

EVALUATING THE PERFORMANCE OF LOGISTICS SERVICE PROVIDERS

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ABSTRACT

Purpose: The aims of this research are to gather insights on logistics outsourcing in Singapore from the perspective of the 3PL customer (i.e. service user), determine the importance of decision criteria as perceived by service users and develop a decision-making framework to assist 3PL service users when they select a 3PL provider.

Design/methodology/approach: Selected professionals in the manufacturing and service sectors were surveyed to gather perspectives on the 3PL market as well as to shed light on the criteria they consider to be important when selecting a 3PL provider. Information from 30 respondents was used in the analysis. The structure for the selection of a 3PL provider was conceptualised as a two-level multi-criteria decision-making model. The analytical hierarchy process (AHP) was used to compute the criteria weights based on the judgements of selected supply chain managers from oil and gas, PC manufacturing and commodity trading companies.

Findings: 90% of the respondents reported that their company outsourced their logistics activities. The most outsourced activities tended to be transactional, operational and routine in nature. The least outsourced activities tended to be more strategic and IT-intensive in nature. The four criteria (delivery, cost, quality and flexibility) and 12 associated sub-criteria were found to have a high level of importance. The weights derived from the AHP method reflected the differences in priorities for the selected industries and the products that flow through their supply chain.

Research Implications: Different businesses have different considerations when selecting the most appropriate 3PL provider. Quality and delivery seem to be important considerations for the oil and gas industry, while flexibility and quality are important for PC manufacturers. Commodity trading companies tend to be cost-oriented. 3PL providers need to be agile to align with different customers' expectations.

Originality/Value: The decisions involved in selecting a 3PL service provider are examined from the perspective of the 3PL service user across different industries.

Introduction

In this globalised and competitive environment, the effective management of product, information and cash flows are essential to supply chain success (Chopra and Mendl, 2013). Many logistics functions are now being outsourced to third-party logistics (3PL) service providers. One compelling reason for logistics outsourcing is that it allows businesses to concentrate on their core competencies. 3PL providers are capable of supporting their clients with expertise and experience that would otherwise be difficult to develop in-house or to acquire. 3PL customers are able to leverage on 3PL providers to improve customer service, respond to competition and reduce assets (Handfield *et al.*, 2011).

The selection of a 3PL provider is essential for businesses looking to reduce supply chain costs and improving service quality for their customers. Companies who outsource their logistics activities to 3PLs are realising the importance of measuring and evaluating logistics performance. This paper aims to study the 3PL market in Singapore from the perspective of the 3PL customer (i.e. service user), determine the importance of decision criteria as perceived by service users and develop a decision-making framework to assist 3PL service users when they select a 3PL provider (Wai, 2012).

Literature Review

Many papers have been published on the performance measurement and selection of 3PL providers. Some recent studies on 3PL performance evaluation are included here.

Jharkharia and Shankar (2007) developed a methodology for the selection of a 3PL. They formulated an Analytic Network Process (ANP) model with three levels of decision-making: determinants, dimensions and enablers.

- Determinants (Level 1): Compatibility, quality, cost and reputation
- Dimensions (Level 2): Long-term relationships, operational performance, financial performance and risk management. These dimensions support their respective determinants.
- Enablers (Level 3): 16 enablers were identified. These enablers support their respective dimensions, but are allowed to have interdependencies among themselves.

The ANP approach was applied to a medium-sized fast-moving-consumer-goods company. The results showed that compatibility between the user and the 3PL was the most important determinant that influenced the selection process.

Maukar and Dewi (2009) studied the performance of one 3PL company in Indonesia that provided transport and warehousing services in several large cities. They measured the performance of this company using two levels of decision-making. The main criteria (or Level 1 performance indicators) considered in their study were: quality, delivery, cost and flexibility. Within each criterion, they identified several sub-criteria (or Level 2 performance indicators). The weights were obtained for each performance criteria using the analytic hierarchy process (AHP). Their findings indicated that the delivery criterion resulted in the highest weight.

Liu and Lyons (2010) studied the relationship between 3PL performance and service provision of UK and Taiwanese 3PLs. They extensively reviewed past studies and found that there was general consensus that delivery, quality, flexibility, cost and innovation can describe the operational performance of 3PLs. The study used the postal questionnaire for data collection. The sample of 3PL customers was drawn from large manufacturing companies in the UK and Taiwan. Their results suggested that excellence in operations was more important than providing a wide range of services.

