An Empirical Taxonomy for Logistics Service Providers

ABSTRACT

This study investigates the existence of different types of logistics service providers (LSPs) and the relationship of type with service performance. A cluster analysis of the survey data from 221 LSPs resulted in the identification of four types of LSP. The taxonomy was developed that reveals that LSPs are at various stages of development in terms of service capability, and highlights the service strategies of the different LSP types and their performance implications. The taxonomy provides insights into the characteristics of different types of LSPs, which underpin different market segments of the logistics service business. Discussions of the use of the taxonomy for LSPs to improve their service capability and performance are provided.

Keywords: Logistics services, Capability, Performance, Cluster analysis, Market segments

INTRODUCTION

Logistics has developed into an integral part of the corporate strategy of many firms, contributing to the primary activities of their value chain (which span inbound logistics, operations, outbound logistics, marketing and sales, services), and ultimately creating cost and service advantages to the firm (Porter 1985). On the other hand, many manufacturers and retailers nowadays have adopted a supply chain management (SCM) focus and increasingly outsource their logistics activities to logistics service providers (LSPs) to cater to their logistics service needs. Generally, an LSP carries out the logistics activities for a shipper. These activities consist of at least the management and running of the transportation function. An LSP can also provide other services, for example, inventory management, warehousing, materials management, information-related services such as tracking and tracing, value-added services such as secondary assembly and the installation of products, and even supply chain management (Berglund, van Laarhoven, Sharman and Wandel 1999). In this study, LSP is broadly defined as a provider of logistics services that performs all or part of a client company's logistics function (Coyle, Bardi and Langley 1996; Delfmann, Albers and Gehring 2003).

Indeed, using the services of an LSP has become a popular business practice for many large companies. In a study of the use of LSP services by Australian firms over the period 1995 to 1999, Sohal, Millen and Moss (2002) found that, over time, firms have become more comfortable with outsourcing logistics. More firms have expanded their use to include international activities and have made a longer commitment to their service providers. Similarly, Lieb and Miller (2002) conducted a survey of the chief logistics executives of large manufacturers in the United States on their use of LSP services and found that 77% of the Fortune 500 manufacturers in the U.S. use LSP services. They speculated that such use will

continue to grow due to the major cost savings and service improvements experienced by the users. Their study concluded that the scope of the service requirements of users of logistics services will continue to expand. To capture this market opportunity, many LSPs have taken the initiative to offer a wider variety of logistics services. One of their important decisions concerns the extent to which they should expand their service capability and improve their service performance (Lai and Cheng 2003).

There are studies on how value can be created by LSPs and the strategic segmentation of the industry. For instance, Berglund et al. (1999) developed a conceptual taxonomy for value creation by LSPs and outlined the skills required to achieve value creation. Their taxonomy suggests that there are four ways that LSPs can add value with an increasing degree of operational complexity, namely 1) operational efficiency, 2) integration of customer operations, 3) vertical or horizontal integration, and 4) supply chain management and integration. The emphasis in the first two ways of adding value is on operational efficiency (e.g. freight forwarding consolidation efficiency) and on the sharing of resources that are entirely internally focused (e.g. warehouses) among several shippers. The third way to add value is achieved by outsourcing activities to other LSPs that have the best expertise or by joining forces with similar, but complementary, LSPs, e.g. developing a network of service providers. The fourth way for LSPs to create value is to use conceptual logistics skills to improve the supply chains of customers, e.g. by introducing cross-docking facilities to eliminate the unnecessary storage of inventories.

Furthermore, topics related to LSPs have received a great deal of attention in the logistics literature. For instance, Leahy, Murphy and Poist (1995) examined the operational characteristics of LSPs and the factors that affect successful relationships with their customers. Daugherty,

Stank and Rogers (1996) conducted a survey on the capabilities of LSPs from purchasers' perception and identified the differences between high-performance and low-performance LSPs. Sink and Langley (1997) proposed a managerial framework for the buying process for logistics services from LSPs. Harding (1998) developed a technique for LSPs to evaluate and prioritize actions for improving their service performance. Mentzer, Flint and Kent (1999) expanded the service quality domain into a logistics context and established a measurement scale for evaluating logistics service quality. Persson and Virum (2001) examined the growth strategies for LSPs and proposed a matrix categorizing LSPs on the basis of their strategic positions. Similarly, Bolumole (2001) investigated the supply chain role of LSPs and identified several factors that might affect the capability of LSPs to add value to the supply chain. In view of the potential of electronic commerce for reducing logistics costs and improving customer services, there were studies on the use of electronic commerce and its impact on LSPs (e.g. Lynagh, Murphy, Poist and Grazer 2001; Delfmann, Albers and Gehring 2002). Recently, Stank, Goldsby, Vickery and Savitskie (2003) examined the relationships among logistics service performance, satisfaction, loyalty, and firm market share in the LSP context.

Nevertheless, the research thus far on LSPs has tended to focus on investigating the important facets of logistics services (Murphy and Poist 2000), customer selection criteria (Menon, McGinnis and Ackerman 1998), and on the strategic development of LSPs (Hertz and Alfredsson 2003). Very little research has been devoted to understanding different types of LSPs and linking them with their service performance. There are publications examining the revenue issues, shipper and customer relationships, industries served, capabilities and case histories of LSPs from the practitioner's perspective (e.g. Armstrong 1999). However, the academic literature is unclear as to the current state of development of the service capabilities of LSPs: are

all LSPs similar or are there different types of LSPs in terms of service capability? If different types of LSPs do exist, it would be useful to understand the extent of the service capability of each type of LSP and how that capability is related to service performance. The objective of this study is to empirically investigate whether different types of LSPs exist and, if so, what is the service capability of each type of LSP and how service capability is related to service performance.

Our research findings contribute to the logistics literature in that we have constructed an empirical taxonomy for LSPs. The study represents an important step forward in sharpening the description and analysis of LSP types, and enabling predictions of the service performance of a particular type of LSP. In addition, the knowledge of the classification of LSPs should facilitate future studies of LSPs. This should be valuable for both academics and practitioners.

The rest of this paper is organized as follows. The next section describes the benefits of applying taxonomies in logistics research and the use of cluster analysis for classification research. Section 3 describes the research design and Section 4 provides details of how each type of LSP was formed, interpreted and validated. Section 5 addresses the theoretical contributions and the major implications of this study for both academics and practitioners. Section 6 concludes the study by suggesting directions for further research in this important, but under-explored area, in logistics research.

