane two-way highway at reasonable speeds, according to the slope, curve, and road conditions (e.g. 40 to 60 km/h at mountain condition). The design is expected to meet the international standards enabling container trucks participation in transportation.

The foreseen barrier of the route is the delay of the Mekong bridge construction crossing at Chiang Khong. However, the ferry boat can be temporarily utilized though causing a system bottleneck.

The characteristics of Kunming-Bangkok route can be summarized as shown in Table 1. Although the distances of these three routes are not significantly different, each route has its own peculiarity. Presently, the Mekong river route is the major logistics route. On the other hand, due to the Myanmar political issues and the transit fee, the R3W route is rarely used. When the R3E section is completed, this Bangkok- -Kunming expressway is hypothesized of bringing major changes into this region.

Table 1: Basic Characteristics of Kunming-Bangkok Routes

Logistics Infrastructure		Route Choice (Distance, km)		
		through Myanmar (R3W)	via Mekong River	through Loas (R3E)
Bangkok-Chiang Rai	4 lanes highway	830	830	830
Chiang Rai – Mai Sai	4 lanes highway	60		
Chiang Rai – Chiang San	2 lanes highway		60	
Chiang Rai – Chiang Khong	2 lanes highway			110
R3W	2 lanes highway	253		
Mekong River	Mekhong River w/ Port		360	
R3E	2 lanes highway			228
R3W/R3: Tachilek, Mong La, KunMing	6, 4, and 2 lanes highway	674		
R3: Yunjinghong to KunMing	6 and 2 lanes highway		534	
R3E/R3: Boten/Mohan to KunMing	6, 4, and 2 lanes highway			688
		1817	1784	1856

Remark: Approximated distances after all projects is completed in 2007

Modeling Methodology

Typically, in analyzing the behavior of mode choice in transportation, econometric formulation (e.g. logit and probit model) is used. This method has several advantages, particularly in the detail analysis level. However, it has several drawbacks, in term of computational and data requirements, that the standard discrete choice models are immense. This study suggests a schematic model for analysis mode choice that is based on the Analytical Hierarchy Process (AHP) concept. Banai-Kashani (1989) proposed the application of AHP in near-by domain. (i.e. a procedure for the problem of

multimodal urban corridor travel demand estimation by using the Analytic Hierarchy Process). He noted that the AHP approach deals efficiently with multidimensionality, nested demand structure and discrete travel decision making behavior. Liberatore (1995) successfully applied this method in the transport carrier and mode selection problem.

This study extends this concept for the logistics flow path problem, which considers route and mode selection. The model consists of three main parts: system assessment, AHP, and sensitivity analysis (see Figure 9). A network mode represents a logistics infrastructure system, including arches and nodes. Arches represent potential logistics route that normally are lowest transportation cost (e.g. shortest path). Nodes stand for major cities or economic hubs. The information from the assessment part is used the AHP for evaluating choices. After that, sensitivity analysis can be applied.

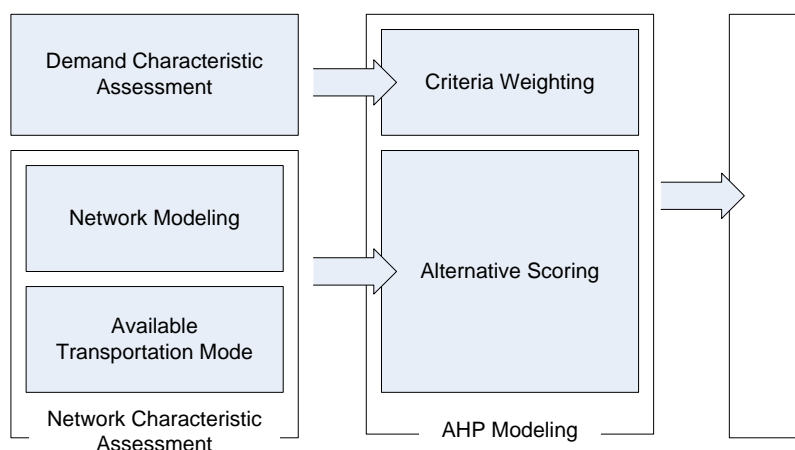


Figure 9: Modeling Framework

This methodology can be extended from deterministic to stochastic level of analysis by using Monte-Carlo technique. Stochastic modeling can give flexibility in terms of subjective judgment of inputs.

