

Empirical Study of Multimodal Transport Route Choice Model in Freight Transport between Mongolia and Korea

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Abstract : According to the globalization of world economy on distribution and sales, logistics and transportation parts are playing an important role. Especially, they have to decide what is the key factor of route choice model and how to choose the right transport route in multimodal transport system. By considering the key factors in route choice model for freight forwarders between Mongolia and Korea, this paper propose 4 main factors: Cost, Delivery time, Freight and Logistics service with 13 sub factors. The importance of factors is surveyed base on AHP through interview with freight forwarders. In results, the empirical insights about current status of Mongolian forwarders are provided with different factors between transportation modes. Especially, the Time factor is a role factor to choose transport route for air transportation forwarders.

Key words : multimodal transport, transport route choice model, freight transport, Analytical Hierarchy Process(AHP)

1. Introduction

In recent years, multimodal transportation has been used for freight transportation in global cooperation, worldwide trade, distribution and sales. Due to the necessity of logistics service providers and forwarders, their high competitiveness for choosing a suitable multimodal transportation have been increased. Also in multimodal transportation, there is an important relationship between consignees and consignors and it has been effected the right transport route and mode selection.

Last literatures has been focused on ship owners and consignee's for port selection issue (Murphy et al. 1991, Gibson et al. 1993, Murphy and Daley 1994) and some of the researchers focused on freight forwarders (Slack 1985, Bird and Bland 1988, De Langen 2007). And few studies have identified and examined the factors which determine route choice by communication, safety, economy factors, freight value, cost, image, reliability and other (Slater, 1982; D. Murphy and P. Hall, 1995).

On the other hands, Mongolia is a rich for natural resources: mining, leather products and so on. On the location between big economic countries: Russia and China, but it makes expensive logistics cost and long delivery time to transport into Korea even though Mongolia has established the Mutually Complementary Friendly Relations

and Cooperation with Korea.

Korea is highly developed country in Asia that has a good structure in logistics system and international trade. By the international cooperation of Mongolia and Korea trade started in 1985, the international trade is continuously increasing year by year.

In view point of logistics service providers and freight forwarders between Korea and Mongolia, there have 3 kind of main routes: by only air cargo, by mixture shipping and railway through China and by mixture shipping and railway with Russia. Those complicated transportations are required to get an optimal solution for freight forwarders with considering delivery time, logistics cost, freight type and logistics service level.

Only few researchers had evaluated criteria for multimodal transport route selection issues. Slater(1982) researched route choice models with 3 factors. D. Murphy and P. Hall(1995) considered reliability, freight rates, transit time, carrier considerations, shipper market considerations, short and damaged factors. Kim S.Y et al(2006) has evaluated route selection criteria. However these studies only focused on shippers and consignees.

In this study, we will focus on determine what kind of criteria is important to choose a transportation route for forwarders between Korea and Mongolia, and identify difference of main and sub factors ranking on air and

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shipping transportation. To do this, AHP methodology for freight forwarders is applied with 4 main factors: Cost, Time, Freight and Logistics service with 13 sub factors for selecting the route and mode of multimodal transports between and Mongolia and Korea.

First, we will collect and assess literature review and then, describe problems and disadvantages of transportation between Korea and Mongolia. Second, we will also describe the definition of survey variables based on literature review and survey a questionnaire for forwarders. Finally, the analyse of AHP methodology is applied and summarize main results.

2. Literature Reviews on Mongolian logistics

2.1 Literature reviews

Some researches have studied about Mongolian logistics to determine current status of Mongolian logistics and identification. Urtnasan(2013) determined the advantage of Mongolian location for deciding Eurasian trade hub. Hurelbaatar B(2012) studied the activation plan of Mongolian logistics politic and regional hub role. Boldbaatar T, Yoon D. G(2011, 2012) determined the Mongolian maritime development issues and the current situation of Mongolian logistics. Jang E.K(2010) also determined Korean maritime role in development of Mongolian maritime logistics.

Also some of the researchers studied about Mongolian railway logistics issues. Kim E.H(2009) identified development trends in Mongolian railway system and hardware structural problem. Park E.G(2010) studied TMGR(Trans Mongolian Railway) and TKR(Trans Korean Railway) connection and its expectation on international transportation route for export mineral resource in Mongolia. Lastly, Kim H.J and Yoon S.H(2010) applied the activation plan of Mongolian logistics need to construct infrastructure with network system.