TAXONOMIES FOR LOGISTICS RESEARCH

Classification is the process of sorting out a collection of objects, ideas or systems and of developing a set of categories (Simon 1978). Classification research aims at deriving a taxonomy that bears a close relationship to the empirical world and, by so doing, achieving categories that mirror reality (Nachmias and Nachmias 1981). There are two fundamental aims of classification

research: etiology and prediction (Everitt 1993). Etiology seeks to understand the characteristics of a certain group and the reasons behind their formation, while prediction foresees the consequences associated with the characteristics of that particular group.

A classification scheme may represent a convenient method for summarizing a large set of data and describing patterns of similarity among objects by means of a class label (Everitt 1993). The classification label serves as an aid to memory, a tool to investigate the patterns of the data, and a means to facilitate communication between different groups of studies (Kerlinger 1986, Everitt and Dunn 1991). The process of researching organizational taxonomies involves describing business phenomena, providing summaries, understanding the characteristics within the groups, and explaining differences among categories.

Methodologically, both quantitative and qualitative measurements are important in developing empirical taxonomies. Although the placement of specific groups into a taxonomy should be the result of the numerical procedures of multivariate techniques, the selection of classification constructs and methods is entirely based on theories. A taxonomy should be built upon a strong foundation in the literature that explains the basis for the classification and the emergence of classified groups. Theories should be further used to assess the validity of the classified systems (Rich 1992).

The empirically developed taxonomy in fact meets the strict requirements of theory building. Classification theories define multiple patterns of the organizational factors that determine the characteristics of organizations. Interactions between organizational factors are also essential considerations in organizational research. Common factors in a particular group of organizations may interplay and result in a certain type of organizational performance. For example, equifinality is a characteristic of open organizational systems (Katz and Kahn 1966),

which when applied in logistics research may imply that an organization can reach the same level of cost and service performance by following different logistics strategies and practices. Constructing a taxonomy using multivariate techniques such as cluster analysis may provide a mechanism for incorporating a holistic set of principles of management in a single study of organizational research (Doty and Glick 1994). Indeed, cluster analysis has been widely used in transportation research (e.g. Corsi, Grimm, Smith, and Smith 1992) and taxonomies have begun to emerge in logistics research. For instance, Lu (2003) evaluated the market segmentation of international distribution centers based on the service requirements of shippers. Using cluster analysis, he classified users of international distribution centers into three segments, namely consolidation and storage service oriented firms, cargo-related services oriented firms, and support-service oriented firms. Knemeyer, Corsi and Murphy (2003) explored logistics outsourcing relationships and examined if there exists distinct levels of partnership development between customers of logistics outsourcing services and their LSPs. Similarly, they used cluster analysis to classify customers of logistics outsourcing services into three partnership types based on a set of logistics partnership variables and found that the partnership types differ in the elements and outcomes of their relationship marketing.

METHODOLOGY

A survey questionnaire was developed to collect information from LSPs in Hong Kong on their demographic characteristics and on their ability to provide different types of logistics services, i.e., service capability, and service performance. To ensure the diversity of LSPs in the study sample, a total of 1,176 LSPs were identified from the membership list of the Hong Kong Association of Freight Forwarding and Logistics Limited (HAFFA), and from a list of LSPs published in the *Shipping Gazette*, a bi-weekly magazine published by the shipping industry of

Hong Kong. This sampling frame has broad coverage of different potential types of LSPs in Hong Kong, where most LSPs in Hong Kong appear in either or both lists. The sampled companies were cross-checked to avoid double mailings. The questionnaire was mailed to the general managers of the sampled LSPs, as these target respondents were assumed to have a good knowledge of the organizational characteristics, service capability and performance of their companies. Only one response was solicited from each sampled LSP. We acknowledge that bias in data collection may stem from the use of a single respondent in this study. However, we adopted this strategy of using a "key informant" because only such a person has the necessary knowledge to respond, and this person is likely to be a more reliable source of information than other sources. As the development of service capability and performance improvement in LSPs requires a company-wide focus, it is natural to assume that these informants have a good knowledge of the service capability and performance of their companies.

Each sampled LSP received an initial mailing, which consisted of a cover letter explaining the purposes of the study, a copy of the questionnaire, and a postage-paid return envelope. Approximately one month later, a second mailing identical in content to the initial one was sent to the non-respondents, followed by a reminder letter two weeks after the second mailing. After the two mailings, 89 surveys were returned as undelivered mail because the sampled LSPs were either no longer in business or their address had changed. The large number of undelivered returns might be due to volatility of the LSP industry, which reduced the effective sample size of this study to 1,087.

A total of 232 responses were received after the two mailings and a follow-up reminder. Of the 232 returned questionnaires, two expressed a refusal to participate, four were returned blank, three had significant data missing, and two were received too late to be included in the

data analysis. In sum, there were 221 usable responses - 114 in the first mailing and 107 in the second mailing - representing an effective response rate of 20.3% (221/1,087). This response rate is comparable to those obtained in previous studies of a similar nature (e.g. Lai and Cheng 2003).

As the survey response was less than 100%, a non-response bias could contaminate the reliability of the study's findings. Therefore, a test of non-response bias was conducted to assess the extent of the potential bias in the results (Armstrong and Overton 1977). The non-response bias was assessed by dividing the 221 responses into two groups, namely early (n = 114, 51.6%) and late (n = 107, the remaining 48.7%). The answers of the two groups to the 24 questionnaire items, which were used to measure their service capability (see Table 2), were then compared using a series of t-tests. The test results indicate that, at a 5% significance level in all 24 items, no statistical differences existed between the mean scores of the early and late respondents. Therefore, non-response bias should not be a problem in this study.

Table 1 summarizes the organizational characteristics of the respondent companies with respect to their firm size (number of employees), business volume (annual revenues), and firm age (number of years in business). Most of the 221 respondent companies are small in size, with approximately 67% employing fewer than 50 employees. Around 60% have annual revenues of less than HK$200 million (approximately US$1 = HK$7.8). Nearly 50% have been in business for less than ten years.

