An Exploratory Study of Carrier Selection in International Trade with China: A Focus on the U.S. and South Korean Firms

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This research focuses on the international trade with China to understand the need of U.S.-based or South Korea-based international shippers and to provide international carriers with practical business suggestions based on shippers' needs in international transportation to and from China. The research suggests several important factors in selecting international carriers in the trade with China. They are organization quality and after sales service, convenience and supply chain collaboration, service dependability, price and financial stability, and service and equipment availability.

Keywords: carrier selection, outsourcing, transportation collaboration

Ⅰ. Introduction

As globalization accelerates, firms realize the necessity of strategic collaborations with related organizations in international level. They look for long-term and mutually beneficial relationships not only with suppliers or

Received. June 30, 2011; Revision received. July 27, 2011; Accepted. July 28, 2011

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customers but also with eligible third-party service providers to achieve better supply chain performance.

In international business, due to the complexity of border-crossing processes and relatively long physical distances and lead-time, finding and maintaining businesses with third-party service providers who have experience and knowledge in international markets are essential in the success of global supply chain management. In particular, the role of international carriers who may impact a firm's supply chain-wide competitiveness in terms of costs and time is critical in successful global supply chain management. In a study of the globalization of both 3PL demands and provider service offerings, Lieb and Hickey (2002, Third Party) revealed the 3PLs were becoming increasingly internationalized in nature and increasing international service offerings. The authors figured out that freight forwarding and customer brokerage were the most widely used 3P services.

A strategic relationship in a supply chain encompasses many dimensions of inter-organizational collaborations such as risk and benefit sharing, extendedness of relationships and information sharing. Ellram (1990) defined a strategic relationship as a mutual ongoing relationship involving a commitment over an extended time period and sharing of information, risks and rewards. The endurance of relationships (i.e., long-term expectations of relationships) and both parties' willingness to sacrifice their own benefits to certain extents to achieve higher supply chain-wide benefits makes basis of strategic relationships. Gardner et al. (1994) also stressed the importance of these factors. The authors defined a partnership as an area on a continuum of possible relationship styles

between firms. Their components of partnerships included planning, extendedness, sharing of benefits and burdens, systematic operational information exchange, and mutual operating controls. They noted that extendedness referred to the loyalty and long-term expectations of the two parties in the relationships. Sharing of benefits and burdens referred to the willingness of the both parties to accept short-term conflicts with the expectation that the opposite party would do the same, which would result in mutual long-run benefits.

From carrier' standpoints, long-term collaborative relationships with shippers can insure business stability and gradual business growth. In order to provide required services by shippers, carriers should identify what future or current customers (or shippers) need. To identify customers' needs, carriers must understand how they evaluate and select carriers. Many studies in carrier selection and evaluation suggest that carriers must understand customers' needs and set their strategies in line with those needs. For example, McGinnis et al. (1995) argued that the outsourcing decision was not caused by any generalized advantages or disadvantages and thus that 3PL selection processes should focus on the user's market needs. Crosby & LeMay (1998) and Premeaux (2002) also reported that it was important to provide services corresponding to customer needs. Researchers also have stressed the importance of strategic relationships with carriers. For instance, Gentry (1996) reported the importance of carriers within the strategic supply chain partnership. In a study of motor carrier deregulation in U.S., Rindhart (1989) stated that the use of contract motor carrier services increased in 1980s providing more benefits to both carriers and shippers. The author reported that motor carriers could increase the utilization of

their assets due to guaranteed business from customers while shippers could gain benefits including dedicated equipment options, stability in rates based on pre-established service levels, and potential for increased levels of service offered by motor carriers. Recently, Lieb and Hickey (2002) reported that nearly two-third third-party logistics providers (i.e., 3PLs) maintained long-term relationships with shippers for more than 5 years. They also reported that 3PLs were becoming increasingly internationalized in nature and increasing international service offerings.

Identification and analysis of shippers' decision criteria to evaluate carriers has been a major research subject for the past two decades. Research in this issue has been conducted to provide carriers with suggestions corresponding to shippers' needs or to provide shippers with appropriate carrier evaluation tools. However, most studies on carrier selection are concerned only with domestic or general transportation environments in developed countries.

The purpose of this survey study is to identify international shippers' needs in transportation to and from China, where the large portion of international trade happen, and to provide international carriers with useful business suggestions, when they attempt to build alliances or strategic relationships, based on the shippers' needs. To study shippers' needs and use them to help carriers, this research concerns U.S. and South Korean managers' perceptions of carrier selection rather than service levels with which they are actually provided by carriers. That is, it does not measure shippers' satisfaction level of the services that carriers provide but measures how managers perceive the importance of each chosen carrier selection criterion.

The research has three objectives. First, it examines criteria that U.S. and South Korea-based shippers consider important when evaluating carriers. To achieve this objective, the shippers' levels of perceived importance of a set of selected carrier selection criteria are measured. Second, a comparison of the selection criteria between U.S.-based firms and South Korea-based firms are done to understand how the perceived importance of each carrier selection criteria in the two countries is different. Third, the underlying construct (i.e., factors) of the selection criteria are identified on both U.S.-based and South-Korea based firms.

Ⅱ. Literature Review

1. Carrier Selection

Many researchers have used systematic categorization of carrier selection criteria by shippers to provide carriers with practical business suggestions under deregulating and globalizing business environments.