The previous study determine and applied only activation plan of Mongolian logistics in maritime and railway fields. For efficient and beneficial cooperation between Korea and Mongolia we need more specific and detailed research about Mongolian logistics and transportation route.

2.2 Current status of Korea and Mongolia freight flows

The territory of Mongolia is located in the Northeast

part of Asia, neighboring with Russia and with China, comprises 1,564,100km² of territory landlocked country. Mongolia is divided administratively into 21 Aimags (provinces) and the capital city Ulaanbaatar. Mongolia possesses significant reserves of coal, copper, gold, tin and uranium. At present, Mongolian government tries to protect itself from the losses that could be incurred by creating logistics policies and strategies that are excessively lucrative; but it could bring rapid development while it evaluates to move forward in order to develop a sustainable logistics industry.

Trade between Mongolia and Korea was started in 1982 when Korea imported fiber raw material from Mongolia. Figure 1 shows statistical review of Mongolia and Korea export and import status during 1995 to 2013 (Mongolian Customs, 2014).

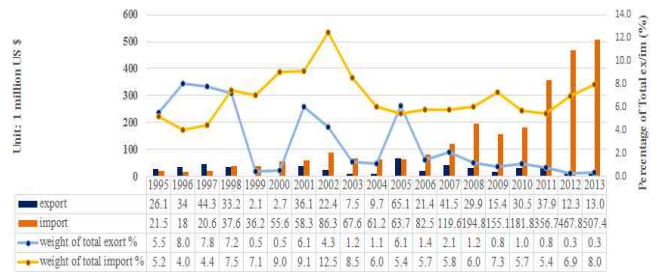


Fig. 1 Mongolia · Korea export and import

The freight transportation model between Korea and Mongolia involves many modes of transport. The direct model from Korea to Mongolia is basically by air plane and the indirect model is by maritime and railway through China or Russia. Figure 2 shows current transport route and its freight transportation model between Korea and Mongolia.

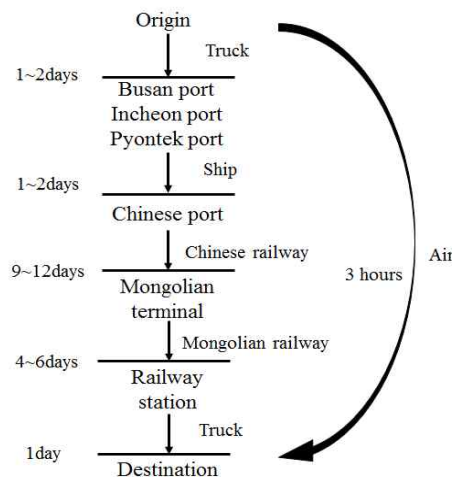


Fig. 2 Transportation route between Korea and Mongolia

Current freight transportation model shows that total delivery time taken is 14 - 20 days, and its cost is 3,700\$ - 4,800\$ in multimodal transport route(Ministry of Roads, Transport, 2014). By using air transportation it takes only 3 hours flight time but there need to pay higher cost.

3. Research Methodology

3.1 Transport route choice model

The most of the shipping flow activities related to the selection of the carrier and the ship owners have been studied with respect to the designation of the port. Those research has attempted to identify and explain the various factors in shippers' port choice using various methodologies. Such study includes Murphy et al.(1991, 1992), Gibson et al.(1993), Murphy and Daley(1994), Mangan et al.(2002), Tiwari et al.(2003), and Ugboma et al.(2006). Some of the results are focused on freight forwarders and exporters by Slack(1985), Bird and Bland(1988) and De Langen(2007).

Few of researchers had an evaluation criteria for multimodal transport route selection issues. Slater(1982) researched route choice models with 3 factors: management factor, transport route characteristic, route condition factor. D. Murphy and P. Hall(1995) considered reliability, freight rates, transit time, carrier considerations, shipper market considerations, short and damaged factors. Kim S.Y et al(2006) evaluated route selection criteria as: cost, time, freight characteristics, logistics service factors. Choi C. H (2009) study shows different route choice factors between truck and rail transportation.

3.2 Survey and variables

Previous studies about multimodal transport only have focused on shippers and consignees. However this study will focus on transport route choice model of freight forwarders. This study based on literature review of Kim S. Y et al(2006), Choi C. H (2009), D. Murphy and P. Hall(1995)'s survey variables and definition. Thus, in this paper, 4 main factors with 13 sub factors among freight forwarders between Korea and Mongolia will be considered. Table 1 shows these criteria factors for multimodal transportation route choice model.