< Insert Table 1 about here >

RESULTS

To examine the service capability of the sampled LSPs, we developed a list of 24 items covering the different logistics services that are generally expected of a comprehensive LSP. The items were developed by referring to previous logistics research on service and performance

evaluations (Sink, Langley, Gibson 1996; Murphy and Poist 2000; Larson and Gammelgaard 2001; Lieb and Miller 2002) and from discussions with academics and practitioners in logistics. The targets of the survey were requested to indicate, using a five-point Likert scale, where 1.0 = very low capability and 5.0 = very high capability, the extent to which they perceived their companies capable of performing each of the 24 logistics service categories. Table 2 summarizes the results where the service categories are ranked in descending order of the perceived capability of the respondent LSPs to perform the services.

< Insert Table 2 about here >

Factor analysis

An exploratory factor analysis (EFA) was conducted to assess the dimensionality of the 24 items for logistics services. The purpose of this analysis was to examine whether some underlying constructs (factors) were represented by these measurement items. If these items could be effectively summarized by a few underlying factors, it would provide further insights into the dimensionality of the logistics service categories. As we did not have a priori theory on the number of factors for extraction, we considered the use of EFA appropriate to search for structure among the 24 items for logistics services. In doing so, we followed the criteria suggested by Hair et al (1998) for factor extraction. The EFA was performed using principal component factor analysis with VARIMAX orthogonal rotation. Multiple criteria (i.e., eigenvalues, interpretability, and internal consistency) were used to determine the appropriate number of factors (Ford, MacCallum and Tait 1986).

In the analysis, an item was not considered to load on a factor if its factor loading was less than 0.50. Furthermore, the eigenvalue criterion (i.e., $\lambda > 1.0$) was used to determine an

initial set of factors. As the eigenvalue criterion tends to overestimate the number of factors (Ford et al. 1986), the interpretability of the factors (i.e., whether a group of items loaded on a given factor makes sense and whether a factor substantively increases the cumulative variance for the total variance explained) was used to determine the number of factors that should remain.

The initial factor solution resulted in four factors with eigenvalues greater than unity. The four-factor solution for the 24 items accounted for 69.8% of the variance. In order to purify the list, items with loadings of 0.50 or greater on more than one of the factors were eliminated. This resulted in the removal of the following items: logistics planning, inventory management, pick and pack, bar code scanning, call center operations, billing function, performance reporting, interface with ERP systems, and customs clearance. The remaining 15 items were factor-analyzed again, using the same procedures. Three factors accounting for 69.1% of the variance emerged and one cross-loaded item was found - receive purchase and/or sales order from customers through EDI. The cross-loaded item was eliminated and a further EFA was conducted for the remaining 14 items.

The results in Table 3 show a purified list of 14 items with a clear factor structure in three factors. These items account for 68.8% of the variance, and no items have loadings of 0.50 or above in more than one factor. Such a figure is considered satisfactory in the social sciences, where information is often less precise (Hair, Anderson, Tatham and Black 1998). As shown in Table 3, the three factors identified can be summarized as follows:

Factor 1: “Value-added logistics services - VAL” accounts for 35.8% of the total explained variance and consists of service elements relating to assembling/re-assembling, repackaging/re-labeling, purchasing/procurement, cross-docking, order processing, customer-specific label printing, fleet management, L/C compliance and negotiation, and warehousing.

Factor 2: “Technology-enabled logistics services - TEL” accounts for 24.4% of the total explained variance and is concerned with such service elements as information systems management, the tracking and tracing of shipment information, web-based linkages, receive/send shipment notices, and advanced ship notices (ASN) through EDI.

Factor 3: “Freight forwarding service - FFD” accounts for 8.7% of the total explained variance and includes only one item, i.e., freight forwarding.

< Insert Table 3 about here >

The 14 final items derived from the EFA were tested for their reliability by subjecting them to item analysis using item-total correlations. Cronbach alpha reliabilities were analyzed to assess the reliability of the items that were dominantly loading on each of the three factors. As FFD only has one measurement item, these procedures were not performed for that factor. The results indicate that all of the items loaded highly on their respective factors with item-total correlation coefficients ranging from 0.56 - 0.77 for VAL, and from 0.75 - 0.85 for TEL. The reliability coefficient alpha values of the two factors are high - 0.91 for VAL, and 0.90 for TEL - far exceeding the benchmark of 0.70 for exploratory research (Nunnally and Bernstein 1994).

Exploration of clusters

Clustering, a technique commonly used to classify respondents on some characteristics of interest when little is known about the population (Punj and Stewart 1983), is a popular tool for analyzing similarity relations. In this study, the interest is in identifying categories or clusters of LSPs based on their logistics service capability. Hence, cluster analysis was performed on the variables pertaining to the logistics service categories. The composite scores of the three factors,

i.e., VAL, TEL and FFD, which were derived by taking the arithmetical means of their underlying items, were used in the cluster analysis.

Both hierarchical and non-hierarchical cluster methods were used in the analysis as suggested by Hair et al. (1998). The hierarchical method was used to examine the number of clusters that should be formed, and the non-hierarchical method was employed to produce the clusters. The Ward Method of agglomerative hierarchical cluster analysis was used to determine the number of clusters. This method begins by treating each of the 221 respondent LSPs on the three factors of logistics services as a cluster. In a series of steps, it then combines the nearest clusters until it has created a single cluster for the entire sample population. The Ward method determines the distance between two clusters as the sum of the squares between the clusters summed over all variables, which minimizes the total within-group sums of squares. A cluster analysis with a hierarchical technique using squared Euclidean distances on VAL, TEL, and FFD was performed. The agglomeration coefficient, i.e., the squared Euclidean distance between the two causes of clusters being combined, was used to determine the number of clusters. A small coefficient indicates that fairly homogenous clusters are being merged. As the merging of two very different clusters would lead to a large coefficient, a large percentage change in the agglomeration coefficient suggests that two non-homogenous groups will be combined in a further agglomeration. The results of the analysis suggested that a division of four clusters represents the best solution.

After the hierarchical analysis, a K-mean cluster analysis (a non-hierarchical clustering technique) of VAL, TEL and FFD was performed. K-means is an iterative partitioning method that begins by dividing observations into a predetermined number of clusters (four in this study)

as suggested by the results of the hierarchical cluster analysis. The results in Table 4 show that the 221 respondent LSPs were all assigned to four clusters in the K-mean cluster analysis -- 85 in Cluster 1, 58 in Cluster 2, 60 in Cluster 3, and 18 in Cluster 4. The final centroids of the clusters of the three factors are plotted in Figure 1. The centroids of the clusters are the mean values for each factor of logistics services (i.e., VAL, TEL and FFD) in a cluster, which represents the general characteristics of a cluster.