Logistics Infrastructure Modeling

To have an insight in the logistics between Bangkok and Kunming, a network model of the logistic infrastructure system is formulated, as shown in Figure 10. Bangkok and Kunming are the primary economic hubs of Thailand and Yunnan, respectively. Chiang Mai is the secondary economic hub that locates between these two cities. Chiang Rai and Yunjinghong are defined as gateway cities. Each of these has its own border and port cities, such as Mai Sai, Chiang San, Chiang Khong for Chiang Rai and Kuanlei for Yunjinghong. These figures imply the confrontation of two economic zones: Chiang Rai and Yunjinghong economic zones. Figure 11 shows the Kunming-Bangkok routes (e.g. R3W, Mekong river, R3E) and also the other modes of transports, such as airway and seaway.

According to the model, the channels from Bangkok to Kunming are simplified as 1) Airway, 2) Seaway, 3) Continental link via R3W, 4) Continental link via Mekong

river, and 5) Continental link via R3E. Approximated details of the channels are set up as shown in Table 2.

Key Performance Indexes of A Logistics System

This study suggests four main indexes for selecting proper logistics links: cost, time, reliability of service, and safety of service. Cost refers to net logistics cost (e.g. transportation, tax, logistics service costs, etc.). Time stands for total travel time (e.g. transportation time, idle time, custom processing time, etc.). Reliability of service means ability to delivery on-time. Safety of service refers to chance of damaging or defecting of packages due to transportation.

Access to data in the ASEAN region is quite difficult, particularly in the border zones (Banomyong, et al., 2002). According to the nature of data sources and limited assessment, this study measures the data in both quantitative and qualitative ways.

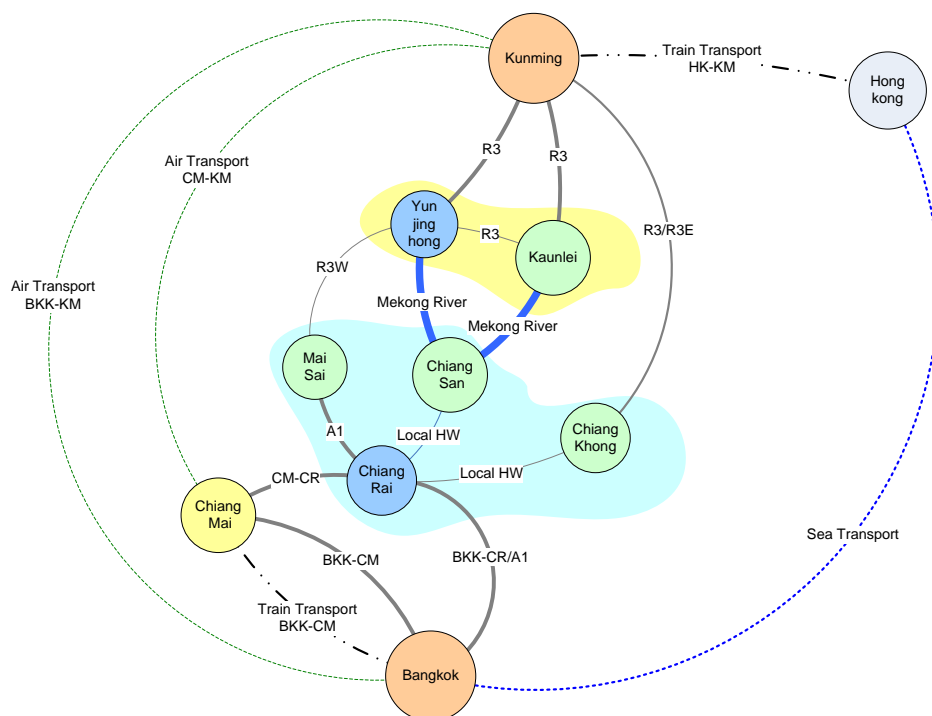


Figure 10: A Network Model of Bangkok-Kunming Logistics Infrastructure

Table 2: Examples of Logistics Performance for Each Channel

	Cost (Bath/Ton)	Time (days)	Reliability of Service*	Safety of Service*
Airway	40000	0.5/1	5	5
Seaway	2000-6000	12-16	4	4
Continental link				
R3W	n/a	n/a	2	3
Mekong River	8000-10000	4-10	3	2
R3E	3000-4000	1-2	4	4

Remark * Subjective Assessment

For the continental link, variability of cost is relatively high, particularly in the part of border and China sections. The cost typically depends on marketing mechanism and bargaining power (e.g. volume of order and relationships between customer and providers). For example, the cost of Mekong transportation will be high during the dry season. Variability of delivery time is tentatively high too, typically logistics service providers (LSPs) put high contingency time for their customer. Normally variability locates at custom or any logistics service processes. For the Mekong river, time variability is very high during the dry season.

