Journal of Marine Science and Technology

Volume 21 | Issue 2 Article 10

INVESTIGATING CRITICAL FACTORS THAT INFLUENCE SHIPPERS' AND INTERNATIONAL FREIGHT FORWARDERS' PREFERENCES IN CARRIER SELECTION USING INTEGRATED HIERARCHICAL INFORMATION INTEGRATION APPROACH

Jin-Long Lu
Department of Shipping and Transportation Management, National Kaohsiung Marine University, Kaohsiung, Taiwan, R.O.C., jlu@mail.nkmu.edu.tw

Recommended Citation

Lu, Jin-Long (2013) "INVESTIGATING CRITICAL FACTORS THAT INFLUENCE SHIPPERS' AND INTERNATIONAL FREIGHT FORWARDERS' PREFERENCES IN CARRIER SELECTION USING INTEGRATED HIERARCHICAL INFORMATION INTEGRATION APPROACH," *Journal of Marine Science and Technology*: Vol. 21: Iss. 2, Article 10.
DOI: 10.6119/JMST-012-0309-2
Available at: https://jmstt.ntou.edu.tw/journal/vol21/iss2/10

INVESTIGATING CRITICAL FACTORS THAT INFLUENCE SHIPPERS' AND INTERNATIONAL FREIGHT FORWARDERS' PREFERENCES IN CARRIER SELECTION USING INTEGRATED HIERARCHICAL INFORMATION INTEGRATION APPROACH

Acknowledgements

The authors of this paper would like to thank Ms. Meng-Tsu Chang for her assistance in collecting the data.

Journal of Marine Science and Technology, Vol. 21, No. 2, pp. 182-190 (2013)
DOI: 10.6119/JMST-012-0309-2

INVESTIGATING CRITICAL FACTORS THAT INFLUENCE SHIPPERS' AND INTERNATIONAL FREIGHT FORWARDERS' PREFERENCES IN CARRIER SELECTION USING INTEGRATED HIERARCHICAL INFORMATION INTEGRATION APPROACH

Jin-Long Lu

Key words: integrated hierarchical information integration, part-worth utility, preference in carrier selection, international freight forwarders.

ABSTRACT

This study adopts an integrated hierarchical information integration (HII) approach to collect the preference data from Taiwanese shippers and international freight forwarders (IFFs) of ocean carriers. In total, data from 345 shippers and 245 freight forwarders were included in the sample for analysis. The study then uses multiple linear regression models to investigate the critical factors that influence the preferences in carrier selection among shippers and IFFs. Through model estimations and part-worth utility analyses, this paper suggests that the critical factors of concern to shippers and IFFs are obviously different. Shippers place much importance on factors related to financial stability, reliability, and accuracy of documents. In contrast, IFFs place more emphasis on rates, including negotiate rates and transportation rates, as well as reputation, space available, and on-time performance. This study also highlights that shippers are more likely to consider a carrier according to its overall performance, while IFFs only value a few of critical factors when choosing a carrier.

I. INTRODUCTION

In recent decades, many studies have used survey data to explore the impact of service factors on the selection of ocean carriers from shippers' perspective. Some studies, such as Kannan *et al*. [3], Lu *et al*. [9], Panayides and Cullinane [13], Wong and Bamford [17], and so on, use descriptive statistics (i.e., means) to represent the influence of service factors on shippers' decisions. Some studies use multivariate analysis techniques to turn the attributes into fewer but more meaningful dimensions and then conduct further analyses on the basis of these dimensions in order to obtain more information on shippers' preferences in carrier selection (e.g., Lai [4]; Lu [8]; Wong *et al*. [16]; Yang *et al*. [18]).

The abovementioned studies have found that several factors have significant impacts on shippers' choices of ocean carriers, including price (rates), delivering time, service capability, reputation, reliability, punctuation, and so on. However, their conclusions were generally based on raw data analysis and most of them do not use econometric models. Hence, their results could not be validated from a theoretical perspective of statistical inference.

In addition, international freight forwarders (IFFs) also play an important role in the maritime transportation market. In particular, they act as agents of shippers who have few shipments and little shipping expertise. Thus, their preferences in selecting ocean carriers might be different from those of general shippers. Nevertheless, past studies also paid little attention to investigating the factors that influence IFFs' preferences for carriers or to analyzing the differences in their preferences as compared to those of shippers.

Accordingly, the current study investigates the importance of the service attributes with regard to shippers' as well as IFFs' preferences in ocean carrier selection. Multiple linear regression models are used to identify the statistically significant factors by surveying Taiwanese shippers and IFFs. In order to construct an efficient model that considers many potential explanatory factors, a hierarchical integrated experimental design for data collection extended from conjoint analysis (CA) is adopted. This study is one of the few that

Paper submitted 11/04/10; revised 08/22/11; accepted 03/09/12. Author for correspondence: Jin-Long Lu (e-mail: jlu@mail.nkmu.edu.tw).
Department of Shipping and Transportation Management, National Kaohsiung Marine University, Kaohsiung, Taiwan, R.O.C.