< Insert Figure 1 about here >

< Insert Table 4 about here >

As the capability of LSPs on the different service categories are measured on an interval scale, where 5.0 represents the maximum positive evaluation and 1.0 means the maximum negative evaluation, we divided the scale into three ranges ($5.0 - \geq 3.71$, $3.70 - 2.30$, $2.29 \leq - 1.0$) to classify LSPs into high, medium, and low performers, respectively, according to their cluster mean values on the service factors. The range for classifying high and low performers (1.30) is smaller than that for medium performers (1.40) to slightly differentiate the former (extreme) group from the latter (ordinary) group. In the analysis, the relative magnitude of the factors among the four clusters is interpreted in the following ways. LSPs in a cluster achieving a cluster mean value of 3.71 or above in a factor are considered to possess a high level of capability to perform that aspect of service. An LSP in a cluster receiving a cluster mean value of between 2.30 and 3.70 in a factor suggests that that LSP has a medium level of capability to carry out that service. If a company attains a value of 2.29 or below in a factor, this suggests that it has a low level of capability to perform that aspect of service.

To assess whether the means of the three factors were significantly different across the four clusters, Analysis of Variance (ANOVA) and the Scheffe Multiple Comparison test were performed. The Scheffe method was used to test for differences across the clusters because the identification of distinct characteristics of the clusters is important in providing clear descriptions of the derived clusters. The test results are shown in Table 5. As indicated by the Scheffe Multiple Comparison Test, each cluster has unique attributes. Although the Scheffe test is a very conservative procedure in terms of protesting against type I errors (Stevens 1992), 15 pairs out of the 18 possible combinations in the three logistics service factors were highly significant ($p < 0.05$).

< Insert Table 5 about here >

Interpretation of clusters

The first cluster (n = 58), labeled "traditional freight forwarders" (TFF), accounted for 24.9% of the sample. This group was labeled in this manner because they had a low capability to carry out VAL and TEL (mean < 2.0). A closer look at the results reveals that they were highly capable in FFD (mean = 4.53). The results suggest that they were TFF with a limited capacity to perform logistics services beyond freight forwarding.

Accounting for 38.5% of the sample, the largest of the clusters (n = 85) was labeled "transformers" (TMR). This group achieved a medium level of capability to perform VAL and possessed a high level of capability in TEL and FFD. Similar to TFF, this group was particularly good at FFD (mean = 4.81). But they were taking steps to expand into other aspects of logistics services. For instance, they possessed a medium level of capability in VAL (mean = 2.72) and

TEL (mean = 3.60). The results suggest that this group of companies was making efforts to transform themselves into a comprehensive LSP.

More than one-fourth of the sampled companies (27.1%) were labeled “full service providers” (FSP), primarily because members of this cluster (n = 60) reported that they possessed a high level of capability in all of the three logistics service factors, i.e., VAL, TEL and FFD. Compared to TMR, they had a higher capability in VAL (mean = 3.99). On the other hand, their capabilities in TEL (mean = 3.60) and FFD (mean = 4.83) were even higher than those of TMR. Their high capability in all three logistics service factors seems to suggest that they are comprehensive LSPs with the capability to provide a wide variety of logistics services.

At 8.1% of the sample, the smallest of the clusters (n = 18) was labeled “Nichers” (NCR). In contrast to TFF, TMR and FSP, this group of LSPs were particularly weak in FFD (mean = 2.33). One possible explanation is that they lacked the consolidation efficiency to perform FFD. They might not have the economies of scale in collecting shipments from shippers, consolidating these shipments into large loads, and making profit from the consolidated shipments. However, they possessed a medium level of capability in carrying out VAL (mean = 2.80) and TEL (mean = 3.54). While they lacked capability in FFD, it is possible that they targeted the niche markets for VAL (e.g. warehousing and order processing) and TEL (e.g. information management for logistics) in order to avoid head-on competition with either TFF or FSP.

Types of LSP and performance

In order to determine whether there were performance differences among the four types of LSPs, the sampled LSPs were requested to rate on a five-point Likert scale (where 1.0 = very

low and 5.0 = very high) their perceived performance on 12 questionnaire items spanning different typical performance measures for logistics services. These items were developed by referring to Daugherty, Stank and Rogers (1996) and Lai, Ngai and Cheng (2002), as well as from discussions with academics and practitioners in logistics. The overall service performance was derived by the arithmetic mean of the 12 items. Consistent with the interpretation of service capability, the classification of high, medium and low levels in all of the items and the overall performance were set at the values of mean > 3.70, mean between 2.30 and 3.70, and mean < 2.30, respectively.

A one-way analysis of variance (ANOVA) was performed to examine if differences existed between the mean values of the 12 items and the overall performance in each of the four types of LSP. The ANOVA results reported in Table 6 indicate that statistically significant differences, i.e., $p < 0.05$, existed among the four LSP types in all of the 12 items and the overall performance. The post hoc test results using Tukey, Scheffe and Bonferroni procedures for all of the ANOVA results generated were similar. In sum, FSP appeared to have the highest level of overall service performance (mean = 4.60), followed by TMR (mean = 4.14), and then NCR (mean = 4.05). TFF were found to have the lowest level of service performance. On the basis of the self-reported performance by the respondent LSPs, service performance differs between different types of LSP.

A closer look at the service performance of the four LSP types reveals that none of the items was below 2.93, far exceeding the minimum value for medium performance, i.e., 2.30. This suggests that the LSPs recognize the different performance aspects of their services and give them equal attention when carrying out their services. Among the 12 items, they perceived

that they were particularly good at helping customers to solve problems (mean = 4.38 for TFF, 4.62 for TMR, 4.91 for FSP, 4.11 for NCR), making an effort to help in emergencies (mean = 4.38 for TFF, 4.46 for TMR, 4.76 for FSP, 4.28 for NCR), and at giving pre-alerts of shipment or delivery problems (mean = 4.39 for TFF, 4.32 for TMR, 4.68 for FSP, 4.22 for NCR). These were the services rated in the top three among the 12 items by all four types of LSP. However, TFF (mean = 2.93), TMR (mean = 3.57) and NCR (mean = 3.56) should spend more effort on providing periodic performance reports to their customers, an item on which they achieved only a medium level of performance and perceived as their "weakest" area among the 12 measures. This is important if they are to maintain a "balanced" focus on their service performance.