Analysis and Results

According to the study assessment, the characteristics of each alternative channels are shown in Figure 11. Cost and time are quantified and normalized. For the reliability and safety of service, Eigenvector method is used to determine the relative ranking of alternatives (Saaty, 1990). The higher the value, the better the performance.

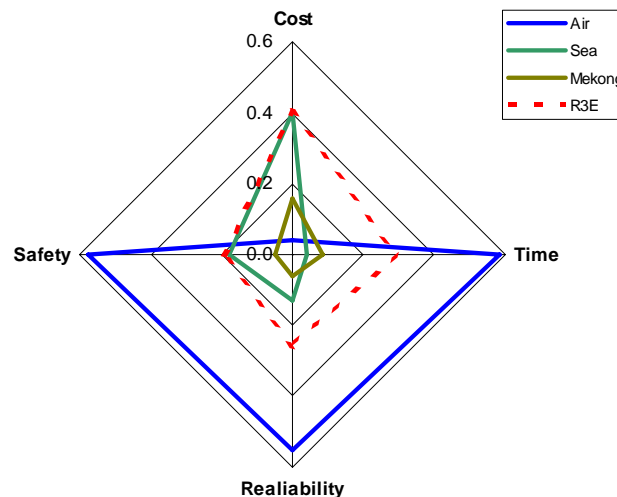


Figure 11: Logistics Performance Assessment of Each Alternative Channel

If the characteristics of logistics demand are cost-oriented (e.g. bulk commodities), the Bangkok-R3E-Kunming and Seaway routes give the highest score, respectively, as shown in Table 3. However, if the characteristics of logistics demand is time-oriented (e.g. flower and handicraft), the Airway and Bangkok-R3E-Kunming routes give the highest score, respectively, as shown in Table 4.

Table 3: Examples of Logistics Performance for Each Channel: Cost-Oriented

Performance Dimensions	Alternative Logistics Channels				Weight, w_i
	Air	Sea	Mekong	R3E	
Cost	0.04	0.40	0.16	0.40	0.609
Time	0.58	0.04	0.08	0.29	0.168
Realiability	0.55	0.13	0.06	0.26	0.139
Safety	0.58	0.18	0.05	0.20	0.084
	0.247	0.284	0.124	0.345	1.000

Table 4: Examples of Logistics Performance for Each Channel: Time-Oriented

Performance Dimensions	Alternative Logistics Channels				Weight, w_i
	Air	Sea	Mekong	R3E	
Cost	0.04	0.40	0.16	0.40	0.058
Time	0.58	0.04	0.08	0.29	0.372
Reliability	0.55	0.13	0.06	0.26	0.372
Safety	0.58	0.18	0.05	0.20	0.198
	0.538	0.122	0.072	0.267	1.000

Figure 12 and 13 shows examples of stochastic perspectives of the logistics channel analysis. Time and cost variability are included. In terms of cost-oriented, the Bangkok-R3E-Kunming route gains higher score than the others; however, it cannot dominate anyone (Figure 13). In terms of time/quality-oriented, the Airway and Bangkok-R3E-Kunming routes are the first two dominant routes.