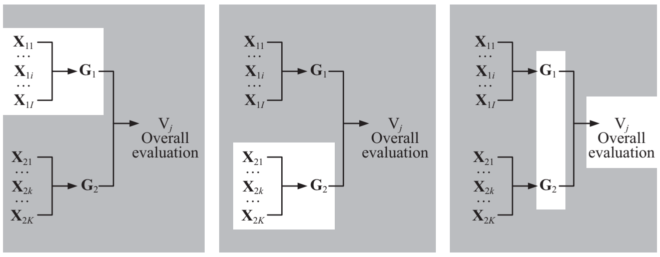

Fig. 1. Conventional HII experiments [10].

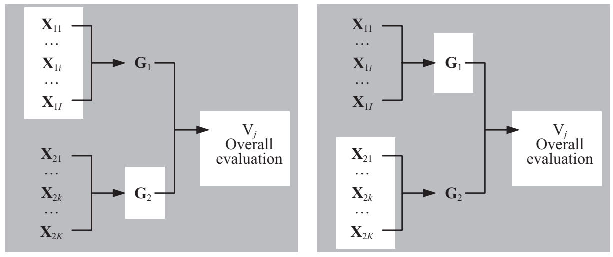

Fig. 2. Integrated HII experiments [10, 11].

uses econometric models to explore the influence of critical factors on shippers' and IFFs' decisions regarding ocean carriers.

II. CONJOINT ANALYSIS AND INTEGRATED EXPERIMENTS

Conjoint analysis (CA) is a method for measuring and modeling consumer preferences for multi-attribute alternatives [1, 6]. However, the conventional CA only handles a few attributes (e.g., normally five) in a profile at a time. If the profile is constructed by using larger numbers of attributes (e.g., more than ten), as in the current study, the hierarchical information integration (HII) method is applied [7]. The advantage of the HII method is that it enables the respondents to handle a large number of attributes via a smaller number of perception dimensions that are pre-defined by researchers. Hence, it may reduce the complexity of experiment tasks and thus avoid a situation in which respondents pay attention only to some particular attributes [15].

The HII method usually includes three steps [10]. First, the entire set of attributes is split into several non-overlapping, higher-level decision constructs on the basis of theory, logic, empirical evidence, or application demands. Fig. 1 illustrates the concept of HII with the case of two decision constructs, $\mathbf{G}_1$ and $\mathbf{G}_2$. Second, the sub-experimental design is applied for each separate construct and the CA is applied to the limited number of attributes in each construct (i.e., **X** in Fig. 1). The highlighted parts in Fig. 1 indicate which of the elements are modeled in each particular sub-experiment. Finally, the overall or bridge design is developed on the basis of the non-overlapping constructs to obtain one fully specified utility model.

In this original HII approach, the attributes in each sub-experiment are not directly related to the final response of interest. Therefore, Oppewal *et al.* [11] developed an integrated HII approach, which adds the other decision constructs to the combinations of attributes in the sub-experiments. Fig. 2 presents the essentials of this integrated HII approach for the case of two decision constructs. In this manner, each profile always presents a description of all the major aspects that are relevant to the respondents. Accordingly, the following concatenated model can be estimated across all experiments [10]:

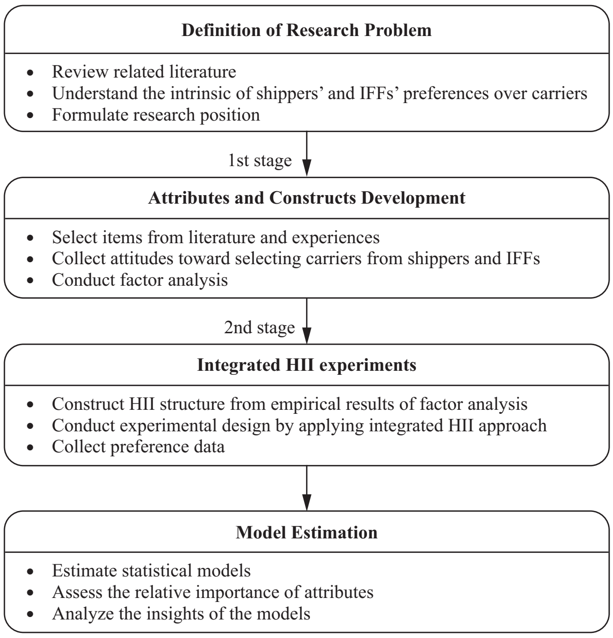

Fig. 3. Two-stage method research process.

$$V_j = \beta_0 + \sum_{m}^{M} \left(\sum_{n=1}^{N} \beta_{mn} X_{mn} + \tau_m G_m \right) + \varepsilon_j \tag{1}$$

where $V_{\cdot}$ is the utility (overall evaluation) for a hypothetical carrier service, β_0 is the constant, β_{mn} is the parameter of attribute n defining decision construct m (in Fig. 2, m = 2, and $n = I + K$), τ_m is the parameter associated with decision construct m, and $\varepsilon_{\cdot}$ is the error term.