Researchers have tried to understand the difference between what shippers need and what carriers would provide. Evans & Southard (1974) and Jerman et al. (1978) performed survey research to compare the important perceived factors between shippers and carriers. They tried to find the perceived gap between what shippers needed and how carriers would operate. Krapfel and Mentzer (1982) also did research on perceptual gaps between the two carriers and shippers. Their study focused on the usage of intermodal transportation

related with shippers' perception of transportation services under deregulated environments. They presented that shippers' selection of transportation modes and carriers were dependent on their perception of modes and carriers while carriers focused on maximizing their operations. That is, operational gaps still exist between shippers and carriers under deregulated transportation environments. Abshire and Premeaux (1991, Transportation Journal) attempted to identify shippers' perceived carrier selection variables to detect detailed steps required in carrier selection processes so that logistics managers understand what must be considered when they evaluate the performance of potential carriers. They tried to prove that why carriers' perceptions differ from shippers' perceptions was that carriers misunderstood the real needs of the shippers. According to the authors, carriers' perceptions of the importance were higher than shippers' perceptions in categories such as carrier cooperation with shipper's personnel, past performance of the carrier, freight damage experience with carrier, carrier representative's knowledge of shipper needs, ease of claim settlement (loss or damage) and information provided to shippers by the carrier. Meanwhile, shippers' perceptions of the importance were higher than carriers' perceptions in carrier's leadership in offering more flexible rates, carrier attitude toward acceptance of small shipments, carrier response in emergency situation, and carrier transportation equipment designed to facilitate easy and fast loading and unloading. Recentlly, Premeux (2002) reported that shippers were more concerned with information access, solid customer relations, and availability of certain desired services while carriers realizes importance of providing information access, providing consistent carrier performance, and providing

services in line with carrier needs. He asserted that carriers must shift toward a better understanding of the nature of shipper needs and customer satisfaction was a critical success factor for carriers.

Several studies focus on specific carrier selection criteria such as freight rate and service factors. For instance, McGinnis (1989) indicated that carrier selection was a constrained optimization decision whereby freight rates were minimized subject to dynamic array of reliability, transit time, damage, shipper market conditions, carrier considerations, and product characteristic constraints. On the other hand, Dunn (1982) reported that the service variables are more important than the freight rate. Foster and Strasser (1990) also stated that shippers perceived that detailed service factors such as schedule reliability and willingness to negotiate were more important than cost categories. Abshire and Premeaux (1991, Logistics and Transportation Review) also alerted that the shippers were missing critical criteria which shippers importantly perceived including many service factors. Lambert et al. (1993) supports their assertions stressing the importance of service factors.

In research on determinants of shipper perceptions of modes, many researchers have identified variables and factors beyond rates or service factors. Such variables include timeliness and information technology initiatives. For example, Evers et al. (1996) used eighteen criteria to evaluate carriers in different transportation modes including, intermodal, railroad, and motor carrier. The authors extracted six statistically significant underlying factors including timeliness, availability, suitability, firm contact, restitution, and cost from the variables. Whyte (1993) revealed that the most important selection determinant

were customer services measured with transit time reliability, transit time consistency, flexibility, ability to meet requirements at short notice and ability to understand problems and willingness to help. Kent et al. (2001) used Internet and EDI capabilities as main measurements of information technology in exploratory factor analysis to examine the motor carrier selection process by motor carrier industrial segment. Lieb and Hickey's (2002, Third Party) stressed the importance of information connectivity and the efficiency of information systems for U.S. firms. In their annual survey to identify capabilities that third-party logistics service providers must have, they identified the importance of information technology (IT) capabilities in shipper-carrier relationships. Premeaux (2002) also suggested that carriers focused on developing advanced information exchange systems such as Web-based EDI to better serve shipper date needs to meet the changing market environments.

2. Transportation in China

Li (1994) identified the key problem areas in the Chinese transportation to suggest possible reactions that firms could take. His problem areas in the Chinese transportation include: lack of cargo tracing services, local carriers' lack of delivery dependability, lack of carrier selection, excessive loading and unloading time at terminals, inadequate transportation infrastructure, and unavailability of transportation services. He proposed that various actions, such as establishing the firms' own transportation fleets, being more careful in selection of carriers, switching to foreign suppliers to support their china

operations, and seeking strategic alliances with local carriers were being taken by firms to reduce the transportation barriers. Speece and Kawahara (1995) also found out several problems existing in the Chinese national freight transportation system including theft problems, excessive time consumption, and inconvenient operations of rail, road and water way systems.

Regarding the quality of China's transportation system, many researchers report that operational fragmentation may cause inefficiencies in supply chain management. According to Bolton and Wei (2003), more than 18,000 registered companies claimed to offer logistics services in China in 2003 however, no one could offer nationwide distribution services or no single logistics provider shared more than two percent of the market. The fragmented transportation services caused increases in lead-time and logistics costs. The authors also reported that ninety percent of a Chinese manufacturer's time is spent on logistics and ten percent is spent on manufacturing on average and logistics costs in China are proportionally 40 to 50 percent higher than they would be in the United States for many commodities. Trunick (2003) also noted that China's trucking industry was still severely fragmented. According to his investigation, there were 2.5 to 2.7 million cargo carriers registered with a total of 5.1 million tractor units in China in 2003. The average length of hauls by the cargo carriers was only 37 miles and long-haul truck freight movement often meant loading and unloading cargo at provincial boarder as it is handed from carrier to carrier (Trunick, 2003). Other researchers, such as Jiang and Prater (2002), Jiang (2002) and Eaton (2003) commonly raise the problems of fragmentation in Chinese transportation system.

Insufficiency of transportation capacity is another major problem pointed out by researchers. Li (1994), Carter et al. (1997), Jiang (2002), Trunick (2003) and Eaton (2003) commonly reported the problems of underdevelopment of transportation infrastructure in China. They suggest that China must improve the transportation capacity in railways, highways, and terminals to improve the national supply chain efficiency ad to attract more foreign investment.