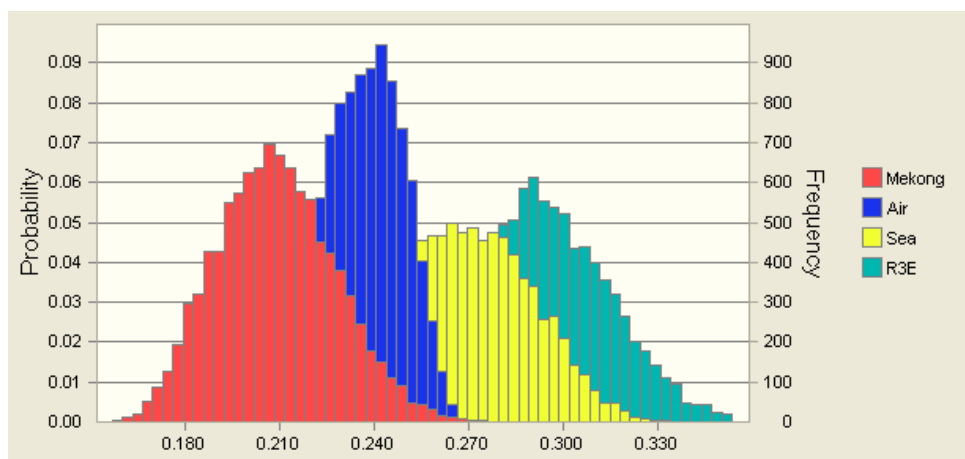


Figure 12: Examples of Logistics Performance for Each Channel: Cost-Oriented

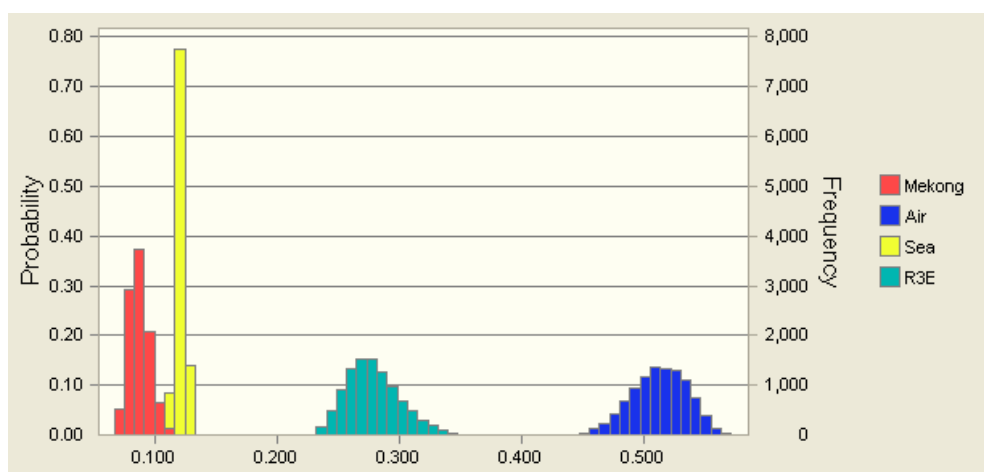


Figure 13: Examples of Logistics Performance for Each Channel: Time-Oriented

Summary

This study illustrates the basic information of the Bangkok-Kunming routes. A network model of the logistics system between these two cities is also formulated. A quantitative methodology, named Analytical Hierarchy Process (AHP), is used to evaluate the potential of these routes. Deterministic and stochastic examples are also presented. According to the assumptions, the results indicate that the Kunming-Bangkok will play an importance role as a new logistics channel for connecting between the main economic cities of Thailand and Yunnan, China. Once the Kunming-Bangkok expressway project is accomplished, This expressway is expected to be a capstone of logistics breakthrough in this region.

References:

- Banai-Kashani, R. (1989), "Discrete mode-choice analysis of urban travel demand by the Analytic Hierarchy Process", *Transportation*, Vol. 16, No. 1, March, 1989, Springer Netherlands, 81-96
- Banomyong R, Iwata S, & Kumazawa K (2002) *Issues in cross-border inter-city freight transport in ASEAN*, Thammasat Journal of Business Administration, Special Issue on Supply Chain Challenges in Asia, 19 November 2002, pp. 59-69, ISSN 0125-233X.
- Banomyong, R., Sopadang, A., Thiengburanathum, P., Taesiriphet, C., Saichan, K. (2006), "A Study of Logistics System of Thailand-Chinese Trade in the Context of ASEAN-China Free Trade Agreement: Case Study of Border and Transit Trade." Progress Report #1.
- Berman, M. L. (1998), "Opening the Lancang (Mekong) River in Yunnan: Problems and Prospects for Xishuangbanna," Master Thesis, University of Massachusetts Amherst, USA.
- Liberatore, M. (1995). "A decision support approach for transport carrier and mode selection". *Journal of Business Logistics*,
- United Nations (2001), Asian Highway: the Road Networks connecting China, Kazakhstan, Mongolia, the Russian Federation and the Korean Peninsula, Policy-level Expert Group Meeting, 10-12 October, Bangkok.
- Winston, W.L. (1994), *Operations Research: Decision Making*, 3rd Edition, Thomson Learning, China