< Insert Table 6 about here >

DISCUSSION

Service capability and performance

As an exploratory study, we used a survey questionnaire to collect data on the service capability and performance of sampled LSPs. A cluster analysis of the data resulted in the identification of four discernible types of LSP. They are labeled traditional freight forwarders, transformers, full-service providers, and nichers according to the service capability displayed by each LSP type. The four identified LSP types were found to differ in various performance measures on the basis of their self-evaluated performance.

Interestingly, the results of this study are congruent with the conceptual taxonomy of value creation by LSPs suggested by Berglund et al. (1999). It was found that the four types of LSP might be roughly explained by Berglund et al.'s four stages of value creation by LSPs. TFF only focus on operations efficiency in FFD, i.e., taking a number of small shipments and combining them into a single larger shipment. They add value by offering lower rates than the

customers could obtain from the transport carriers directly. TMR expand their service capability in VAL and TEL. In addition to FFD, they add value by sharing resources between customers, e.g., by running a warehouse or by developing an electronic data exchange platform for several customers. They seem to possess more complex operations and information technology skills for value creation.

Alternatively, NCR only aim to offer VAL and TEL. They facilitate vertical and horizontal integration, i.e., the development of a network of service providers, each carrying out the activities at which they are best. One possible explanation is that NCR complement the lead integrators (i.e., FSP) by taking on outsourced logistics activities from them which the NCR have the comparative advantage to perform. FSP create value for customers by using conceptual logistics skills to improve the supply chains of their customers (e.g., by introducing cross-docking facilities to eliminate the unnecessary storage of inventories) or by redesigning the distribution network to optimize customer service levels. In addition to operational efficiency, the skills required for this type of value creation are wide-ranging. They include supply chain analysis and operations research techniques, as well as knowledge of innovative logistics concepts such as cross-docking or merge-in-transit. As such, FSP are highly capable in all three aspects of logistics services.

It was found that these four types of LSPs achieved different service performances according to the stage of development of their logistics service capability. The results show that FSP outperform the other three types of LSPs in all 12 service performance measures. The consistently higher mean scores of service performance in FSP over the other LSPs imply that service performance may be enhanced by improving organizational capability in performing different logistics services.

The findings indicate that the service performance of different types of LSPs can be enhanced through progressing along different stages of service capability development. For instance, TFFs first develop their capability in FFD, which improves their operations efficiency and sustains their survival in business. As service expectations of their customers continue to rise, TFFs might consider transforming into TMRs and improve their service performance by expanding their service menus beyond FFD. This development might lead to some improvement in service performance, but they need to enhance their service capability further in VAL and TEL in order to evolve as FSPs and raise their overall service performance.

Academic and practical implications

The findings of this study are useful for both researchers and managers. From a research perspective, understanding the types of LSPs and how this may affect service performance opens up new avenues for the development of theories in logistics research. For instance, under what circumstances do LSPs take service capability enhancement as a way to improve service performance? How do LSPs adjust their efforts in service capability enhancement and hence their service performance? Will certain aspects of capability in logistics services be more (or less) important to LSPs than to others? Answers to these questions are crucial to the further development of research on LSPs. This study provides an important step for further research to specify and test 1) the conditions under which a LSP should transform from one type to another, and 2) the conditions under which the service performance of different types of LSPs could be enhanced.

From a managerial point of view, this study reveals that differences in service performance exist between LSP types. To this end, we have identified the degree of service

capability in different types of LSPs, and our findings have shed light on the various areas where service performance can be improved. For instance, the empirical taxonomy for LSPs suggests that there are different types of LSPs serving different market segments, i.e., groups of customers or prospective customers who may have similar responses to a product/ service offering. The four types of LSPs identified in this study reflect that there are several market segments for LSPs to compete in. They can choose to compete in the freight forwarding segment based on their consolidation efficiency in freight forwarding, or in the full logistics service segment by providing comprehensive service packages, or in the niche segment by customizing the logistics service needs of specific customer groups. To succeed, it is important for LSPs to understand how or why their customers use their services, how they can fit their competencies to the needs of customers, and how they should develop strategies for enhancing their cost and service performance. The characteristics of each LSP type identified in the empirical taxonomy underpin different market segments in logistics service businesses. The taxonomy provides a starting point for the reference of LSPs to understand which market segments they are serving or target to service. It provides insights for them to discern whether their service capability and performance are fit for the market segments they are serving. This is particularly important for new entrances or those intending to enter a particular market segment in logistics service to ensure that their service capability and performance are on a par with that of the competition. The study results on the different types of LSPs and their characteristics can help LSPs track change over time and provide additional information with which to plan and set goals for service capability and performance improvement in different logistics service market segments.

CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

There are some limitations to the interpretation of the results of this study, and we leave them as topics for future research. Methodologically, the data collected here were based on the self-assessment of LSPs. However, the LSPs might have offered a one-dimensional focus. As the success of an LSP demands a supply chain-wide focus, it is desirable to generate information from different parties, e.g. shippers, in the supply chain. On the other hand, the small sample size (n = 221) in this study might affect the interpretation of the research results (e.g. the performance of different types of LSPs), where they were clustered into four groups of unequal size. In addition, the current study is based on a cross-sectional survey study, which provides limited longitudinal evidence on exactly how the different types of LSP evolve and how service performance improves. There might also be delayed effects of service capability enhancement on service performance. It might be useful to conduct a longitudinal study to document the evolution of LSP types and service performance and to augment the findings of our survey.

In terms of the scope of the study, this research was limited to the study of LSPs in Hong Kong. We collected data only from LSPs in one culture, i.e., Hong Kong. This may limit the generalizability of the results to other cultures. Studies of LSP types and their service performances in different cultural and social contexts will not only help to generalize the findings, but also contribute to determining how differences in cultural and social contexts may influence the development of LSP types and their service performance. Future research may also be conducted on other driving forces behind the development of different types of LSP. It is possible that LSPs seek to enhance their service capability under customer pressures and institutional forces, or according to operations and information technology needs, resulting in different patterns of development in their service capability.

REFERENCES

Armstrong, Richard D. (1999), *Armstrong's Guide to Third Party Logistics Service Providers*, Vol. 7, Stoughton, WI: Armstrong and Associates, Inc.