Researchers also report the bright future of the Chinese transportation. Bolton and Wei (2003) mentioned that Chinese distribution and logistics sector was rapidly growing. They revealed that the national logistics spending amounted to one-fifth of the nation's GDP, which was twice the proportion spent in the United States in 2001, and the capacities and the quality of logistics/carriers were expected to improve fast. The annual average revenue growth rate of Chinese logistics industry was 31 percent in 1999, 35 percent in 2000, and 55 percent in 2001. The forecasted average annual growth rate during 2002 to 2004 was as much as 50 percent. (Bolton and Wei, 2003) Trunick (2003) said that the road network of China was ten times better than it was 10 years ago and it was constantly improving as time goes by. He described that the Chinese government had invested heavily in improving infrastructure, marking about two thirds of government infrastructure spending for highways from 1996. In addition, Trunick reported that the Chinese government fully intended to deregulate motor carriage and to end provincial protections. He also reported that foreign ownership restrictions were expected to end by the end of 2004. Therefore, though China's third-party logistics industry is in infancy, major players from Europe, the U.S., and Asia were developing resources in China.

China's 3PL industry will grow, but presently it was held back by the absence of awareness of the merits and benefits of supply chain solutions and a low propensity of Chinese companies to outsource non-core activities (Trunick, 2003). Easton (2003) reported that China's current supply chain infrastructure and operational paradigms restrained economic development and limited the performance potential of local and foreign companies. He introduced the Chinese governments' and service providers' efforts to improve the transportation environment. The Chinese government was committing large sums of money to modernize China's logistics and transportation infrastructure. China's accession to the World Trade Organization in late 2001 and its increasing deregulations implied that modern Chinese supply chains were close at hand. Local and foreign providers of supply chain services, including State-Owned Enterprises, were rushing to upgrade their capabilities. (Easton, 2003) Dai et al. (2003, Jan.) also introduced the dramatic improvement of China's transportation infrastructure. According to their survey result, new modern facilities such as airports, ports, highways, logistics parks, and warehouses were being built at a record setting pace. They reported that companies were extensively investing in information technologies and software and thus, on average, IT expenditures accounted for 9.6% of the companies' annual operating costing 2002.

Ⅲ. Survey

To collect necessary data, a survey research was conducted. Survey questionnaires were delivered to managers in operations, transportation,

purchasing, logistics, supply chain, and marketing managers or CEOs of U.S.-based and South Korea-based manufacturing and distribution firms.

Two different survey collection methods, mail survey and online survey, were used. To avoid damages on internal validity of the research, same questions were used and respondent managers were selected in the same database, the membership directory of Council of Logistics Management (CLM). Both mail and online survey guaranteed anonymity of the respondent managers.

First, the English version mail questionnaires were sent to randomly-selected 349 members of Council of Logistics Management (CLM) who were involved in transportation or logistics management in U.S.-based manufacturing firms (U.S. mail survey group) during February, 2004. Only nineteen manufacturers returned questionnaires. Second trial of the U.S. mail survey was conducted in March, 2004 and third trial was conducted in April, 2004. Seven more questionnaires were returned at the second trial and another seven were returned at the third trial. 37 (or 10.6 % response rate) English version mail survey questionnaires were collected but 32 (or 9.2 %) were completed and usable. Second, the Korean version mail survey was conducted on 95 members of Samsung Electronics Suppliers Association (SECSA) members in South Korea in June, 2004. SECSA is composed on 180 manufacturers supplying parts, components or products to Samsung Electronics. All member firms of SECSA are headquartered in South Korea. Korean version mail questionnaires were sent to only 95 members and 51 (or 53.7 %) were returned. However, two of them were not acceptable so 49 questionnaires (or 51.6 %) were used for the analyses. Thus, the overall response rate with usable

questionnaires from the overall mail survey, including U.S. mail survey and Korean mail survey, was 18.2 percent.

Third, an online survey was performed on CLM members. Because the response rate of the online survey was expected to be low, the predetermined sample size was quite large. The questionnaires were sent to CLM members who work for U.S.-based firms involved in manufacturing or distribution. It was impossible to correctly identify who operated in China and who were responsible for international transportation. Thus, the response rate was low. At the first trial, the online questionnaires were sent to 4,931 managers during the second week of August, 2004 but 947 were returned due to incorrectly informed e-mail addresses. Thus, 3,991 managers received the survey and only 55 managers (or 1.4 %) returned the survey. The second trial of the online survey was done during the third week of August, 2004. The same numbers (4,931) of online questionnaires were sent but 931 were returned due to incorrect e-mail addresses. Thus, 4,007 managers received the online questionnaires and 59 managers completed questionnaires (or 1.5%). Another trial of the online survey was conducted during the fourth week of October, 2004. The questionnaires were sent to 4,931 CLM members again and 1,051 surveys with incorrect e-mail addresses were returned. Thus, 3,889 managers received the survey and only 35 managers (or 0.7 %) returned the questionnaires. Thus, 149 surveys (55 at the first trial, 59 at the second trial, and 35 at the third trial) were returned out of 4,931 and the response rate was as low as three percent. Among the 149 returned questionnaires (or 3 %), only 48 were completed and usable. The reason why the number of incorrectly addressed e-mails was fluctuating is

figured out but it was probably the temporary vacancy of respondents or automatic e-mail filtering. The reason why the response rate of the online survey was so low was probably that it was difficult to target one person in a firm as the respondent and that firms are frequently overloaded these days with questionnaires from universities, consultancy firms and professional organizations so often refuse to answer. Thus, overall online response rate with all returned questionnaires was 3.8 percent and the online response rate with usable questionnaires was 1.2 percent. In all, 129 usable questionnaires (32 questionnaires from U.S. mail survey group, 48 from U.S. online survey group, and 49 questionnaires from South Korean mail survey group) were collected.