Miodrag and Clausen (2011) developed a performance measurement system for forwarders in Germany. This system was designed to support small and medium-sized forwarding companies. Three criteria were identified as company targets: financial, performance and quality levels. Within each target level, several sub-criteria or second level indicators were used. Their paper did not specifically mention about the weights for the indicators.

Methodology

Figure 1 shows the study methodology adopted to achieve the research objectives. The methodology allowed us to gather insights on logistics outsourcing in Singapore, test the importance of the chosen decision criteria for 3PL selection and develop a decision-making model for 3PL selection.

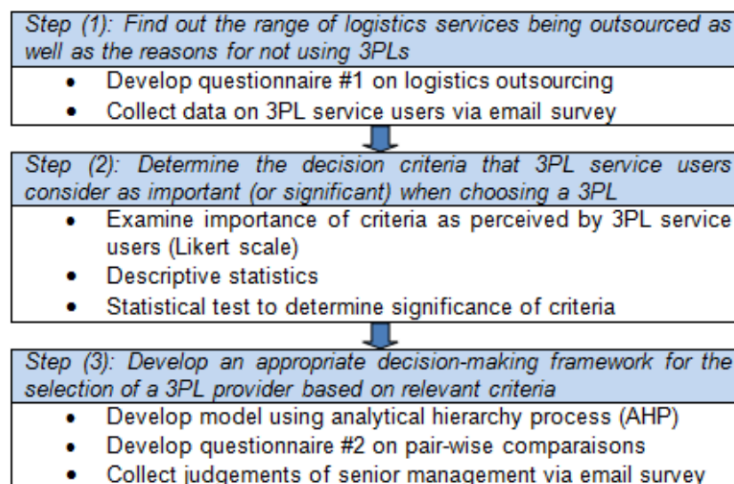


Figure 1: Study methodology

Survey on logistics outsourcing

The first questionnaire was designed to be easy to self-complete and captured information on: (1) company and respondent profile; (2) whether the company outsourced logistics activities to 3PLs; (3) range of activities outsourced; (4) rating of decision criteria perceived as important by 3PL users on a Likert scale of 1 to 7; and (5) reasons for not using 3PLs if logistics was not outsourced.

Similar to Maukar and Dewi (2009), we conceptualised the model for the selection of a 3PL provider as a two-level problem. Figure 2 shows the structure of the multi-criteria decision-making model. Decision criteria (Level 1) chosen were delivery, cost, quality and flexibility. For sub-criteria (Level 2), we considered 12 performance indicators of 3PL capabilities. Table 1 describes the decision criteria.