Armstrong, J. Scott. and Terry S. Overton (1977), Estimating nonresponse bias in mail surveys, *Journal of Marketing Research*, Vol. 14, No.3, pp. 396-402.

Balumole, Yemisi A. (2001), "The Supply Chain Role of Third-Party Logistics Providers," *International Journal of Logistics Management*, Vol. 12, No.2, pp. 87 – 102.

Berglund, Magnus, Peter Van Laarhoven, Graham Sharman, and Sten Wandel (1999), "Third-party Logistics: Is There a Future?" *International Journal of Logistics Management*, Vol.10, No.1, 1999, pp.59-70.

Corsi, Thomas M., Curtis M. Grimm, Ken G. Smith, Raymond D. Smith (1992), "The effects of LTL Motor Carrier Size on Strategy and Performance", *Logistics and Transportation Review*, Vol.28, No.2, 1992, pp.129-146.

Coyle, John J., Edward J. Bardi and John C. Langley Jr. (1996), *The Management of Business Logistics*, Sixth Edition, West Publishing Company, New York.

Daugherty, Patricia J., Theodore P. Stank, and Dale S. Rogers (1996), "Third-Party Logistics Service Providers: Purchasers' Perceptions," *International Journal of Purchasing and Materials Management*, Vol. 32, No.2, pp. 23-29.

Delfmann, Werner, Sascha Albers, and Martin Gehring (2002), "The Impact of Electronic Commerce on Logistics Service Providers," *International Journal of Physical Distribution & Logistics Managemen*t, Vol. 32, No.3, pp.203-222.

Doty, D. Harold and William H. Glick (1994), "Typologies as a Unique Form of Theory Building: Toward Improved Understanding and Modeling", *Academy of Management Review*, Vol. 19, No. 2, pp. 230-251.

Everitt, Brian S. (1993), *Cluster Analysis*, Third Edition, Edward Arnold, London.

Everitt, Brian S. and Graham Dunn (1991), *Applied Multivariate Data Analysis*. Edward Arnold, London.

Ford, J. Kevin, Robert C. MacCallum and Marianne Tait (1986), "The Application of Exploratory Factor Analysis in Applied Psychology: A Critical Review and Analysis", *Personnel Psychology*, Vol.39, No. 2, pp. 291-314.

Hair, Joseph. F., Rolph E. Anderson, Ronald L. Tatham, and William C. Black (1998), *Multivariate Data Analysis*, Fifth Edition, Prentice Hall, New Jersey.

Harding, Forrest E. (1998) “Logistics Service Provider Quality: Private Measurement, Evaluation, and Improvement,” *Journal of Business Logistics*, Vol. 19, No.1, pp. 103-120.

Hertz, Susanne and Monica Alfredsson (2003), “Strategic Development of Third party Logistics Providers”, *Industrial Marketing Management*, Vol.32, No.2, pp.139-149.

Katz, Daniel and Robert L. Kahn (1966), *The Social Psychology of Organizations*, Wiley, New York.

Kerlinger, Fred N. (1986), *Foundation of Behavioral Research*, Third Edition, New York: Holt, Rinehart and Winston.

Lai, Kee-hung, and T. C. Edwin Cheng (2003), “Supply Chain Performance in Transport Logistics: An Assessment by Service Providers”, *International Journal of Logistics: Research and Applications*, Vol.6, No.3, pp. 151-164.

Lai, Kee-hung, Eric W. T. Ngai, and T. C. Edwin Cheng (2002), “Measures for Evaluating Supply Chain Performance in Transport Logistics”, *Transportation Research: Part E, Logistics and Transportation Review*, Vol.38, No.6, pp. 439-456.

Larson, Paul D. and Britta Gammelgaard (2001), “Logistics in Denmark: A Survey of the Industry”, *International Journal of Logistics: Research and Applications*, Vol. 4, No.2, pp. 191-206.

Leahy, Steven E., Paul R. Murphy, Richard F. Poist (1995), “Determinants of Successful Logistical Relationships: A Third-Party Provider Perspective”, *Transportation Journal*, Vol. 35, No.2, pp.5-13.

Lieb, R. and Miller, J. (2002), “The Use of Third-party Logistics Services by Large US Manufacturers, The 2000 Survey”, *International Journal of Logistics: Research and Applications*, Vol.5, No.1, pp. 1-12.

Lu, Chin-shan. (2003) “Market Segment Evaluation and International Distribution Centers”, *Transportation Research: Part E, Logistics and Transportation Review*, Vol. 39, No.1, pp. 49-60.

Lynagh, Peter M., Paul R. Murphy, Richard F. Poist, and William F. Grazer (2001) “Web-based Informational Practices of Logistics Service Providers: An Empirical Assessment”, *Transportation Journal*, Vol. 40, No.4, pp. 34-45.

Knemeyer, A. Michael, Thomas M. Corsi, and Paul R. Murphy (2003) “Logistics Outsourcing Relationships: Customer Perspectives”, *Journal of Business Logistics*, Vol. 24, No.1, pp. 77-109.

Menon, Mohan K., Micheal A. McGinnis and Kenneth B. Ackerman (1998), “Selection Criteria for Providers of Third-party Logistics Services: An Exploratory Study”, *Journal of Business Logistics*, Vol. 19, No. 1, pp. 121-137.

Menzter, John T., Daniel J. Flint, and John L. Kent (1999), "Developing a Logistics Service Quality Scale," *Journal of Business Logistics*, Vol. 20, No.1, pp. 9-32.

Murphy, Paul. R. and Richard F. Poist (2000), "Third-party Logistics: Some User Versus Provider Perspectives", *Journal of Business Logistics*, Vol. 21, No. 1, pp. 121-131.

Nachmias, David and Chava Nachmias (1981), *Research Methods in the Social Sciences*. New York: St. Martin's Press.

Nunnally, Jun C. and Ira H. Bernstein (1994), *Psychometric Theory*, Third Edition, New York: McGraw-Hill.

Persson, Gøran and Helge Virum (2001), "Growth Strategies for Logistics Service Providers: A Case Study," *International Journal of Logistics Management*, Vol.12, No.1, pp.53-64.

Porter, Michael E. (1985) *Competitive Advantage: Creating and Sustaining Superior Performance*, New York: Free Press.

Punj, Girish and David W. Stewart (1983) "Cluster Analysis in Marketing Research: Review and Suggestions for Application", *Journal of Marketing Research*, Vol. 20, No. 2, pp. 134-148.