Ⅵ. Data Analysis

Among all 126 respondent managers, 47 were responsible for top management, 51 were responsible for logistics, transportation or purchasing management and 28 were responsible for other functions (including, operations, R&D, human resource, marketing or others). Only 7 managers in Korean mail survey group were in logistics, transportation or purchasing and only 3 managers in U.S. mail survey group were in other functions.

The overall average length of operation experience of the respondent firms in China was 11.26 years. However, it varied between U.S. and South Korean respondents as well as between mail survey and online survey. The average length of operation experience in China of U.S. survey group (i.e., U.S. mail survey group plus U.S. online survey group) was 15.1 years and that of

South Korean survey group (i.e., South Korean mail survey group) was 5.1 years. The average length of operation experience in China of mail survey group (i.e., U.S. mail survey group plus Korean mail survey group) was 8.3 years and that of online survey group (i.e., U.S. mail survey group) was 16.3 years. To test the differences between groups, Kruskal Wallis test was used. The test was based on three measurement values (i.e., less than 5 yrs, between 6-10 yrs, and over 10 yrs). This test is based on Chi-square statistic and used to compare ordinal or interval data of more than two populations (OTT, 1993). Table 1 shows the differences between and among groups.

<Table 1> Kruskal Wallis Test Results between Groups on the Length of Operation Experience in China

Compared groups	Three groups *-U.S. mail survey* *-S. Korean mail survey* *-U.S. online survey*	U.S. vs. S Korea *-U.S. mail survey and U.S. online* *-S. Korean mail survey*	Mail survey vs. Online Survey *-U.S. mail survey & S. Korean mail survey* *-U.S. online*
Chi-square	27.4219	23.9863	2.3125
Degree of Freedom	2	1	1
Pr>Chi square	<0.0001 (Difference at 0.05 level)	<0.0001 (Difference at 0.05 level)	0.1283 (No difference at 0.05 level)

Note: test is based on three measurement levels: 1=less than 5 yrs, 2=between 5-10 yrs, 3=over 10 yrs

From Table 1, the length of operation experience in China was different among the three survey groups at 0.05 level. Moreover, a difference was detected between U.S. and South Korea at 0.05 level. However, between survey methods, no significant difference was identified at the same level. Thus, in the length of operation experience in China, U.S.-based firms and South Korea-based firms are not same. The length of experience in China of U.S.-based survey respondent firms was longer than that of South Korea-based

respondent firms.

The distribution of total sales in 2003, the portion of sales from China in the total sales in 2003, and the portion of purchasing from China in the total company purchasing in 2003 were also compared using Kruskal Wallis test. Table 2, Table 3 and Table 4 show the results.

<Table 2> Kruskal Wallis test results between groups on total sales in 2003

Compared groups	Three groups *-U.S. mail survey* *-S. Korean mail survey* *-U.S. online survey*	U.S. vs. S Korea *-U.S. mail survey and U.S. online* *-S. Korean mail survey*	Mail survey vs. Online Survey *-U.S. mail survey & S. Korean mail survey* *-U.S. online*
Chi-square	36.5554	36.2041	10.3200
Degree of Freedom	2	1	1
Pr>Chi square	<0.0001 (Difference at 0.05 level)	<0.0001 (Difference at 0.05 level)	0.0013 (Difference at 0.05 level)

Note: test is based on three measurement levels: 1=$0-$50 mil., 2=$50 mil.-$1 bil. 3=over $1 bil.

In total sales, U.S.-based and South Korea-based survey groups showed significant differences at 0.05 level. The average total sales of U.S.-based firms (US$6,057.95 million) were much higher than that of South Korea-based firms (US$73.5 million). Only 19 percent of the U.S. firms were categorized as SMEs with less than $50 million of total annual sales. Almost 50 percent of Korean firms were SMEs. This is probably because the Korean mail survey respondent firms were smaller part or component suppliers while U.S. mail and online survey respondent firms include larger manufactures as well as distribution firms. Total sales amount among the three groups and between data collection methods were also different. 36 percent in the mail survey group were SMEs and 22 percent in the online survey group were SMEs. The average total sales

of the mail survey group was $3,319 million and that of the online survey group was $4,000 million.

<Table 3> Kruskal Wallis test results between groups on the portion of sales from China in total sales in 2003

Compared groups	Three groups *-U.S. mail survey* *-S. Korean mail survey* *-U.S. online survey*	U.S. vs. S Korea *-U.S. mail survey and U.S. online* *-S. Korean mail survey*	Mail survey vs. Online Survey *-U.S. mail survey & S. Korean mail survey* *-U.S. online*
Chi-square	22.1444	22.0547	10.4145
Degree of Freedom	2	1	1
Pr>Chi square	<0.0001 (Difference at 0.05 level)	<0.0001 (Difference at 0.05 level)	0.0013 (Difference at 0.05 level)

Note: test is based on three measurement levels 1=0-2 %, 2=2-10 %. 3=over 10 %

The portion of sales from China in total sales in 2003 was different between the country groups (i.e., S. Korean mail survey group vs. U.S. mail and online survey group) at 0.05 level. U.S.-base firms showed lower portion of sales from China (13 % average) than South Korea-based firms (27% average). Thus, from the stand point of sales, U.S.-based firms were less dependent on China than South Korea-based firms. For the mail survey group, the average portion of sales from China in 2003 was 22 percent. For the online survey group, it was 12 percent. The two groups also showed difference at 0.05 level.