This concatenated model includes terms for the effects of the attributes and the evaluations of decision constructs, both of which can be further expressed as the part-worth utility of each attribute or construct level. It has been proved in the study of Molin *et al.* [10] that this method is preferred for general conjoint models that involve many influential factors.

III. RESEARCH DESIGN

A two-stage method is developed to construct the integrated HII experiments and collect the stated preference data from the shippers and IFFs. Fig. 3 presents the research process of the two-stage method.

Table 1. Research constructs and attributes.

Construct/attribute	References
Reliability	
· Pickup and delivery reliability[S]	[3, 8, 9, 14, 16, 17]
· On-time arrival and departure[F]	
· Schedule reliability	
· Transit time reliability	
· Condition of equipment and containers	
General Reputation	
· Historical operating performance	[3, 8, 9, 14, 16, 17]
· Carrier reputation	
· Financial stability	
· Loss and damage records	
Rates	
· Transportation rates	[3, 13, 16, 17]
· Negotiate rates	
Service Capability	
· Various services	[3, 4, 9, 13, 14, 16, 17]
· Tracking capability	
· Multimodal services	
· Convenience of the location for picking-up and unloading goods	
· Coverage of destination ports	
· Expertise/Knowledge of sale representatives	
· Frequency of sailing	
· Acceptance of less shipments	
Shipping Order and Operation	
· Speed of issuing shipping documents	[3, 16, 17]
· Accuracy of shipping documents and bills	
· Speed of claims	
· Space availability	
Communication	
· Interaction with customers	[3, 9, 14, 16, 17]
· Willingness to negotiate services to satisfy needs	
· Responses and communication with regard to shipping business	
· Familiar with local regulations and systems	

[S]: Shippers; [F]: IFFs

Table 2. Service attributes and means from shippers and IFFs.

	Shippers (N = 345)	IFFs (N = 218)
Pickup and delivery reliability[S]/On-time arrival and departure[F]	4.61	4.58
Schedule reliability	4.55	4.50
Responses and communication with regard to shipping business	4.53	4.42
Tracking capability	4.52	4.46
Accuracy of shipping documents and bills	4.50	4.44
Space availability	4.44	4.59
Transportation rates	4.43	4.48
Transit time reliability	4.43	4.55
Negotiate rates	4.36	4.45
Speed of issuing shipping documents	4.34	4.31
Willingness to negotiate services to satisfy needs	4.31	4.30
Expertise/Knowledge of sale representatives	4.26	4.44
Interaction with customers	4.20	4.42
Speed of claims	4.18	4.19
Familiar with local regulations and systems	4.18	4.04
Loss and damage records	4.15	4.14
Frequency of sailing	4.09	4.23
Convenience of the location for picking-up and unloading goods	4.06	4.23
Financial stability	4.03	4.32
Carrier reputation	3.97	4.05
Condition of equipment and containers	3.97	4.08
Coverage of destination ports	3.93	4.05
Multimodal services	3.89	4.19
Historical operating performance	3.85	3.91
Various services	3.66	4.02
Acceptance of less shipments	3.60	3.85

[S]: Shippers; [F]: IFFs

1. First Stage: Determining Service Constructs, Attributes, and Their Levels

The first step in constructing the integrated HII experiments concerned the decomposition of the complex problem of shippers'/IFFs' preferences for ocean carriers. After reviewing several studies that analyze the service quality of carriers (see Section 1), a preliminary list of six constructs and associated 26 attributes was drawn up, as described in detail in Table 1. The list of the constructs/attributes in had been modified after considering suggestions from several experts and preliminarily analyzing data from pre-test.

These attributes were then transformed into a paper questionnaire and mailed to Taiwanese manufacturers whose export shipments were ranked in the top 1,000 firms and to almost 500 IFFs that mainly provide ocean freight-forwarding services. The measurement task was based on a five-point importance scale, from "very important", "important", "neutral", "unimportant", to "very unimportant", of each attribute in the shippers' or IFFs' decisions with respect to ocean carriers. Moreover, the questionnaire used in this stage also included questions regarding respondents' backgrounds and their firm size. Also, respondents were asked to indicate their willingness to participate in the second stage.

A total of 345 useful responses were received from shippers (manufacturer firms) and 218 from IFFs. Table 2 indicates that attributes that are considered much important for shippers include reliable pickup/delivery and scheduling, good communication, tracking capabilities, and accuracy of related

Table 3. Results of factor analysis – Shippers.