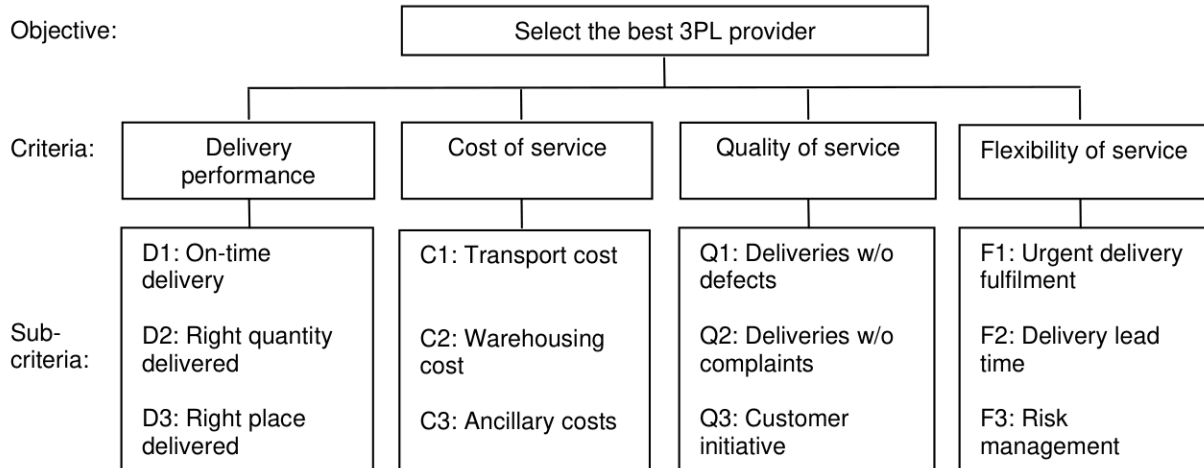


Figure 2: Structure of decision-making model for 3PL selection

Criteria	Sub-criteria	Description	Remarks
Delivery performance	D1: On-time delivery	Number of deliveries delivered on-time divided by total deliveries	On-time delivery affects supply planning and customer satisfaction
	D2: Right quantity delivered	Number of deliveries delivered at the right quantity divided by total deliveries	Short- or over-shipment affects production or supply schedules; cause custom delays; affects customer satisfaction
	D3: Right place delivered	Number of deliveries delivered to the right place divided by total deliveries	Wrong delivery of items to wrong location causes unnecessary surcharges in transport; affects customer satisfaction
Cost of Service	C1: Transport cost	Total transport cost divided by total revenue	Efficiency in delivery cost
	C2: Warehousing cost	Total warehousing cost divided by total revenue	Efficiency in warehouse cost
	C3: Ancillary cost	Handling costs, port charges, etc divided by total revenue	Transport and warehousing costs may not reflect how efficient a 3PL moves goods
Quality of service	Q1: Deliveries without defects	Number of deliveries without defects divided by total orders	High ratio indicates low defective rate
	Q2: Deliveries without complaints	Number of deliveries without complaints divided by total orders	High ratio indicates high service quality level
	Q3: Customer initiative	3PL's commitment to enhance customer success	Commitment of the 3PL to propose value-added solutions to reduce supply chain cost
Flexibility of service	F1: Urgent delivery fulfilment	Number of urgent deliveries fulfilled divided by total number of urgent delivery requests	Ability to accommodate last minute requests improves shippers ability to provide better customer service
	F2: Delivery lead time	Ability to provide quicker delivery lead time to customers	Lower delivery lead time increases customer satisfaction for shippers
	F3: Risk management	Ability to handle unexpected events, e.g. change of route or transport mode	Increases shippers' confidence in a 3PL to manage unexpected events

Table 1: Description of the decision criteria used

The sampling technique chosen for this study was purposive or judgemental sampling (Saunders *et al.*, 2009). The questionnaire on logistics outsourcing was emailed to 33 professionals from different companies in Singapore in April/May 2012. The companies they represent were mainly in the manufacturing and services sector. Before emailing the questionnaire, the respondents were contacted and briefed on the survey objectives. Eventually, information from 30 respondents was used in the analysis. As we worked with individuals that we knew, data were obtained at a very high response rate (91%).

This technique was considered practical given that this was an exploratory study and we were dealing with very small samples due to time and resource constraints. The limitation with this technique is that the sample cannot be considered statistically representative of the total population.

Survey on pair-wise comparisons

The model structure enabled the use of a mathematical technique for decision-making known as the analytic hierarchy process (AHP). Developed by Saaty (1980), the AHP is a widely used approach to handle multi-criteria decision-making. It uses a method for assigning ratings and weights that is considered reliable and consistent. To derive the weights, the AHP requires the judgements of decision-makers known as pair-wise comparisons, i.e. the relative importance of one criterion over another.

The second questionnaire was designed to capture these pair-wise comparisons on a scale of 1 to 9. Figure 3 shows an example of comparisons made between delivery performance versus cost of service, and delivery performance versus quality of service. Here, delivery was considered 5 times more important than cost, while delivery was perceived as equally important as quality.