Meanwhile, in the portion of purchasing from China in the total purchasing in 2003, the respondent firms based on U.S. and South Korea did not show significant differences. No significant difference was detected among the three groups or between the data collection methods. The average of the U.S. firms was 17 percent and the average of Korean firms was 15 percent. Between the online and mail survey groups, no difference was detected and the average of the purchasing portion from China was about 16 percent for both groups.

<Table 4> Kruskal Wallis test results between groups on the portion of purchasing from China out of the total company purchasing in 2003

Compared groups	Three groups *-U.S. mail survey* *-S. Korean mail survey* *-U.S. online survey*	U.S. vs. S Korea *-U.S. mail survey and U.S. online* *-S. Korean mail survey*	Mail survey vs. Online Survey *-U.S. mail survey & S. Korean mail survey* *-U.S. online*
Chi-square	0.8667	0.2598	0.8595
Degree of Freedom	2	1	1
Pr>Chi square	0.6483 (No difference at 0.05 level)	0.6103 (No difference at 0.05 level)	0.3539 (No difference at 0.05 level)

Note: test is based on three measurement levels 1=0-2 %, 2=2-10 %. 3=over 10 %

Table 5 summarizes the types of investment of the respondent firms in China. South Korean firms preferred wholly-owned investment type while U.S. firms showed not much difference in investment types. More than 77 percent of mail survey groups directly invested in forms of wholly-owned business or joint venture in China while 50 percent of online survey group directly invested in China.

Over 90 percent of Korean firms had manufacturing facilities in China. Many U.S. firms (77 %) also had manufacturing facilities in China. Almost 83 percent of mail survey group had manufacturing facilities in China and almost 70 percent of online survey group had manufacturing facilities in China. Only small number of mail survey group (close to 3 %) and online survey group (18.8 %) had only logistics facilities in China. The types of facilities of the respondent firms are summarized in Table 6.

<Table 5> Types of Investment in China

Group	Wholly-owned		Joint venture		Indirect Export		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
U.S. mail survey group	14	11.02	14	11.02	4	3.15	32	25.2
S. Korea mail survey group	44	34.65	2	1.57	3	2.36	49	38.58
U.S. online survey group	15	11.81	8	6.3	23	18.11	46	36.22
Subtotal	73	57.48	24	18.9	30	23.62	127	100
U.S. survey group *(U.S. mail survey & U.S. online survey)*	29	22.83	22	17.32	27	21.26	78	61.42
Korea survey group *(S. Korea mail survey group)*	44	34.65	2	1.57	3	2.36	49	38.58
Subtotal	73	57.48	24	18.9	30	23.62	127	100
Mail survey group *(U.S. mail survey & S. Korea mail survey)*	58	45.67	16	12.6	7	5.51	81	63.78
Online survey group *(U.S. online survey)*	15	11.81	8	6.3	23	18.11	46	36.22
Subtotal	73	57.48	24	18.9	30	23.62	127	100

<Table 6> Types of Facilities

Group	Manuf only		Logistics only		Both		Misc		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
U.S. mail survey group	19	17.59	2	1.85	2	1.85	7	6.48	30	27.78
S. Korea mail survey group	41	37.96	0	0	1	0.93	4	3.7	46	42.59
U.S. online survey group	9	8.33	6	5.56	4	3.7	13	12.04	32	29.63
Subtotal	69	63.89	8	7.41	7	6.48	24	22.22	108	100
U.S. survey group *(U.S. mail survey & U.S. online survey)*	28	25.93	8	7.41	6	5.56	20	18.52	62	57.41
Korea survey group *(S. Korea mail survey group)*	41	37.96	0	0	1	0.93	4	3.7	46	42.59
Subtotal	69	63.89	8	7.41	7	6.48	24	22.22	108	100
Mail survey group *(U.S. mail survey & S. Korea mail survey)*	60	55.56	2	1.85	3	2.78	11	10.19	76	70.37
Online survey group *(U.S. online survey)*	9	8.33	6	5.56	4	3.7	13	12.04	32	29.63
Subtotal	69	63.89	8	7.41	7	6.48	24	22.22	108	100

23.54 percent of the firms had their strategically most important facilities in north east area (i.e., Beijing, Heilongjiang, Liaoning, or Tianjin). 12.75 percent of the firms had their strategically most important facilities in upper middle east area (i.e., Shandong or Shanxi) and 48.05% had in lower middle east area (i.e.

Chongqing, Fujian, Hebei, Jiangsu, Shanghai, Yunnam, or Zhejiang). Only 15.95 percent had their strategically most important facilities in south east area (i.e., Guangdong or Hong Kong). Many Korean firms (57 %) had their strategically most important facilities in northeastern or upper middle-eastern areas while most U.S. firms (over 84 %) had theirs in lower middle-eastern and southeastern areas.

In 63.21% of the respondent firms, headquarters mostly chose international carriers for trading with China and Chinese facilities chose carriers in 32.08% of the firms. Only 4.72 of the respondent firms shared carrier selection decisions in both headquarter and Chinese facilities. Korean firms were more dependent on the headquarters for the selection of international carrier selection. 17 percent of the respondent Korean firms answered that their local branches in China select international carriers while 44 percent of U.S. firms answered so. There was no difference was detected between mail survey group and online survey group. 32 percent of mail survey group firms answered that their local branches in China independently select international carriers while 30 percent of the online survey group firms gave the same answers.