Rich, Philip (1992), "The Organizational Taxonomy: Definition and Design", *Academy of Management Review*, Vol. 17, No. 4, pp. 758-781.

Simon, Julian. L. (1978), *Basic Research Methods in Social Science, The Art of Empirical Investigation*, Second Edition, New York: Random House.

Sink, Harry L., and C. John Langley, Jr. (1997) "A Managerial Framework for the Acquisition of Third-Party Logistics Services," *Journal of Business Logistics*, Vol. 18, No.2, pp.163 – 189.

Sink, Harry L., C. John Langley, Jr., Brian J. Gibson (1996) "Buyer observations of the US third-party logistics market", *International Journal of Physical Distribution and Logistics Management*, Vol. 26, No.3, pp.38-46.

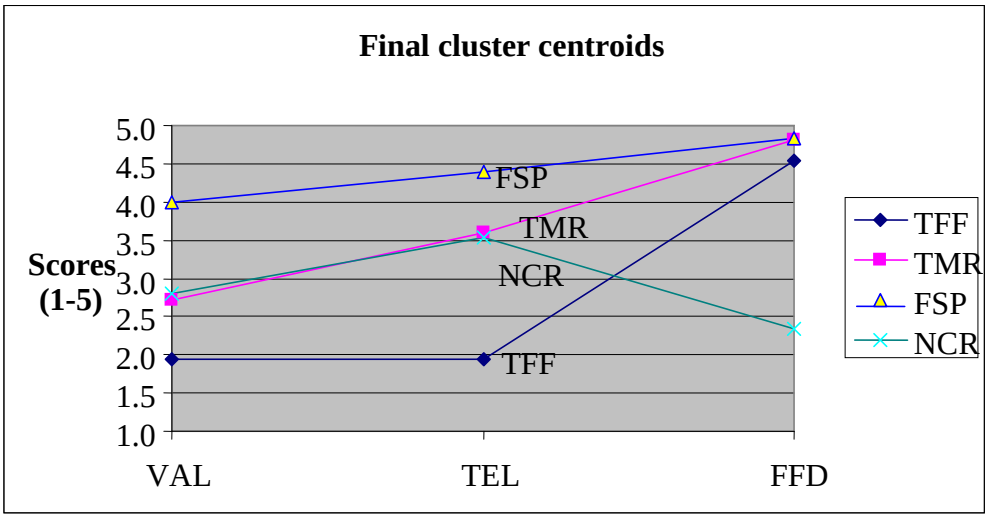
Sohal, Amrik S., Robert Millen and Simon Moss (2002), "A Comparison of the Use of Third-party Logistics Services by Australian Firms between 1995 and 1999", *International Journal of Physical Distribution and Logistics Management*, Vol. 32, No. 1, pp. 59-68.

Stank, Theodore P., Thomas J. Goldsby, Shawnee K. Vickery, Katrina Savitskie (2003) "Logistics Service Performance: Estimating its Influence on Market Share", *Journal of Business Logistics*, Vol. 24, No.1, pp.27-55.

Stevens, James (1992), *Applied Multivariate Statistics for the Social Sciences*, Second Edition, Lawrence Erlbaum Associates, New Jersey.

FIGURE 1

GRAPHICAL PRESENTATION OF THE CENTROIDS OF THE FOUR CLUSTERED GROUPS



NOTE: Logistics service factors: VAL = Value-added logistics services; TEL = Technology-enabled logistics services; FFD = Freight forwarding services

NOTE: LSP Types: TFF = Traditional freight forwarders; TMR = Transformers; FSP = Full service providers; NCR = Nichers

TABLE 1
PROFILE OF THE RESPONDENT COMPANIES (n = 221)

Company characteristics	**Frequency (Percentage)**
Number of employees	
1 to 49	148 (67.0)
50 – 99	31 (14.0)
100 – 149	13 (5.9)
150 - 199	9 (4.1)
200 or above	19 (8.6)
Unknown	1 (0.5)
Level of turnover (HK$)	
Below 100 million	87 (39.4)
100 - 199 million	46 (20.8)
200 - 299 million	24 (10.9)
300 - 399 million	11 (5.0)
400 million or above	43 (19.5)
Unknown	10 (4.5)
Length of business operations	
1 - 5 years	49 (22.3)
6 - 10 years	60 (27.2)
11 - 15 years	28 (12.8)
16 - 20 years	30 (13.6)
21 - 25 years	21 (9.5)
26 - 30 years	11 (5.0)
31 - 35 years	8 (3.7)
36 years or above	12 (3.9)
Unknown	2 (0.9)

TABLE 2
LOGISTICS SERVICE CAPABILITY AS PERCEIVED BY THE RESPONDENT COMPANIES

Services	Mean	S.D.	1 = Very low (%)	2 = Low (%)	3 = Moderate (%)	4 = High (%)	5 = Very high (%)
Freight forwarding	4.54	0.85	2.3	0.9	6.5	20.5	69.8
Customs clearance	3.88	1.12	4.4	6.3	23.3	28.6	37.4
Tracking and tracing shipment information	3.74	1.20	4.9	14.1	16.5	31.1	33.5
Warehousing	3.67	1.16	6.1	9.9	23.0	32.9	28.2
Information systems management	3.32	1.25	10.9	14.4	27.2	27.7	19.8
Performance reporting	3.30	1.38	17.0	11.0	19.5	30.0	22.5
Web-based linkages	3.23	1.31	14.8	12.8	27.1	25.6	19.7
Receiving/sending shipment notices using EDI	3.22	1.44	18.6	13.7	19.1	24.0	24.5
Logistics planning	3.21	1.24	12.1	14.1	32.0	23.8	18.0
Picking and packing	3.21	1.28	12.7	16.7	25.5	27.0	18.1
Billing function	3.18	1.41	18.7	14.1	19.2	26.8	21.2
Repackaging/ re-labeling	3.11	1.32	15.3	17.2	27.6	21.2	18.7
Inventory management	3.06	1.32	16.4	17.9	24.4	25.4	15.9
L/C compliance and negotiation	2.92	1.35	20.1	19.6	24.1	20.6	15.6
Order processing	2.89	1.37	22.3	15.2	28.9	17.3	16.2
Fleet management	2.83	1.37	22.4	20.9	23.0	18.4	15.3
Receiving purchase and/or sales orders from customers using EDI	2.81	1.45	28.0	15.5	20.5	19.5	16.5
Cross-docking	2.78	1.30	21.0	21.0	29.2	16.4	12.3
Assembling/re-assembling	2.70	1.36	24.9	23.4	21.8	16.8	13.2
Customer-specific label printing	2.67	1.41	31.0	15.7	19.8	21.8	11.7
Bar code scanning	2.50	1.48	37.7	17.1	18.1	11.6	15.6
Interfacing with ERP systems; e.g., SAP	2.49	1.42	36.3	17.4	18.4	16.3	11.6
Call center operations	2.42	1.27	33.8	17.4	27.7	14.4	6.7
Purchasing/ procurement	2.22	1.20	36.4	25.8	21.7	11.1	5.1