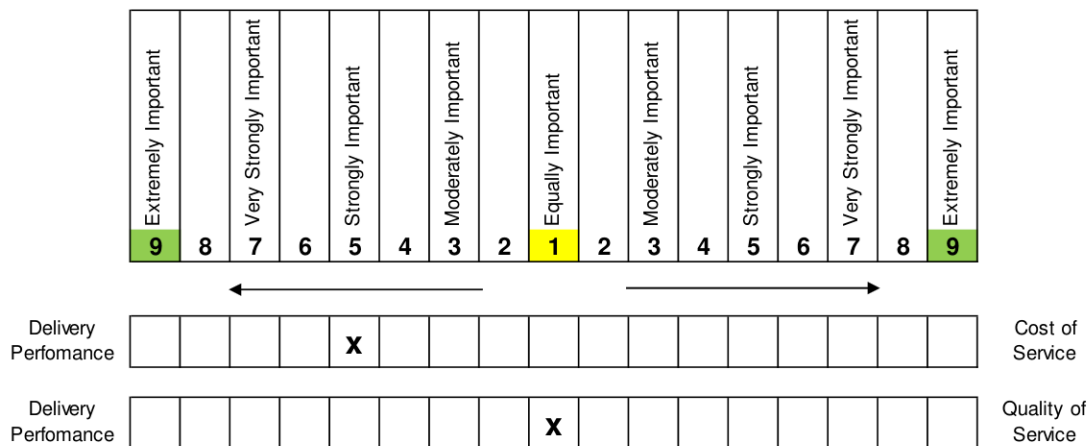


Figure 3: Example of pair-wise comparisons

We applied the multi-criteria decision-making model structure to three different industries by seeking the judgments of senior supply chain managers from these industries. For the survey on pair-wise comparisons, the self-completion questionnaire was emailed to six supply chain managers who had agreed to participate in the following industries:

- Oil and gas – 2 participants
- PC manufacturing – 2 participants
- Commodity trading (e.g. dry bulk, engineered metal, polymer products) – 2 participants

Results and Discussion

Company and respondent profile

Figure 4 shows the percentage distribution of the 30 respondents by type of industry from the first survey. The companies in the sample represented a range of industries in Singapore. Electronic and electrical equipment manufacturing had the highest percentage representation (27%), followed by wholesale trade (23%), petrochemical manufacturing (14%), and machinery and equipment manufacturing (13%). Most respondents were executives (67%) and in junior management (23%).

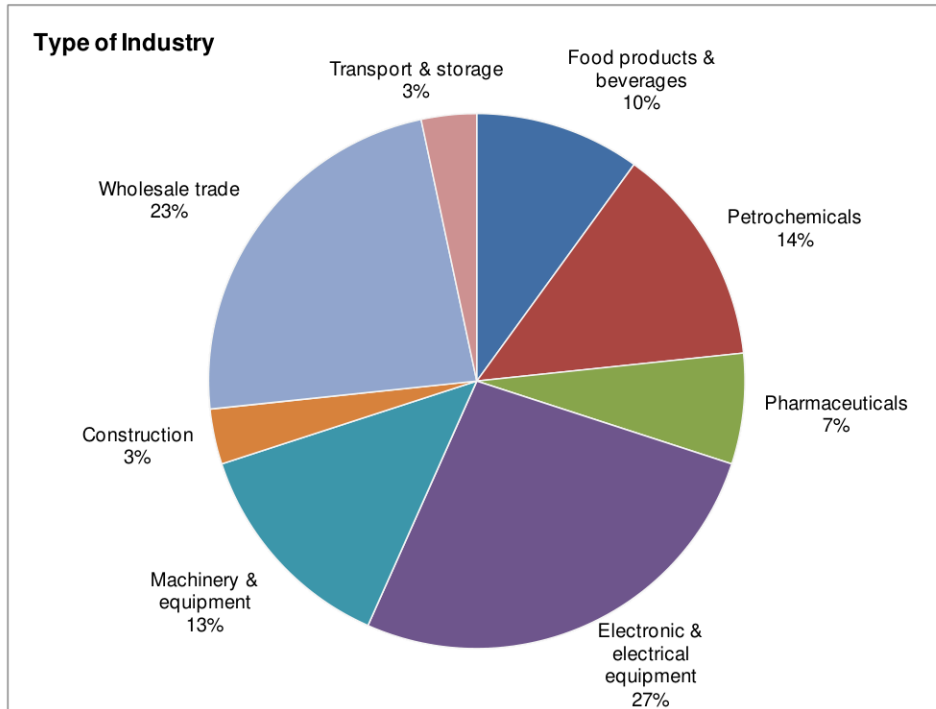


Figure 4: Percentage distribution of respondents surveyed by industry type (n = 30)

Extent of logistics outsourcing

Out of the 30 respondents, 27 (90%) reported that their company outsourced their logistics activities. This finding reaffirms the important role that 3PLs play in providing logistics capabilities to Singapore-based businesses. Figure 5 summarises the range of logistics activities that were reported as outsourced. The distribution was not uniform and some activities were more often outsourced than others. Clearly, 3PLs have not taken over the customer's entire logistics and supply chain operations.