69.17 percent of the respondents answered that their companies continued relationships with international carriers for trades with China between 1 to 5 years and 18.33 percent continued the relationships more than 5 years. Only 5 percent of the respondent firms used different carriers every time and 7.5 percent maintained relationships with international carriers less than one year. Thus, most respondents in the sample maintain relationships with international carriers for longer than one year. 9 of 72 U.S. firms did not establish long-term

relationships with international carriers and only 15 of 48 Korean firms did not establishes long-term relationships with international carriers. Only 10 percent of the firms in the mail survey group answered that they did not maintain relationships with international carriers longer than one year while 17 percent of the firms in the online group gave the same answers.

To the question asking whether they have ever used state-owned carriers such as China Ocean Shipping Company (COSCO) for trading with China, 43.59 percent of the managers gave positive answers and 56.41 percent provided negative answers. Among the 51 firms with positive answers, 53.06 percent answered that they did not feel differences of the performances between privately-owned carriers and state-owned carriers. Only 8.16 percent answered that state-owned carriers perform better than privately-owned carriers while 38.77 percent of respondents answered that privately-owed carriers were better. In 1-5 Likert-type scale, the mean value was 2.6 and the standard deviation was 0.7. Thus, there is no large difference between the performance of SOEs and privately-owned carriers in international trades with China.

Table 7 shows the mean values and standard deviations of carrier selection variables provided by the respondent firms.

The respondent managers believed that all the selection categories were important. All the mean values were larger than 3.5 in 1-5 Likert-type scale. Ten variables showed relatively large mean values with over 4.0: guaranteed on-time delivery offered, dependability of delivery, transit time reliability, scheduling flexibility, quality of operating personnel, management expertise, operational collaboration to obtain optimal service, availability of freight

<Table 7> Results of Carrier Selection Variable

Variable ID	Variable Name	Mean	Stan. Dev.
S1	Guaranteed on-time delivery offered	4.29	0.99
S2	Dependability of delivery	4.48	0.90
S3	Transit time reliability	4.36	0.80
S4	Convenience of contact	3.89	0.89
S5	User-friendly ordering process	3.66	0.84
S6	After sales customer service level	3.79	1.00
S7	Scheduling flexibility	4.11	0.90
S8	Variety of services offered	3.52	0.94
S9	Availability of transportation equipment(including special equipment)	3.61	1.05
S10	Availability of pickup and delivery service	3.85	1.08
S11	Quality of sales personnel and their knowledge	3.74	0.94
S12	Quality of operating personnel	4.06	0.89
S13	Management expertise	4.00	0.88
S14	Operational collaboration to obtain optimal service	4.04	0.86
S15	Emphasis on long-term strategic relationship	3.91	1.01
S16	Information technology used for transportation operations	3.92	0.97
S17	Availability of freight tracking/tracing system	4.17	0.88
S18	Company reputation	3.92	0.90
S19	Price level (freight rate)	4.43	0.84
S20	Financial stability	4.12	1.00

tracking/tracing system, price level, financial stability. All the standard deviations were less than or close to 1.00 showing low variances in all international carrier selection categories in trades with China.

Table 8 shows the mean values and difference analyses of the twenty variables. When we compare all the three groups, we could detect a difference in “quality of operating personnel.” Between U.S. and Korean firms, “quality of operating personnel” and “company reputation” showed differences. Between the mail survey group and the online survey group, “transit time reliability”, “quality of operating personnel”, and “management expertise” showed differences. No other difference is detected in the comparison of the groups. Therefore, we bring the 20 variables to exploratory factor analysis to identify the latent variables (i.e., factors or underlying constructs).

Of the 190 pairs of correlation, only one (between “guaranteed online delivery” and “availability of transportation equipment”) was statistically

<Table 8> Frequencies and Differences of Carrier Selection Variable between groups

	3 Group			U.S. Vs.	S. Korea	Mail Vs.	Online
Variable ID	U.S. Mail	S. Korea Mail	U.S. online	U.S.	S. Korea	Mail survey	Online Survey
S1	4.47	4.57	3.90	4.13	4.57	4.53	3.90
Difference		No			No		No
S2	4.63	4.43	4.46	4.53	4.43	4.51	4.46
Difference		No			No		No
S3	4.31	4.20	4.40	4.36	4.20	4.25	4.40
Difference		No			No		Yes
S4	3.78	3.98	3.88	3.84	3.98	3.90	3.88
Difference		No			No		No
S5	3.59	3.71	3.67	3.64	3.71	3.67	3.67
Difference		No			No		No
S6	3.72	3.88	3.75	3.74	3.88	3.81	3.75
Difference		No			No		No
S7	4.22	4.00	4.15	4.18	4.00	4.09	4.15
Difference		No			No		No
S8	3.38	3.57	3.58	3.50	3.57	3.49	3.58
Difference		No			No		No
S9	3.94	3.16	3.88	3.90	3.16	3.47	3.88
Difference		No			No		No
S10	4.22	3.35	4.13	4.16	3.35	3.69	4.13
Difference		No			No		No
S11	3.56	3.76	3.83	3.73	3.76	3.68	3.83
Difference		No			No		No
S12	4.31	3.63	4.33	4.33	3.63	3.90	4.33
Difference		Yes			Yes		Yes
S13	4.00	3.84	4.19	4.11	3.84	3.90	4.19
Difference		No			No		Yes
S14	3.94	4.00	4.15	4.06	4.00	3.98	4.15
Difference		No			No		No
S15	3.84	3.96	3.90	3.88	3.96	3.91	3.90
Difference		No			No		No
S16	3.81	3.94	3.98	3.91	3.94	3.89	3.98
Difference		No			No		No
S17	4.16	4.12	4.23	4.20	4.12	4.14	4.23
Difference		No			No		No
S18	4.00	3.76	4.04	4.03	3.76	3.85	4.04
Difference		No			Yes		No
S19	4.50	4.45	4.38	4.43	4.45	4.47	4.38
Difference		No			No		No
S20	4.16	3.94	4.27	4.23	3.94	4.02	4.27
Difference		No			No		No

Note: difference is measured with Kruscal-Wallis test at 0.05 level significant at the 0.05 level.