	Reliability	General Reputation	Transportation Rates	Service Capability	Shipping Documentation Process
Tracking capability	0.817				
Pickup and delivery reliability	0.786				
Transit time reliability	0.725				
Carrier reputation		0.725			
Financial stability		0.803			
Transportation rates			0.871		
Various services				0.710	
Multimodal services				0.686	
Coverage of destination ports				0.640	
Speed of issuing shipping documents					0.762
Accuracy of shipping documents and bills					0.803
Cronbach's alpha	0.841	0.752	–	0.817	0.660
Cumulative explained variance	8.583				
Percentage of cumulated explained variance	78.027%				

Table 4. Results of factor analysis - IFFs.

	Reliability	General Reputation	Rates	Communication	Space Availability
Schedule reliability	0.816				
On-time arrival/departure	0.888				
Transit time reliability	0.728				
Historical operation performance		0.850			
Carrier reputation		0.885			
Negotiate rates			0.795		
Transportation rates			0.854		
Willingness to negotiate service to satisfy needs				0.774	
Expertise/Knowledge of sale representatives				0.840	
Interaction with customers				0.851	
Space availability					0.893
Cronbach's alpha	0.862	0.811	0.676	0.887	–
Cumulative explained variance	8.029				
Percentage of cumulated explained variance	72.991%				

documents. In contrast, the most important factor for IFFs is the availability of space, with on-time performance in close second place. These results show that shippers and IFFs ascribe importance to different attributes.

However, among these 345 responses from shippers, only 100 of them deal directly with carriers. In other words, these 100 shippers may have had different considerations when selecting carriers as compared with the IFFs. In addition, among the 218 IFF respondents, some were branch offices of the same company, thereby implying that they were likely to have the same policy for selecting carriers. Accordingly, only 100 IFFs were screened for further analysis. Therefore, these two sets of 100 cases, one each for shippers and IFFs, were used to conduct factor analysis. Further, some of the attributes were deleted due to low factor loadings. The details of the factor analysis are presented in Tables 3 and 4 for shippers and IFFs, respectively.

Table 3 reports that five decision constructs are abstracted from the shippers' sample. They are named on the basis of the meanings of the attributes included in each factor: *Reliability*, *General Reputation*, *Transportation Rates*, *Service Capability*, and *Shipping Documentation Process*. With the exception of *Transportation Rates*, the other four are multi-index constructs. The results of a reliability test, in terms of Cronbach's Alpha values, show that each construct is reliable. Further, the following five constructs are also extracted with regard to IFFs (Table 4): *Reliability*, *General Reputation*, *Rates*, *Communication*, and *Space Availability*. Among these, *Space Availability* is a single-index construct. The magnitudes of Cronbach's Alpha indicate that the constructs are also reliable.

Hence, the hierarchical decision structures for measuring the preferences for carriers among both shippers and IFFs are developed, as shown in Figs. 4 and 5, respectively. All

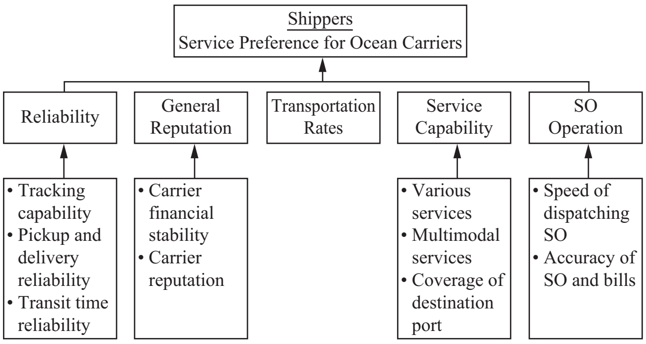

Fig. 4. Hierarchical decision structure for shippers.

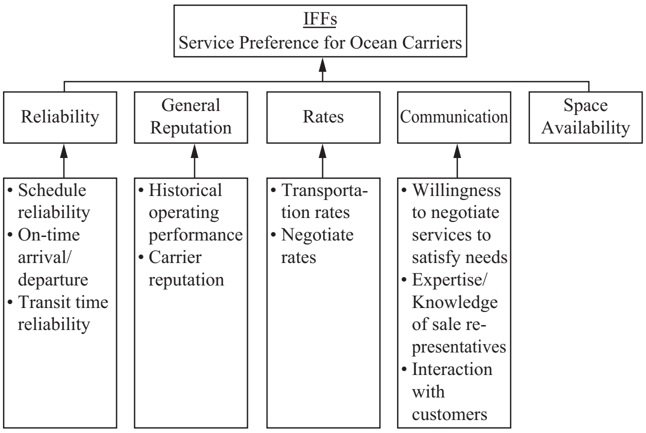

Fig. 5. Hierarchical decision structure for IFFs.

attributes and constructs were assigned three levels and scored 1, 3, or 5 on the basis of a five-point rating scale, with a high score indicating better service performance.