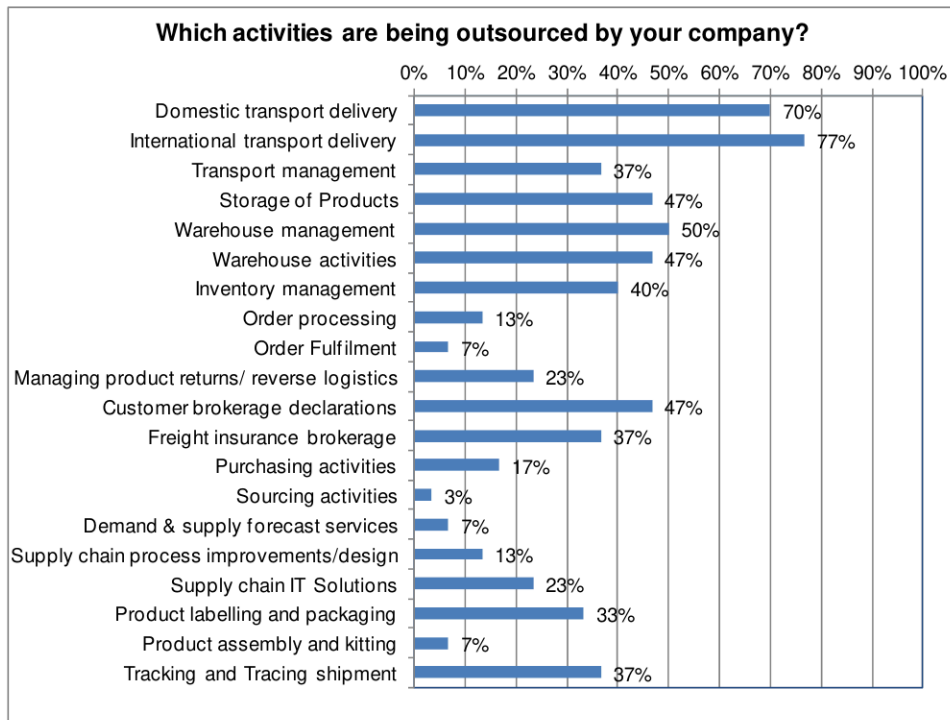


Figure 5: Percentage of respondents who reported the activity was outsourced

The most outsourced activities were international (77%) and domestic (70%) transport. This was followed by warehousing (47-50%) and customs brokerage declarations (47%). These activities tend to be logistics tasks that are transactional, operational and routine in nature. These functions can be readily supplied by many 3PL providers who have been in this business for many years.

The least outsourced activities were sourcing (3%), order fulfilment (7%), demand and supply forecasting (7%), product assembly and kitting (7%). Being more strategic and IT-intensive in nature, companies are less inclined to outsource these important functions. The findings seem to agree well with the trends reported by Langley and Capgemini (2010) in their annual study on third-party logistics.

Of the three respondents (10%) who stated that their company did not outsource logistics activities, they were asked to give reasons for not using 3PLs. The main reason cited was that control over the outsourced function would diminish which could jeopardise the company's service level. Other reasons mentioned were: logistics was a core competency of the company; cost reductions would not be realised; service level commitments would not be realised; the company has more expertise than most 3PL providers; and issues related to security of shipments.

Perceived importance of decision criteria

Table 2 summarises the importance of the decision criteria as rated by the 27 respondents in terms of the mean and standard deviation. Mean ratings for the four main decision criteria were high, ranging from 5.93 to 6.74. The respondents placed delivery (6.74), quality (6.44) and flexibility (6.04) ahead of cost of service (5.93) when selecting a 3PL.

Mean ratings for the 12 sub-criteria were also high, from 5.85 to 6.63. These values mirrored that of the four decision criteria. Delivery sub-criteria (D1, D2 and D3) had the highest mean ratings of 6.52 to 6.63. Cost sub-criteria (C1, C2 and C3) had the lowest mean ratings of 5.85 to 6.04.

The statistical t-test (Walpole et al., 2007) was applied to test whether the mean values were greater than 4 (neutral point) at the 5% level. The null hypothesis (H_0) was $\mu = 4$; the alternative hypothesis (H_1) was $\mu > 4$ (one-sided). The results indicated that the mean ratings for all decision criteria were significantly greater than 4 at the 5% level. Hence, the 3PL users considered these decision criteria to be important in the selection of a 3PL provider. The findings supported the inclusion of these criteria for the second survey on pair-wise comparisons.