Then, using factor analysis, we have tried to explain the phenomenon of

international carrier selection in trades with China with the help of a few major and manageable underlying constructs. Each of these constructs is formed by one or more of the survey questions.

In exploratory factor analysis, 1:4 to 1:10 of item-to-response ratio is recommended (Hinkin, 1998). Because the number of items use for exploratory factor analysis in this research was twenty, the required number of survey responses is 80 to 200. The total number of acceptable questionnaires in this research was 129 thus this number satisfies the item-to-response ratio rule. In this research, common factor analysis was employed to detect underlying constructs of the variables.

Varimax rotation was used in order to easily interpret the results. A factor loading cut-off is dependent on the sample size. Considering item loadings on the factors at 0.5 as acceptable (Hair et al. 1998) for our 129 observations, five factors were obtained and 14 determinants (questionnaire responses) loaded into these factors.

From common factor analysis, five factors were extracted after rotation using Varimax method. Table 9 gives the factor loadings of the variables.

Six of the twenty variables, including “transit time reliability”, “scheduling flexibility”, “variety of services offered”, “information technology”, availability of tracking/tracing system, and “company reputation” were dropped from the analysis. Four variables loaded on Factor 1 labeled “organization quality and after sales service” This factor loaded “after sales customer service level”, “quality of sales personnel and their knowledge”, “quality of operating personnel”, and “management expertise’. Factor 2, labeled “convenience and

<Table 9> Factors and Factor Loadings after Variamax Rotation

Factor	Variable	Cronbach alpha (raw)	Cronbach alpha (stan.)	Factor Loading
Factor 1 (Organization quality and after sales service)	After sales customer service level	0.8461	0.8483	0.549
	Quality of sales personnel and their knowledge			0.613
	Quality of operating personnel			0.741
	Management expertise			0.624
Factor 2 (Convenience and supply chain collaboration)	Convenience of contact	0.8470	0.8496	0.528
	User-friendly ordering process			0.642
	Operational collaboration to obtain optimal service			0.490
	Emphasis on long-term strategic relationship			0.546
Factor 3 (Service dependability)	Guaranteed on-time delivery offered	0.8068	0.8088	0.587
	Dependability of delivery			0.900
Factor4 (Price and financial stability)	Price level (freight rate)	0.7600	0.7672	0.534
	Financial stability			0.759
Factor 5 (Service and equipment availability)	Availability of transportation equipment (including special equipment)	0.6856	0.6857	0.731
	Availability of pickup and delivery service			0.592

supply chain collaboration" included four variables: "convenience of contact", "user-friendly ordering process", "operational collaboration", and "emphasis of long-term strategic relationship." Factor 3 was named "service dependability". "Guaranteed on-time delivery offered" and "dependability of delivery" loaded into Factor 3. Factor 4 named "price and financial stability" included "price level" and "financial stability". Two variable, "availability of transportation equipment" and "availability of pick-up and delivery service" were loaded into Factor 5 labeled "service and equipment availability"

Table 9 contains Cronbach's alpha, the most widely used reliability coefficient that assesses the internal consistency of the scale. The raw and standardized alpha values were all greater than or very close to 0.6, better than the acceptable cut-off value for exploratory research according to Nunnaly (1978), and thus the consistency of the entire scale is assured.

To understand the extent of interrelationships between the factors identified in the factor analysis, we have presented the correlation coefficients among these factors in Table 10. It would be quite evident from an inspection of Table 10 that no significant correlation is found between these factors at 0.05 level. Therefore, we can safely assure non-existence of multi-collinearity among these factors.

<Table 10> Correlation among the Factors

Correlation Coefficients Prob>|r|	Factor1	Factor2	Factor3	Factor4	Factor5
Factor1	1.00000				
Factor2	0.14094 0.1111	1.00000			
Factor3	-0.01460 0.8696	0.04299 0.6286	1.00000		
Factor4	0.04910 0.5805	0.10156 0.2521	0.01362 0.8782	1.00000	
Factor5	0.12219 0.1678	0.00345 0.9690	0.04524 0.6107	0.09214 0.2990	1.00000

V. Managerial Implications and Future Research

The results from the survey showed that managers in U.S. and Korean manufacturing or distribution firms significantly considered the carrier selection criteria used in this research to evaluate and select carriers in international trade with China. Even though compared groups had different characteristics in the length of experience in China, sales, operations, types of trade/investments in China, their perceptions on the international carrier selection U.S. firms and Korean managers were not much different. U.S.-based and South Korea-based showed perceived differences only in “quality of sales personnel and their knowledge” and “company reputation”. U.S.-based firms had higher perceptions

levels on these two categories than South Korea-based firms did. The mail survey group and online survey group showed differences only in “transit time reliability”, “quality of operating personnel” and “management expertise.” These selection categories were higher in the online survey group.

