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Classification and competition analysis of air cargo logistics providers: The case of Taiwan's high-technology industry

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A B S T R A C T

This paper classifies air cargo logistics providers allowing analysis of high-technology manufacturers' choices of providers. Data are collected from high-technology manufacturers in Taiwan's science parks. Forwarder providers are put into three categories and nested logit model are applied to explore what service performance factors influence high-technology manufacturers when selecting third party logistics providers. Delivery is found to be the most important factor. It is found, for example, that two express providers with high levels of customer satisfaction and market share could compete more effectively by exercising differential strategies.

1. Introduction

High-technology industry plays an important part in economies across the globe. Typically, the values of high-technology products are high requiring fast and reliable transportation. High-technology manufacturers consume a wide variety of third party logistics (TPL) services, and in particular air transportation. As a result, the market for TPL services has increased and become highly competitive.

This paper does two things. It identifies important service performance factors that affect the selection of TPL service providers and predicts the TPL market shares in response to changes in service quality. To achieve this, a categorization of providers is made and a carrier choice model is calibrated.

2. Methodology

2.1. Data collection

Taiwan's high-technology industry is export intensive and extremely dependent on TPL firms for international transportation and distribution services. Two science parks, both established by the government of Taiwan, are examined with regard to their use of TPL providers as primary transport sources for moving their products by air to overseas. The survey consists of three sections. The first obtained a profile of the firms and individuals questioned, including such things as the respondent's position, industrial category, years of operation, company capital, number of employees, product status, and sale destinations. The second section concerns on the firms previous shipment records including average frequency of shipment and shipment weight. The final section identifies which TPL firms are used most frequently for major destinations and factors affecting this decisions. Respondents were asked to describe satisfaction levels on a five-point Likert scale from "1 = very dissatisfied" to "5 = very satisfied", and on the same basis to identify and describe satisfaction levels with two competing TPL firms that they had previously used.

Some 498 high-technology firms in the science park were contacted by phone and among the 178 firms who agreed to fill out the survey, 71 returned the questionnaire in October 2006. After removing invalid replies, the sample was further reduced to 67. To enlarge the sample, we asked the high-technology firms who had initially accepted to participate to indicate both choice preferences for TPL providers and customer satisfaction with service performance items for their second and third sales destinations, if available. For example, a respondent might list the US as the major sales destination and Europe and China as the second and third sales destinations. The ultimate number responses are 117.

The survey indicates that business titles of the respondents ranged from senior commissioner for divisions such as logistics management, import/export, production, transportation/warehousing, and global logistics to deputy manager or above. High-technology manufacturers in the science-based industrial parks can be categorized as integrated circuits (32.8%), optoelectronics (19.4%), biotechnology (3.0%), telecommunications (23.8%), precision machinery (10.5%), and computers and peripherals (10.5%); proportions close to the national levels. The majority of respondents had been operational for six to ten years and capital of most

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Table 1
Service performance items and factors of TPL providers.

Factor	Item	Source
Service cost	Service rate	Tsai et al. (2007)
	Level of rate concession	Tsai et al. (2007)
	Fairness of loss or damage claim	Tsai et al. (2007)
Delivery	Speed	Tsai et al. (2007)
	On-time reliability	Tsai et al. (2007)
	Door-to-door service	Tsai et al. (2007)
	Security	Tsai et al. (2007)
	Service frequency	Hsu et al. (2005); Maier et al. (2002); Norojono and Young (2003)
Response	Customer problem solving	Aktas and Ulengin (2005); Boyson et al. (1999); Menon et al. (1998); Norojono and Young (2003)
	Personnel attitude	Aktas and Ulengin (2005); Hsu et al. (2005)
	Exception management capability	Tsai et al. (2007)
Information	Tracking and tracing service	Aktas and Ulengin (2005); Boyson et al. (1999); Hsu et al. (2005); Lu (2004)
	EDI capability	Aktas and Ulengin (2005); Boyson et al. (1999); Lu (2004)
Perceived capability	Past experience and expertise	Tsai et al. (2007)
	Financial status	Tsai et al. (2007)

was less than $13 million. More than 50% of the respondents' firms had less than 100 employees. The most frequently reported shipment destination was China.

2.2. Classification of TPL providers

A large number of number of TPL providers are used by high-technology manufacturing firms. Hsu et al. (2005) found high-technology firms' demand for air cargo logistics services and classified TPL providers by size and scope of operations; international providers (including DHL and UPS) were distinguished from local air logistics firms. Since high-technology manufacturing firms primarily use only air express and freight forwarders in Taiwan these are taken as the focal point of analysis (Tsai et al., 2007).

Although many TPL providers are available, the number of express logistics providers is limited to global companies that compete to serve the high-technology industry. In contrast, forwarding logistics providers often dominate the bulk cargo market where they provide customized and flexible services by coordinating business resources between organizations. In the sample, the high-technology manufacturers used 38 TPL providers, including 35 forwarder providers and three global integrators with air cargo express services as a core competency (FedEx, UPS, and DHL).

3. Analysis

Ward's hierarchical clustering analysis is used to obtain groups of forwarders (Myers and Mullet, 2003). Nested logit analysis is then used to investigate how high-technology manufacturers select TPL providers. Earlier studies have identified a number of service items that can affect selection of TPL providers (Table 1). To narrow these down factor analysis is performed and the results suggest that service performance items can be classified under delivery, service cost, response, information service, and perceived capability (Table 2).

Table 3 gives the results of a hierarchical cluster analysis, in which 35 forwarder providers were divided into three groups. The interpretation is based on the characteristics of each cluster. Taiwan-owned global forwarders (TG) made up 28.5% of the sample. Foreign-owned global forwarders (FG) offer international cargo transport by air and sea with additional value-added logistics services, and make up 48.6% of the sample. The other cluster was labeled as the Taiwan-owned regional forwarder (TR) segment, consisting of TPL firms that are too small to be TGs.

From this we defined a universal choice set consisting of six alternatives: three express TPL providers (E1, E2, and E3) and three types of forwarder firms (TG, FG, and TR). The initial specification of

Table 2
Factor analysis.

Factor and item	Factor loading	*t*-value	Item reliability	Composite reliability	Variance extracted
Factor 1: Service cost				0.84	0.65
Service rate	0.77	11.16	0.59		
The level of rate concession	0.87	11.43	0.76		
Fairness of loss or damage claim	0.77	11.22	0.60		
Factor 2: Delivery				0.89	0.62
Speed	0.88	23.38	0.77		
On-time reliability	0.78	17.59	0.61		
Door-to-door service	0.75	13.33	0.57		
Security	0.79	20.12	0.62		
Service frequency	0.76	15.92	0.57		
Factor 3: Response				0.86	0.66
Customer problem solving	0.86	20.94	0.74		
Personnel attitude	0.80	20.19	0.64		
Exception management capability	0.82	20.45	0.67		
Factor 4: Information service				0.85	0.77
Tracking and tracing service	0.88	27.11	0.77		
EDI capability	0.84	25.30	0.71		
Factor 5: Perceived capability				0.89	0.82
Past experience	0.95	27.29	0.91		
Financial status	0.86	19.15	0.74		

Number of samples = 307; adjusted goodness of fit index = 0.99; comparative fit index = 0.99; non-normed fitted index = 0.99; root mean square error of approximation = 0.043; ratio of chi-square to degrees of freedom (χ^2/df) = 1.57