2. Second Stage: Administering the Integrated Hierarchical Information Integration Experiment

The next step was constructing integrated HII experiments with regard to the combination of attribute levels and decision construct levels in order to create hypothetical profiles of carrier services. As described above, applying the integrated HII experiment needs five sub-experiments for both shippers and IFFs. Each sub-experiment includes a subset of attributes that define a particular decision construct and the remaining four decision constructs.

To illustrate, the first sub-experiment for shippers uses the subset of the attributes of *Reliability*—including tracking capability, pickup and delivery reliability, and transit time reliability—and the other four decision constructs, which are *General Reputation*, *Transportation Rates*, *Service Capability*, and *Shipping Documentation Process*. Therefore, it has 3^7 combination of profiles (i.e., three attributes plus four constructs, each with three levels) and reduces to 27 profiles using fractional factorial design. Similarly, the remaining four sub-experiments contain the 3^6 (*General Reputation*), the 3^5 (*Transportation Rates*), the 3^7 (*Service Capability*), and the 3^6 (*Shipping Documentation Process*) full-factorial designs, each with 27 profiles. The integrated HII experiments for IFFs also generate 27 profiles for each sub-experiment.

Afterward, this study drew one profile from each of the five sub-experiments to integrate into a questionnaire for the second-stage survey. The survey also adopted the mail-back method. The questionnaire was sent only to those who had replied to the first survey and were willing to participate in the second stage of the investigation. This included 100 manufacturing firms conducting freight shipping business directly with carriers, and 100 IFFs. The managers or the employees who work with the shipping department in the manufacturing firms and the upper-level managers in IFFs are the targets in the investigation, as these individuals are supposed to be involved in the selection of ocean carriers. The survey required the respondents to rate how each profile (in each of the sub-experiments) was favored by using the rating scale ranging from (1) "extremely disfavored" to (100) "extremely favored." Besides, backgrounds of firms as well as IFFs are also requested in the survey.

In the end, 79 effective responses from shippers and 70 from IFFs were obtained in the second stage for model estimation. The sample of shippers showed that the average export shipments were generally below 20 TEUs per month. However, 17% of shippers had average export shipments of less than 1 TEU per month, and 19% had export shipments of over 60 TEUs. For IFFs, over 70% of the respondents' monthly shipments were no more than 400 TEUs, and of these, 50% were less than 100 TEUs. In addition, the frequency of exporting for shippers was mostly in the range of two to three days; however, 28% and 20% of IFFs were in the ranges of four to seven days and daily, respectively. Furthermore, up to three-fourths of the shippers had long-term contracts with carriers, while only approximately 50% of IFFs had such contracts. Finally, up to 60% of IFFs had less than 26 employees, thereby indicating that the scale of most freight forwarders in Taiwan is small.

IV. MODEL RESULTS

1. The Estimated Model

Multiple linear regression models were estimated for shippers and IFFs separately by using pooled preference data across all profiles. All attributes and constructs were coded using orthogonal polynomials in order to account for possible non-linear effects among attribute levels. In other words, for any attribute with K levels, K-1 indicator variables are constructed. Table 5 presents the coding scheme. The first indicator is used to capture the linear effects of the attributes, while the second is used to capture any quadratic effects.

The part-worth utility of each attribute level is further calculated using Eq. (2), and the importance of each attribute relative to the other attributes is then derived using Eq. (3) (Hu and Hiemstra, 1996).

$$v_{ij} = \beta_{iL} \cdot I_{Lj} + \beta_{iQ} \cdot I_{Qj} \tag{2}$$

Table 5. The orthogonal coding scheme.

	Indicator 1	Indicator 2
Attribute level 1 (1)	–1	1
Attribute level 2 (3)	0	–2
Attribute level 3 (5)	1	1

where v_{ij} is the part-worth utility of attribute i, level j (j = 1, 2, 3); β_{iL} and β_{iQ} are the coefficients of linear and quadratic components, respectively, of attribute i; I_{Lj} is the coded score for the linear component of level j; and I_{Qj} is the coded score for the quadratic component of level j (see Table 5).

$$W_i = \frac{Max(v_{ij}) - Min(v_{ij})}{\sum_{i=1}^{I} Max(v_{ij}) - Min(v_{ij})} \times 100\% \qquad (3)$$

where W_i is the relative importance of attribute i in percentage terms; $Max(v_{ij})$ is the maximum part-worth utility of level j in attribute i; and $Min(v_{ij})$ is the minimum part-worth utility of level j in attribute i. Tables 6 and 7 report the recovered part-worth utility and importance of the attributes of the shippers' and IFFs' preference models, respectively.

The aim of the conjoint model estimation in this study is to decompose the overall carrier service evaluations into the separate contributions of the attributes. In other words, the major objective of the model analysis is to calculate the importance of the attributes affecting the decisions of both shippers and IFFs. Consequently, the estimated results of decision constructs, also in terms of part-worths and importance, are not reported in Tables 6 and 7.