AHP(Analytical Hierarchy Process) is a multi-criteria decision-making approach that useful pair-wise comparisons to arrive at scale of preferences among a set of alternatives. Survey variables are measured by Likert 5

point scale (Absolutely important:5, Most important:4, Very important:3, More important:2: and Same: 1), and consistency index and consistence ratio are evident at 0.10 or less of informed judgements(Saaty, 1988). From AHP results, the value that best improves inconsistency will be suggested and decision maker then could refine the information for the criteria.

To apply AHP method, our survey is focused on 26 of Mongolian forwarders, who have the head office located in Mongolia and the branch office located in Korea. We choose forwarders for located area and utilization of Mongolian and Korean costumers. A survey was conducted among a sample of freight forwarders through interview with company officials and general managers, at Seoul and Incheon area's 20 forwarders and 1 of the Busan area. Other 5 forwarders located different area.

Table 1 Survey variables

Main factor	Sub factor	Note
Cost factor	Transportation cost	Include transit cost and holding cost
	Transfer cost	Through China or Russia
	Bordering cost	Handling cost and custom fee through China or Russia boarder
Time factor	Transit time	International transportation lead time
	Transfer time	Time for transfer through China or Russia
	Custom time	Time for passing in custom of other country
	Bordering time	Time for passing another country's terminal and transport time to the destination
	Set time	Appointed delivery time
Freight factor	Heavy freight	Heavy and big freight
	Specific freight	Need specific transportation mode or specific packaged freight
Logistics service factor	Safety	Safety mode of logistics service
	Agility	Rapid delivery system
	Flexibility	Degree of flexibility

4. Analysis Results

The interview respondents include total 21 Mongolian forwarder companies located in Seoul and Incheon in Korea. 5 respondent answers excluded for their C.I and C.R value over 0.1.

Table 2 shows the respondents' statistical information. 50% of general managers worked 1 - 3 years and 31.25% worked 3 - 5 years. Company's gross capital between 10million to 30million won (Korean currency) is 37.5% and over 30million won is 37.5%. Annual sales over 30million won is founded to be the highest(56.25%) and between

10million to 30million won is 25%. Total employers that are less than 20 people is 62.5% and over 20 people is 37.5%. The transportation routes by freight forwarders shows 52.8% airway and 47.2% shipping.

Table 2 Statistical information of respondents

Questionnaire item		Response	(%)
work period	less than 1 year	2	12.5
	1-3 years	8	50
	3-5 years	5	31.25
	5-10 years	1	6.25
	over 10 year	0	0
total gross capital(won)	less than 10 million	4	25
	10million - 30million	6	37.5
	over 30 million	6	37.5
annual sales(won)	less than 10 million	3	18.75
	10million - 30million	4	25
	over 30 million	9	56.25
total employers	less than 10 people	3	18.75
	11-20 people	7	43.75
	21-30 people	4	25
	31-39 people	1	6.25
	over 40 people	1	6.25
Route	Shipping	47.2%	
	Air	52.8%	

4.1 Analysis for main factors

Figure 3 shows result of the main factors for the decision hierarchy. The most important factor affecting forwarder’s route choice decisions are; Time(0.434) and Cost(0.288), the C.I and C.R values are 0.06 and 0.07, respectively.

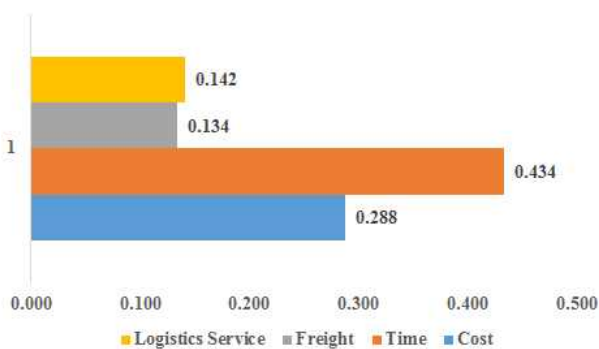


Fig. 3 Importance level for main factors

In results, the Time is the most important factor to choose route to transport between Korea and Mongolia for forwarders, because almost all consignees request to move freight in short time. Previous study (Kim S.Y et al 2006) showed that Cost factor is the most important factor, but in

this study it is the second important factor for forwarders, and then Logistics service factor (0.142) and Freight factor (0.134) are important to choose the transport route.