The research also confirmed that meaningful underlying constricts exist among the carrier selection criteria. The major goal of this study was to identify the underlying factors of international carrier selection criteria. Accomplishment of this would help managers to develop successful strategies for closer inter-organizational collaboration with international carriers. Extracting information from the database and making sense of the interrelated data, factor analysis provides us with five major underlying. These are: organization quality and after sales service, convenience and supply chain collaboration, service dependability, price and financial stability, service and equipment availability.

The limited scope, international transportation to and from China, and adopted research methods of this research posed several limitations of the study. First, China has unique business and transportation environments. Therefore, the approach taken in this research may not be used for other countries. Second, even though the measurements for carrier evaluation were selected through a thorough review of previously validated literature, only a limited number of variables were used in this research to increase the response rate and to reduce response biases. There may be other significant variables to evaluate carriers. Thus, future research can focus on identifying more carrier evaluation variables or variables to capture unique business environments of China. Third, the research method could not reflect the fast changing business environments of

China. Future research may be taken up to reflect changing business environments by adopting time-series analyses or adding time-based national economy analyses of China.

Fourth, the range of research population, which encompassed manufacturing and distribution-related firms operating in China, was too broad. As a matter of fact, it was difficult to research U.S. and South Korean firms operating in China and to correctly define operating in a specific country as well. It was also difficult to distinguish types of investments in China and types of trades with China because firms operated in China in various forms. Moreover, it was impossible to exactly identify managers who were responsible for transportation with China in firms. Thus, the sample size was quite large and the response rate was very low. Thus, it is recommended that future research appropriately define populations and samples by determining specific industries, types of operation, and boundaries of survey respondents.

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[Appendix]

Summary of Research on Logistics Provider/Carrier Selection

Study	Year	Subject	Key factors/variables
Chow & Poist	1984	Carrier selection	• Transportation rates/cost • Transit time reliability • Door-to-door transit time
Bruning & Lynagh	1984	Carrier selection	• Pickup and delivery performance • Carrier line haul performance • Rates and charges
Brand & Grabner	1985	Carrier selection	• Consistency of service • Competitive rates • Meeting pickup/delivery times
Quinn	1987	Motor carrier selection	• Pickup and delivery schedule • Tracing • Flexibility
Raghunathan et al.	1988	Motor carrier selection	• Rate-related • Customer service • Claim handling and follow-up service • Special equipment availability and service flexibility
Lambert & Harrington (exploratory factor analysis)	1989	Customer service, logistics provider selection	• Information system capability • Product availability • Lead-time
Bardi et al. (exploratory factor analysis)	1989	Motor carrier selection	• Transit time reliability • Transportation rates/cost • Total transit time • Willingness to negotiate rates • Financial stability of the carrier
McGinnis	1989	Motor carrier selection	• Dynamic array of reliability • Transit time, damage • Shipper market conditions • Carrier considerations • Product characteristic constraints.

McGinnis & Kohn (exploratory factor analysis)	1990	Logistics provider selection	• Lowest variables are very important • On-time delivery shipments and deliveries are very important • Superior error rates are very important • Financial stability is very important • Creative management is very important • The ability to meet or exceed its promise is very important • The availability of top management when necessary is very important • Responsiveness to unforeseen problems and unexpected events is very important • Logistics service providers must meet performance and quality requirements before serious discussion regarding rates can occur
Murphy et al. (exploratory factor analysis)	1991	Carrier selection for international shipments	• Freight costs • Loss and damage • Equipment availability • Pickup and delivery times • Shipment information • Claims handling • Convenient location • Large and odd-size freight • Large shipments • Special handling

Abshire & Premeaux	1991	Carrier selection	• Carrier attitude toward acceptance of small shipments • Carrier response in emergency situation • Carrier transportation equipment designed to facilitate easy and fast loading and unloading
Lambert, Lewis, &	1993	Less-than-truck-load	• Transit time reliability and complaint management
Menon et al. (exploratory factor analysis)	1998	Logistic provide selection	• On-time delivery • Meet or exceed promises • Availability of top management • Superior error rates • Creative management • Financial stability
Harding	1998	Supply/storage provider selection	• Personnel • Quotations • Order quality • Delivery quality • Post-Order Services • Billing, disputes, and returns • Credit services and policies • Overall satisfaction rating
Kent et al.	2001	Carrier selection	• Service offering • Customer service • 3PL • Economics • Internet and EDI capabilities • Third party logistics capabilities.
Lu & Dinwood	(2002)	International freight forwarder selection	• External factors
Premeaux	2002	Carrier selection	• Information access • Solid customer relations • Availability of certain desired services • Importance of providing information access • Providing consistent carrier performance • Providing services in line with carrier needs

Whyte	1993	Carrier selection	• Customer services • Transit time reliability and consistency • Flexibility • Ability to meet requirements at short notice • Ability to understand problems and willingness to help
Garner et al. (confirmatory facor analysis)	1994	Logistics provider selection	• Extendedness • Operational information exchange • Operational controls • Sharing of benefits and burdens • Planning
Evers et al. (exploratory factor analysis)	1996	Carrier selection	• Timeliness • Availability • Suitability • Firm contact • Restitution • Cost
Gentry (exploratory factor analysis)	1996	Carrier selection	• Increasing on-time delivery • Supporting JIT initiatives • Reducing inventory levels • Meeting customer service goals • Reducing total cycle time • Lowering # of defects • Increasing % complete orders • Reducing total cost of ownership • Improving open communications • Reducing risk through value-added services • Improving quality of product • Reducing administrative costs • Improving information technology • Reducing procurement procedures • Utilizing long-term strategic planning
Crosby & LeMay (exploratory factor analysis)	1998	Trucking service provider selection	• They should have up-to-date equipment • These firms should have a low loss and damage rate • Their employee do not always have to be willing to help customers