2. Results from the Shippers' Model

Table 6 presents the part-worth utilities of each attribute level derived from Eq. (2). The linear terms of attributes are significant at the α-level of 0.1, except for the attributes of various services, multimodal services, and speed of issuing shipping documents. The goodness-of-fit of the shippers' preference model is assessed in terms of R^2. However, R^2 is 0.41 as the model is estimated from the disaggregate perspective.

According to the magnitudes and trends of part-worth utilities across attribute levels presented in Table 6, the effects of attributes on shippers' preferences are indeed non-linear, as the differences among various levels are not equal. Nevertheless, the trends suggest that the effects of these attributes on shippers' preference increase with an increase in service level.

Carrier financial stability is the most important attribute, as it has the largest range of part-worth utility from the lowest to the highest service level. The importance of this attribute accounts for 13.9% of all attributes. This is followed by pickup and delivery reliability, whose importance accounts for 11.3% of the total. The third most important attribute is

Table 6. Attribute part-worths and relative importance in shippers' preference model.

	Part-worths	Importance(%)
Reliability		
- Tracking capability		9.02% (6)[1]
Level (1)	-3.78	
Level (3)	-1.32	
Level (5)	5.10	
- Pickup and delivery reliability		11.29% (2)
Level (1)	-5.46	
Level (3)	-0.20	
Level (5)	5.66	
- Transit time reliability		10.24% (3)
Level (1)	-6.49	
Level (3)	2.89	
Level (5)	3.60	
General Reputation		
- Carrier financial stability		13.93% (1)
Level (1)	-5.77	
Level (3)	-2.18	
Level (5)	7.95	
- Carrier reputation		9.14% (5)
Level (1)	-5.13	
Level (3)	1.25	
Level (5)	3.87	
Transportation Rates		8.08% (9)
Level (1)	-5.05	
Level (3)	2.91	
Level (5)	2.14	
Service Capability		
- Various services		7.01% (10)
Level (1)	-4.12	
Level (3)	1.34	
Level (5)	2.78	
- Multimodal services		8.16% (7)
Level (1)	-3.18	
Level (3)	-1.68	
Level (5)	4.86	
- Coverage of destination port		8.10% (8)
Level (1)	-4.54	
Level (3)	1.10	
Level (5)	3.44	
Shipping Documentation Process		
- Speed of issuing shipping documents		5.22% (11)
Level (1)	-2.09	
Level (3)	-0.96	
Level (5)	3.05	
- Accuracy of shipping documents and bills		9.81% (4)
Level (1)	-6.17	
Level (3)	2.68	
Level (5)	3.49	
Intercept	7.83 (t = 5.38)	
R^2	0.41	
Adj. R^2	0.33	
Number of cases	395	

[1]: the number in parentheses is the rank.

Table 7. Attribute part-worths and relative importance in IFFs' preference model.

	Part-worths	Importance (%)
Reliability		
- Schedule reliability		4.18% (9)[1]
Level (1)	-1.69	
Level (3)	-0.97	
Level (5)	2.66	
- On-time arrive/departure		11.12% (5)
Level (1)	-6.33	
Level (3)	1.07	
Level (5)	5.26	
- Transit time reliability		7.33% (7)
Level (1)	-2.94	
Level (3)	-1.76	
Level (5)	4.70	
General Reputation		
- Historical operating performance		2.91% (10)
Level (1)	-1.74	
Level (3)	0.44	
Level (5)	1.29	
- Carrier reputation		13.84% (3)
Level (1)	-7.87	
Level (3)	1.32	
Level (5)	6.55	
Rates		
- Transportation rates		15.62% (2)
Level (1)	-7.79	
Level (3)	-0.69	
Level (5)	8.48	
- Negotiate rates		18.51% (1)
Level (1)	-10.82	
Level (3)	2.36	
Level (5)	8.46	
Communication		
- Willingness to negotiate services to satisfy needs		0.38% (11)
Level (1)	-0.19	
Level (3)	-0.02	
Level (5)	0.21	
- Expertise/Knowledge of sale representatives		5.86% (8)
Level (1)	-3.43	
Level (3)	0.76	
Level (5)	2.67	
- Interaction with customers		7.40% (6)
Level (1)	-2.75	
Level (3)	-2.20	
Level (5)	4.96	
Space Available		12.85% (4)
Level (1)	-6.49	
Level (3)	-0.40	
Level (5)	6.90	
Intercept	9.47 (t = 10.12)	
R^2	0.49	
Adj. R^2	0.43	
Number of cases	350	

[1]: the number in parentheses is the rank.

transit time reliability. The fourth and fifth are accuracy of shipping documents and bills and carrier reputation, respectively. Accordingly, shippers place greater emphasis on carriers' performance with respect to reliability, accuracy, and overall reputation.