TABLE 3
RESULTS OF EXPLORATORY FACTOR ANALYSIS

Item	Factor loading			Alpha
Assembling/re-assembling	**0.823**	0.255	0.014	0.908
Repackaging/re-labeling	**0.798**	0.242	0.109	
Purchasing/procurement	**0.774**	0.128	-0.175	
Cross-docking	**0.755**	0.150	0.207	
Order processing	**0.719**	0.337	0.076	
Customer-specific label printing	**0.722**	0.358	-0.014	
Fleet management	**0.665**	0.218	0.091	
L/C compliance and negotiation	**0.628**	0.207	0.052	
Warehousing	**0.560**	0.361	0.402	
Information systems management	0.292	**0.876**	0.069	0.904
Tracking and tracing shipment information	0.163	**0.855**	0.225	
Web-based linkages	0.282	**0.835**	-0.064	
Receiving/sending shipment notices, advanced ship notices (ASN) through EDI	0.382	**0.769**	-0.050	
Freight forwarding	0.047	0.029	**0.942**	--

TABLE 4

ANOVA STATISTICS AND CLUSTER MEANS

Factor/ Cluster	**TFF (n=58)**	**TMR (n=85)**	**FSP (n=60)**	**NCR (n=18)**	**F**
VAL	1.94 (L)	2.72 (M)	3.99 (H)	2.80 (M)	137.94
TEL	1.94 (L)	3.60 (M)	4.40 (H)	3.54 (M)	180.67
FFD	4.53(H)	4.81(H)	4.83(H)	2.33(L)	132.69

NOTE: Logistics service factors: VAL = Value-added logistics services; TEL = Technology-enabled logistics services; FFD = Freight forwarding services

NOTE: LSP Types: TFF = Traditional freight forwarders; TMR = Transformers; FSP = Full service providers; NCR = Nichers

NOTE: Entries in the table are mean values on a five-point Likert scale of the four clusters in the three logistics service factors. The relative magnitude of the three factors across the four clusters is denoted in parentheses by H, M, and L, representing high (mean $\geq$ 3.71), medium (mean $\leq$ 3.70 and $\geq$ 2.30) and low (mean $\leq$ 2.29), respectively. All F-statistics are significant at $p < 0.01$.

TABLE 5

SCHEFFE MULTIPLE COMPARISON TEST RESULTS

Factors	Clusters	Level of Significance		
		2	3	4
VAL	1	0.00*	0.00*	0.96
	2		0.00*	0.00*
	3			0.00*
TEL	1	0.00*	0.00*	0.98
	2		0.00*	0.00*
	3			0.00*
FFD	1	0.01*	0.99	0.00*
	2		0.02*	0.00*
	3			0.00*

NOTE: Logistics service factors: VAL = Value-added logistics services; TEL = Technology-enabled logistics services; FFD = Freight forwarding services

NOTE: Cluster mean differences are significant at * $p < 0.05$

TABLE 6

LSP TYPES AND SERVICE PERFORMANCE

Service Performance Measures	TFF (n=58)	TMR (n=85)	FSP (n=60)	NCR (n=18)	F
Helping customers to solve problems	4.38 H (0.78)	4.62 H (0.58)	4.91 H (0.28)	4.22 H (1.11)	9.09
Making efforts to help in emergencies	4.38 H (0.73)	4.46 H (0.70)	4.76 H (0.43)	4.28 H (0.83)	4.40
Providing emergency services	4.13 H (0.85)	4.24 H (0.74)	4.67 H (0.51)	4.12 H (1.17)	6.11
Handling changes	4.07 H (0.83)	4.05 H (0.66)	4.57 H (0.62)	3.94 H (0.87)	7.74
Responding to customer requests in a flexible manner	4.23 H (0.76)	4.19 H (0.69)	4.62 H (0.62)	4.11 H (0.83)	5.25
Adjusting operations in a flexible manner to meet unforeseen customer needs	4.07 H (0.89)	4.05 H (0.67)	4.62 H (0.59)	4.06 H (0.80)	8.51
Helping customers in value analysis, cost reductions, problem solving, etc.	3.59 M (1.11)	3.86 H (0.79)	4.48 H (0.60)	3.94 H (1.11)	10.71
Advising customers of potential problems in meeting their needs	3.82 H (0.90)	3.95 H (0.70)	4.53 H (0.60)	3.83 H (1.29)	9.57
Handling customer complaints	3.96 H (0.81)	4.20 H (0.69)	4.60 H (0.56)	4.23 H (0.75)	8.25
Giving pre-alert notices of shipment/delivery problems	4.39 H (0.80)	4.32 H (0.71)	4.68 H (0.51)	4.22 H (0.88)	3.53
Recommending alternative actions when unforeseen problems arise	3.89 H (0.89)	4.10 H (0.69)	4.57 H (0.60)	4.11 H (0.90)	8.38
Providing performance reports periodically	2.93 M (1.21)	3.57 M (1.01)	4.33 H (0.95)	3.56 M (1.25)	16.18
Overall service performance	3.99 H (0.65)	4.14 H (0.47)	4.60 H (0.35)	4.05 H (0.77)	15.25

NOTE: LSP Types: TFF = Traditional freight forwarders; TMR = Transformers; FSP = Full service providers; NCR = Nichers

NOTE: Entries in the table are mean values on a five-point Likert scale of the four LSP types in service performance measures and entries in parentheses are standard deviations. The relative magnitude of the twelve performance measures across the four clusters are denoted by H, M and L, representing high (mean ≥ 3.71), medium (mean ≤ 3.70 and ≥ 2.30) and low (mean ≤ 2.29), respectively. All F-statistics are significant at $p < 0.05$ level.