Table 3 Comparison of air and shipping transportation

Air transportation			Shipping transportation		
	Average	Rank		Average	Rank
Cost	0.234	2	Cost	0.377	1
Time	0.499	1	Time	0.325	2
Freight	0.125	4	Freight	0.153	3
Logistics service	0.142	3	Logistics service	0.145	4
C.I	0.062		C.I	0.067	
C.R	0.070		C.R	0.075	

Table 3 shows the comparison of forwarders airway transportation versus shipping transportation and it shows different priority in each sector.

In air transportation sector, most important factor is Time(0.499) and second important factor is Cost(0.234), third Logistics service factor(0.142) and last Freight(0.125). But, in shipping transportation sector, most important factor is Cost(0.377), second is Time(0.325), third Freight(0.153) and last Logistics service(0.145).

This result shows that the Time factor is 2 times bigger than the Cost factor for forwarders, who use air transportation. Whereas for shipping transportation forwarders, Time and Cost factor are almost same (just Time 13% bigger than Cost).

Table 4 Comparison with company scale

Large scale company			Medium and small scale company		
	Average	Rank		Average	Rank
Cost	0.208	2	Cost	0.337	2
Time	0.522	1	Time	0.381	1
Freight	0.122	3	Freight	0.142	3
Logistics service	0.148	4	Logistics service	0.140	4
C.I	0.063		C.I	0.067	
C.R	0.072		C.R	0.076	

Next comparison is forwarders company scale divided by employers and annual sales. The large scale company include more than 20 employees and annual sales over 30million won, others included medium and small scaled company.

In the result, big scale forwarder company consider that Time (0.522) is most important factor, second important factor is Cost(0.208). The Time factor is 2 times bigger than the Cost factor. But medium and small scale forwarder company consider that Time(0.381) and Cost(0.337) are

almost same value.

In this results, Time is the most important factor in both company scales. But there are some difference from value of Time and Cost ranking. In large scale company, Time is 2 times bigger than Cost factor. Whereas in medium and small scale company, Time and Cost factor have very small difference (0.044). It means both Time and Cost factors are important in medium and small company. On the other hand, Time is the most important factor than other factors (cost, freight, logistics service) in large scaled company.

4.2 Analysis for sub factors

Table 5 shows the comparison of the sub factors analysis. First we divided Cost factor into Transportation cost, Transfer cost and Bordering cost. Result of the pair-wise comparison shows that Transportation cost(0.464) is the 1st rank and Bordering cost(0.269) is the 2nd rank in Cost factor.

Table 5 Importance level and ranking in each sub factors

Main factor		Sub factor		Rank
Cost factor	0.288	Transportation cost	0.464	1
		Transfer cost	0.268	3
		Bordering cost	0.269	2
Time factor	0.434	Transit time	0.204	2
		Transfer time	0.111	5
		Custom time	0.195	3
		Bordering time	0.129	4
		Set time	0.361	1
Freight factor	0.134	Heavy freight	0.490	2
		Specific freight	0.510	1
Logistics service factor	0.142	Safety	0.488	1
		Agility	0.329	2
		Flexibility	0.183	3

Time factor is divided into: Transit time, Transfer time, Custom time, Bordering time and Set time. The pair-wise comparison result shows that Set time(0.3661) is the 1st rank, Transit time(0.204) is 2nd, and Custom time(0.195) is 3rd in Time factors respectively.

Freight factor is divided into 2 sub factors: Heavy freight and Specific freight. The result is almost same. Finally, Logistics service factor is divided into 3 sub factors: Safety, Agility and Flexibility. Result shows that Safety is the first rank (0.488) and Agility is the second (0.329) in Logistics service factor.

Table 6 shows the ranks for important level of each sub factors. The 1st ranking for sub factors is Set time of whole transport route choice criteria. The Set time weight

is 15.7%, second rank sub factor is Transportation cost which is 13.3% and then Transit time 8.8%. Other 63.2% includes Custom time, Bordering time, Transfer fee, Safety, Specific freight, Heavy freight, Bordering time, Transfer time, Agility and Flexibility factors.

Table 6 Total importance level and ranking

Main factor		Sub factor	Weight	Rank	
Cost factor	0.288	Transportation cost	0.464	0.133	2
		Transfer fee	0.268	0.077	6
		Bordering fee	0.269	0.077	5
Time factor	0.434	Transit time	0.204	0.088	3
		Transfer time	0.111	0.048	11
		Custom time	0.195	0.084	4
		Bordering time	0.129	0.056	10
		Set time	0.361	0.157	1
Freight factor	0.134	Heavy freight	0.490	0.066	9
		Specific freight	0.510	0.069	8
Logistics service factor	0.142	Safety	0.488	0.069	7
		Agility	0.329	0.047	12
		Flexibility	0.183	0.026	13

Tables 7 and 8 show the weight and rank for each sub factors in shipping transport and air transport, respectively.