In contrast, the least important attribute is speed of issuing shipping documents, which accounts for only 5.2% of overall importance. This indicates that the processes for issuing shipping orders and related documents are now systemized in most carriers; hence, the speed of issuing shipping documents may not be a critical variable in making a choice of carrier. The second less important attribute is various services. As maritime transportation is a mature industry, most carriers not only provide transportation services, but also offer a wide variety of other services to customers, such as inland transportation, multi-country consolidation, and warehousing services. Thus, the importance of carriers' capability of providing various services may also be a minor consideration.

3. Results from the IFFs Model

In the original estimated model, also not reported here, the linear terms of the attributes of willingness to negotiate services to satisfy needs, expertise/knowledge of sale representatives, and historical operating performance are estimated to be statistically insignificant as their t-statistics values are under 1.645, with p-values greater than 0.1. The goodness-of-fit of the IFFs' preference model, in terms of R^2, is close to 0.5.

According to Table 7, the impact of the attributes on IFFs' preferences for carriers increases along with an increase in the level of service. Negotiate rates is the most important attribute, followed by transportation rates. Both these attributes are attributed to the decision construct of Rates and account for 18.5% and 15.6% of importance of all attributes, respectively. This is because the primary income of IFFs comes from the difference between the amount charged to the shippers and paid to the carriers. Thus, IFFs will prefer a carrier that is willing to negotiate rates and offer good deals.

Further, the importance of carrier reputation and space available rank third and fourth, respectively. Since IFFs play an agent role of shippers, they have to ensure that carriers can offer sufficient space before transferring the shippers' goods to them. The fifth important factor is on-time arrive/departure. Each of the top five factors contributes over 10% of the importance of all attributes.

The least important attributes are willingness to negotiate services to satisfy needs and historical operating performance, both of which account for less than 1% of the total. This suggests that IFFs are also involved in the role of carriers from the shippers' perspective, and most IFFs are capable of providing customized services to shippers (i.e., third-party logistics providers). In addition, IFFs would also expect to obtain customized services from carriers. As a result, when selecting an ocean carrier, the attribute of willingness to negotiate services to satisfy needs might be ignored because

Table 8. Top five important attributes for shippers and IFFs.

Rank	Shippers	IFFs
1	Carrier financial stability (14%)	Negotiate rates (19%)
2	Pickup and delivery reliability (11%)	Transportation rates (16%)
3	Transit time reliability (10%)	Carrier reputation (14%)
4	Accuracy of shipping documents and bills (10%)	Space available (13%)
5	Carrier reputation (9%)	On-time arrive/departure (11%)

this is simply what carriers are expected to do, as opposed to providing a special service. Moreover, most IFFs have long-term partner carriers, and thus they are familiar with those carriers' operating performance.

4. Insights of Model Analysis

This study uses econometric models to investigate the critical factors influencing the preferences of shippers and IFFs with regard to ocean carriers. The models suggest that the critical factors are rather different for shippers and IFFs. Table 8 summarizes the top five important criteria for both groups. With respect to the level of importance of these factors in percentage terms, the top five factors identified by the IFFs account for 70% of overall importance implying that IFFs are mostly concerned with only a few critical factors when choosing an ocean carrier, especially *Rates*. However, shippers seem to value a carrier from the perspective of overall performance, as other factors—apart from the top five—also account for 50% of the total.

These findings have some implications suggesting that carriers should adopt a strategy of modifying or strengthening certain services when dealing with shippers or IFFs. For illustration, carriers should offer good prices when conducting business with IFFs on the one hand; they should also enhance the reliability in the aspect of finance, transit time, and delivery, the accuracy of documents, and the firms' reputation on the other hand to maintain relationships well to general shippers.

V. CONCLUDING COMMENTS

To date, little work has been done to compare the differences between the preferences of shippers and IFFs for ocean carriers. Thus, the current paper can not only add to the academic literature, but also provide carriers with practical suggestions with regard to the manner in which to cultivate their business with shippers and IFFs. This study is also one of the few that uses the integrated HII method and econometric models to explore the importance of the influential factors on the decision-making processes of shippers and IFFs in terms of choosing ocean carriers.

The advantage of the integrated HII method is to incorporate large numbers of attributes into choice profiles at a time to prevent respondents paying attention to only a subset of attributes. This study practically examines the benefits of integrated HII method and concludes the importance of each influenced factor from statistical perspectives. Hence, the findings of this study can be considered stronger than those of other studies as most of these studies derived the conclusions only from raw data descriptive statistical analysis. However, this study only selects 11 critical factors for model analysis. It remains to be seen that the integrated HII method would perform better if the number of attributes increases. This provides a direction for future studies.