Criteria	Rating		Means T-Test Result
	Mean	Std Dev	
Delivery performance	6.74	0.53	Reject H_0 . Mean is significantly greater than 4 at 5% level.
D1: On-time delivery	6.63	0.49	
D2: Right quantity delivered	6.52	0.51	
D3: Right place delivered	6.56	0.58	
Cost of service	5.93	0.92	
C1: Transport cost	6.04	0.90	
C2: Warehousing cost	5.85	1.03	
C3: Ancillary cost	5.96	0.98	
Quality of service	6.44	0.58	
Q1: Deliveries without defects	6.44	0.80	
Q2: Deliveries without complaints	6.48	0.70	
Q3: Customer initiative	6.11	0.80	
Flexibility of service	6.04	0.76	
F1: Urgent delivery fulfilment	6.44	0.70	
F2: Delivery lead time	6.11	0.70	
F3: Risk management	6.19	0.74	

Rating: 1 = extremely unimportant, 2 = very unimportant, 3 = somewhat unimportant, 4 = neutral, 5 = somewhat important, 6 = very important, 7= extremely important

Table 2: Perceived importance of decision criteria (n = 27)

Application of the AHP method

The application of the AHP method involved the following steps:

- (1) Express the pair-wise comparisons provided by each participants as pair-wise comparison matrices; a (4 x 4) matrix for the main criteria and four (3 x 3) matrices for the sub-criteria.
- (2) Compute the relative weights for each criterion based on the judgements given by each participant.
- (3) Check for inconsistent pair-wise comparisons. A consistent judgment is one that returns a consistency ratio (CR) of less than 0.10 (or 10%). If CR is greater than 0.1, we discuss with the participant to improve the consistency of the comparisons.
- (4) If consistent, consolidate the judgements of individual participants and compute the consolidated weights for each criterion.
- (5) Finally, adjust the consolidated sub-criteria weights according to the weights of the main criteria.

In step (2), the relative weights for each criterion were determined by raising the pair-wise comparison matrix to powers that were successively squared each time. This squaring processing stopped when there was no significant change between all elements of the pair-wise comparison matrix in two successive steps of squaring. When this happened, the row sums were calculated and normalised to obtain the eigen-vectors. We used an Excel spreadsheet developed by Goepel (2012) to facilitate the computations.

Consolidated AHP weights

Table 3 summarises the derived AHP weights of the four criteria and 12 sub-criteria when selecting a 3PL provider. The figures in italics are the consistency ratios (CR) for the criteria and sub-criteria. The consolidated weights were grouped according to the type of industry of the participants. The CR values across the three industry groups were less than 0.1 indicating that there was reasonable consistency in the judgements of the consolidated pair-wise comparisons.

Criteria	Oil and Gas			PC Manufacturing			Commodity Trading		
	Weight	Relative Weight	Adjusted Weight	Weight	Relative Weight	Adjusted Weight	Weight	Relative Weight	Adjusted Weight
Delivery performance	0.328			0.197			0.148		
D1: On-time delivery		0.129	0.042		0.268	0.053		0.068	0.010
D2: Right quantity delivered		0.105	0.034		0.268	0.053		0.611	0.091
D3: Right place delivered		0.766	0.251		0.464	0.092		0.321	0.048
Sub-criteria Total		1.000	0.328		1.000	0.197		1.000	0.148
Consistency Ratio		<i>0.092</i>			<i>0.000</i>			<i>0.077</i>	
Cost of service	0.047			0.066			0.599		
C1: Transport cost		0.685	0.032		0.417	0.028		0.699	0.418
C2: Warehousing cost		0.120	0.006		0.218	0.014		0.141	0.084
C3: Ancillary cost		0.195	0.009		0.364	0.024		0.161	0.096
Sub-criteria Total		1.000	0.047		1.000	0.066		1.000	0.599
Consistency Ratio		<i>0.097</i>			<i>0.044</i>			<i>0.044</i>	
Quality of service	0.420			0.359			0.156		
Q1: Deliveries w/o defects		0.762	0.320		0.509	0.183		0.741	0.116
Q2: Deliveries w/o complaints		0.129	0.054		0.141	0.051		0.137	0.021
Q3: Customer initiative		0.109	0.046		0.350	0.125		0.122	0.019
Sub-criteria Total		1.000	0.420		1.000	0.359		1.000	0.156
Consistency Ratio		<i>0.055</i>			<i>0.094</i>			<i>0.001</i>	
Flexibility of service	0.205			0.378			0.097		
F1: Urgent delivery fulfilment		0.432	0.089		0.315	0.119		0.408	0.039
F2: Delivery lead time		0.159	0.033		0.404	0.153		0.475	0.046
F3: Risk management		0.409	0.084		0.281	0.106		0.116	0.011
Sub-criteria Total		1.000	0.205		1.000	0.378		1.000	0.097
Consistency Ratio		<i>0.015</i>			<i>0.012</i>			<i>0.002</i>	
Main Criteria Total	1.000			1.000			1.000		
Consistency Ratio	<i>0.084</i>			<i>0.028</i>			<i>0.084</i>		