Table 7 Shipping transport importance level and ranking

Main factor		Sub factor	Weight	Rank	
Cost factor	0.377	Transportation cost	0.39	0.15	1
		Transfer fee	0.32	0.12	2
		Bordering fee	0.29	0.11	3
Time factor	0.325	Transit time	0.20	0.06	9
		Transfer time	0.10	0.03	12
		Custom time	0.23	0.08	5
		Bordering time	0.13	0.04	11
		Set time	0.34	0.11	4
Freight factor	0.153	Heavy freight	0.50	0.08	6
		Specific freight	0.50	0.08	7
Logistics service factor	0.145	Safety	0.52	0.08	8
		Agility	0.33	0.05	10
		Flexibility	0.15	0.02	13

For shipping transport sector, Table 7 shows that the first important sub factor is Transportation cost, the second is Transfer fee and third Bordering fee. It seems all of cost factors are important to shipping transport. So this result shows Cost factor is most important than Time for shipping forwarders.

Table 8 shows the priority of sub factors for air transport forwarders. These results are almost same with those of

total importance levels in Table 6.

Table 8 Air transport importance level and ranking

Main factor		Sub factor	Weight	Rank	
Cost factor	0.234	Transportation cost	0.51	0.12	2
		Transfer fee	0.24	0.05	11
		Bordering fee	0.26	0.06	8
Time factor	0.499	Transit time	0.21	0.10	3
		Transfer time	0.12	0.06	9
		Custom time	0.17	0.09	4
		Bordering time	0.13	0.07	5
		Set time	0.37	0.19	1
Freight factor	0.125	Heavy freight	0.48	0.06	10
		Specific freight	0.52	0.07	6
Logistics service factor	0.142	Safety	0.47	0.07	7
		Agility	0.33	0.05	12
		Flexibility	0.20	0.03	13

4.3 Discussion

As results of this paper, Time factor is the most important factor to choose route in transportation between Korea and Mongolia. Especially in air transport forwarders and large scaled company, Time factor is much important than others factors. On the other hand, shipping transport forwarders considered that Cost factor is most important, but there is a slight gap with Time factors. It means that shipping transport regards these factors are both important.

In analysis results of the 13 sub factors, Set time is the most important factor, the second is Transportation cost and third Transit time. And for the air transport forwarders, the priority is the same with total sub factor results. But for the shipping transport forwarders, the priority is different with the results of whole sub factors.

From these results, it will be helpful to design the construction of efficiency transportation routes between Korea and Mongolia.

4.4 Implications

This study was helpful to usage of Mongolian under construction infrastructure like a railway, highway and leasing issue of China and Russian port and defining way to export in third market. Also it was support to useful information of choosing operation direction and transportation route for new forwarders. Moreover, this study result was heighten and efficiency of forwarders' transportation between Korea and Mongolia.

Furthermore, this study support useful basic information for next Mongolian logistics study and transportation route

choice model research.

5. Conclusion

In this empirical study, we focused on identifying the most important factor when choosing transport route for freight forwarders between Korea and Mongolia. As results of this paper, Time and Cost were the most important factors to choose transport route. And the result shows shipping and air transportation forwarders have different important factors.

In the sub factors, Set time sub factor was the most important and Transportation cost and Transit time and so on. Especially in shipping transportation sector, Cost factor and Costs' sub factors were the most important to choose transportation route. It means forwarders in air transport or shipping transport sector need to take care with choosing appropriate transportation routes.

Generally, most of the consignees want quick transportation with low transportation cost by freight forwarders. However even if freight forwarders would try to transport them on appointed time, the delivery time taken for shipping transportation is relatively long. Therefore, the cost depends on the transportation planning and route selections.

Most of the freight forwarders try to determine the best route for Time and Cost factors for new route between Korea and Mongolia. By considering exact data about delivery time and cost between Korea and Mongolia, the route selection for multimodal transportation will be studied in future.

This study focused only total cargo transported between Mongolia and Korea, but we should have consider specific item for each transportation route. However, we have some limitations of small quantity of freight transported between two countries with small number of forwarders. Thus further study should be focused to those limitations.

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