APPENDIX

The importance of each attribute in Table 6 and Table 7 is calculated using Eq. (3). For illustration, the importance of the factor of 'Tracking capability' in shippers' preference model = (5.10 – (–3.78)) / [(5.10 – (–3.78)) + (5.66 – (–5.46)) + (3.60 – (–6.49)) + (7.95– (–5.77)) + (3.87 – (–5.13)) + (2.91 – (–5.05)) + (2.78 – (–4.12)) + (4.86 – (–3.18)) + (3.44 – (–4.54)) + (3.05 – (–2.09)) + (3.49 – (–6.17))].

ACKNOWLEDGMENTS

The authors of this paper would like to thank Ms. Meng-Tsu Chang for her assistance in collecting the data.

REFERENCES

1. Green, P. E. and Srinivasan, V., "Conjoint analysis in marketing: New developments with implications for research and practice," *Journal of Marketing*, Vol. 54, No. 4, pp. 3-19 (1990).
2. Hu, C. and Hiemstra, S. J., "Hybrid conjoint analysis as a research technique to measure meeting planners' preferences in hotel selection," *Journal of Travel Research*, Vol. 35, No. 2, pp. 62-69 (1996).
3. Kannan, V., Bose, S. K., and Kannan, N. G., "An evaluation of ocean container carrier selection criteria: An Indian shipper's perspective," *Management Research Review*, Vol. 34, No. 7, pp. 754-772 (2011).
4. Lai, K.-H., "Service capability and performance of logistics service providers," *Transportation Research Part E*, Vol. 40, No. 5, pp. 385-399 (2004).
5. Lai, K.-H. and Cheng, T. C. E., "A study of freight forwarding industry in Hong Kong," *International Journal of Logistics: Research and Applications*, Vol. 7, No. 2, pp. 71-84 (2004).
6. Louviere, J. J., "Conjoint analysis modelling of stated preferences: a review of theory, methods, recent developments and external validity," *Journal of Transport Economics and Policy*, Vol. 22, No. 1, pp. 93-121 (1988).
7. Louviere, J. J. and Gaeth, G. J., "Decomposing the determinants of retail facility choice using the method of hierarchical information integration: A supermarket illustration," *Journal of Retailing*, Vol. 63, No. 1, pp. 25-48 (1987).
8. Lu, C.-S., "The impact of carrier services attributes on shipper-carrier partnering relationships: a shipper's perspective," *Transportation Research E*, Vol. 39, No. 5, pp. 399-415 (2003).
9. Lu, J., Gong, X., and Wang, L., "An empirical study of container terminal's service attributes," *Journal of Service Science and Management*, Vol. 4, No. 1, pp. 97-109. (2011).

10. Molin, E. J. E., Oppewal, H., and Timmermans, H. J. P., "Conjoint modeling of residential group preferences: a comparison of the internal validity of hierarchical information integration approaches," *Journal of Geographical Systems*, Vol. 4, No. 4, pp. 343-358 (2002).
11. Oppewal, H., Louviere, J. J., and Timmermans, H. J. P., "Modeling hierarchical conjoint process with integrated choice experiments," *Journal of Marketing Research*, Vol. 31, No. 1, pp. 92-105 (1994).
12. Oppewal, H. and Vriens, M., "Measuring perceived service quality using integrated conjoint experiments," *International Journal of Bank Marketing*, Vol. 18, No. 4, pp. 154-169 (2000).
13. Panayides, P. M. and Cullinane, K. P. B., "The vertical disintegration of ship management: Choice criteria for third party selection and evaluation," *Maritime Policy and Management*, Vol. 29, No. 1, pp. 45-64 (2002).
14. Plomaritou, E. I., Plomaritou, V., and Giziakis, K., "Shipping marketing and customer orientation: The psychology and buying behavior of charterer and shipper in the tramp and liner market," *Management*, Vol. 16, No. 1, pp. 57-89 (2011).
15. Timmermans, H. J. P. and Molin, E., "Dealing with increased complexity in conjoint experiments: Background and overview of alternative approaches," *Transport Reviews*, Vol. 29, No. 5, pp. 557-567 (2009).
16. Wong, P. C, Yan, H., and Bamford, C., "Evaluation of factors for carrier selection in the China Perl River delta," *Maritime Policy and Management*, Vol. 35, No. 1, pp. 27-52 (2008).
17. Wong, P. C. C. and Bamford, C., "Carrier and mode selection for shippers in the Pearl River Delta of the People's Republic of China - A case study of Zhongshan and Foshan," *Proceedings of the 15th Annual Logistics Research Network Conference, The Chartered Institute of Logistics and Transport UK*, Northamptonshire, UK, pp. 709-718 (2010).
18. Yang, C. C., Marlow, P. B., and Lu, C. S., "Assessing resources, logistics service capabilities, innovation capabilities and the performance of container shipping services in Taiwan," *International Journal of Production Economics*, Vol. 122, No. 1, pp. 4-20 (2009).