Table 3: AHP weights for criteria and sub-criteria used for 3PL selection

Among the four main criteria, the oil and gas participants placed the highest weight on quality of service (0.420) when selecting a 3PL, followed by delivery performance (0.328) and flexibility of service (0.205). Cost of service had the lowest weight (0.047). Quality sub-criteria “deliveries without defects” and delivery sub-criteria “right place delivered” were important considerations for oil and gas companies. This can be due to the strategic value of the product being transported.

The PC manufacturing participants viewed flexibility (0.378) and quality of service (0.359) as the two criteria with nearly similar weight, followed by delivery performance (0.197). Cost of service had the lowest weight (0.066). Quality sub-criteria “deliveries without defects” and flexibility sub-criteria “delivery lead time” were found to be important for PC manufacturers. This can reflect the greater challenges in delivering defect-free products in a timely manner to fulfil customer demand.

The commodity trading participants placed a high emphasis on cost of service (0.599). Quality of service (0.156), delivery performance (0.148) and flexibility of service (0.097) had very low weights by comparison. This is not surprising as the commodity trade is likely to be conscious of profit margins depending on the trade terms used in the transport of goods. “Transport cost” had the highest weight of all the sub-criteria.

Conclusions and Recommendations

This paper attempts to contribute to the research on the performance evaluation of third-party logistics (3PL) service providers taking into account the viewpoints of the 3PL customer or service user. The study provides a methodology to investigate the extent of logistics outsourcing and to develop a decision-making model for 3PL selection.

The survey on logistics outsourcing in Singapore showed that 90% of the respondents reported that their company outsourced their logistics. The most outsourced activities tended to be transactional, operational and routine in nature, such as transport and warehousing. The least outsourced activities tended to be more strategic and IT-intensive in nature. The main reason cited for not using 3PLs was that control over the outsourced function would diminish which could hurt the company's performance.

3PL service users considered the four criteria of delivery, cost, quality and flexibility together with the 12 associated sub-criteria (or performance indicators) to be important in the selection of a 3PL provider. The selection of a 3PL provider was modelled as a two-level multi-criteria decision-making problem. The analytical hierarchy process (AHP) was used to compute the criteria weights. The model was applied to three different industries (oil and gas, PC manufacturing and commodities trading) to see whether the derived weights were sensitive to these industries.

The results showed that the derived weights were different for these industries which can be explained by the unique characteristics of the product delivered, customer demand and trade terms. Quality and delivery were found to be important considerations for the oil and gas industry, while flexibility and quality were found to be important for PC manufacturers. Commodity trading companies tended to be cost-conscious. The implications are that different industries place different levels of importance on the 3PL selection criteria. To be competitive, 3PL providers need to be agile to align with the different expectations of 3PL users.

This paper has a few limitations. We noted the concerns of the small sample size and the sampling technique used for the logistics outsourcing survey. There is room to increase the sample size and to use a probability sampling technique to obtain a more representative sample. Another limitation is that the AHP assumes that the various criteria and sub-criteria are independent of each other. The possibility of interdependence among the criteria cannot be ruled out in this study. One approach is to explore the use of the analytic network process (ANP), which is a general form of the AHP that allows for interrelationships among the decision levels.

There is scope to include more participants for the pair-wise comparisons to reduce the possibility of bias. Further, the participants made the pair-wise comparisons independent of each other. There is room to consider group decision-making to reduce the possibility of conflicting judgements.

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