

## **Business Logistics Performance Measurement in Third-Party Logistics: An Empirical Analysis of Australian Courier Firms**

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### **ABSTRACT**

This paper presents an empirically validated measurement model of logistics performance in Australian courier firms. In third-party logistics firms, logistics performance directly influences both internal and external stakeholders/customers. The courier firm is an important model of third-party logistics. In this study, all measures are validated by both academics and practitioners. Empirical data for the study was collected through a web-based survey. A total of 162 responses were used to verify the measurement model of structural equation modeling. Results indicate that the logistics performance measurement has high reliability and validity in the study. This measurement model contributes to the business performance literature. It provides insight to assess logistics performance in the postal/courier industry. In addition, the measures can be generalized for different business management purposes.

**Keywords:** Performance measurement, logistics performance, business logistics, supply chain management, postal/courier industry

## 1. INTRODUCTION

During the last couple of decades, the logistics industry has boomed worldwide, and competition in the third-party logistics (3PLs) market is now very intensive. The logistics performance of 3PLs is crucial in today's competitive business world [Wang, Jie, and Abareshi, 2015]. Logistics performance in courier service is critical for customers [Ho, Teik, Tiffany, Kok, and Teh, 2012]. It is important for transport logistics service providers in delivering value to members in the supply chain [Lai, Ngai, and Cheng, 2004]. Especially, 3PLs and transport service providers play a vital role in a supply chain system to deliver goods and information to link the different business partners in a supply chain. Thus, the effect of 3PLs' performance is significant. Furthermore, logistics performance is a success factor for both logistics service providers and their customers [Richard and Rein, 2004], because not only are 3PLs and transport service providers impacted by logistics performance, but also other business stakeholders and/or customers in the same supply chain network may suffer negative impacts of logistics performance.

Cohen and Roussel [2005] indicated that performance measurement refers to the indicators of the work performed and the results achieved in an activity, process, or organizational unit. Logistics performance was one of the important factors driving the choice of a 3PLs provider [Feng, Zheng, and Tan, 2007; Ho et al., 2012; Mentzer and Flint, 1999; Thai, 2013]. In addition, an oft-repeated axiom is: "If you can't measure it, you can't manage it." Performance measurement is fundamental to achieving organizational success [Fawcett and Cooper, 1998]. Therefore, logistics performance measurement plays a vital role in today's business management.

The 3PLs provide various services, which include transportation, warehousing, cross-docking, inventory management, packaging, and freight forwarding [Gudehus and Kotzab, 2012]. Between 84% and 90% of companies using 3PL suppliers believe that 3PLs should provide a comprehensive set of offerings [Donlon, 2006]. And, the 3PLs could benefit the companies in various aspects; for example, reduction in cost, reduction in capital investment, and enhanced operational flexibility. A courier company is one of the typical 3PL models in the logistics industry [Cowles, 2012]. Logistics performance in courier service is critical for customer satisfaction [Ho et al., 2012]. Previous studies have found that logistics performance could directly influence customer preferences [Feng et al., 2007; Ho et al., 2012; Mentzer and Flint, 1999; Thai, 2013]. Although less attention has been paid to the logistics performance of

courier services, this paper presents an empirically validated measurement model of logistics performance based on the Australian courier industry.

## 2. BACKGROUND

The earliest record of courier parcel service in Australia can be traced to 1809. Its origin is Australia Post. Postal services were an important feature of Australian life from the early colonial period, being the only means of contact between Australia and Britain for much of the nineteenth century [Post, 2013]. Today, airplanes, ships, trains, trucks, and bicycles have been widely used by couriers to transport customers' messages and parcels. Modern forms of transportation allow parcels to be delivered very quickly over vast distances [Wang, 2011]. These methods are highly efficient and obviously far more reliable than any of the options in the past. The general parcel courier service uses technologies to organize, transport, and even track deliveries. With GPS-style tracking options, customers not only receive parcels quickly, but also can watch the progress of their parcels along the way and get a proof of delivery. Therefore, many information technologies are involved in modern courier service, such as online real-time track and trace technology, which enables customers to monitor their freights from the point of pick-up to the point of delivery.

A courier company is a less-than-a-truckload (LTL) third-party logistics (3PL) carrier. One can sort 3PLs into different types, which include freight forwarders, courier companies, and other companies that integrate and offer subcontracted logistics and transportation services [Cowles, 2012]. A courier company is one of the most significant 3PL modules for all types of 3PLs. The operational costs for a carrier have three major components: costs for drivers and vehicles making local pick-ups and deliveries, line haul costs for transporting freight between terminals, and handling costs for sorting and consolidating freight. Handling freight in an LTL terminal is labor-intensive and therefore expensive because workers must quickly sort a variety of freight [Bartholdi and Gue, 2000]. Generally, road and air are the two most popular transport models in the Australian courier industry.

Today's courier service is different from a traditional postal service. A large number of courier firms, especially the large-scale ones, have begun to offer various services, including inbound freight, freight consolidation, reverse logistics, value-added customer services, distribution, order fulfillment, and outbound freight. Moreover, trends such as globalization, online shopping, and urbanization stimulate demands for courier services [Wang, 2011]. It is

important, therefore, to understand and measure courier performance. This study focuses on the performance of delivering express small parcels (normally under 30kg per item) in Australian courier firms; for example, DHL Express, TNT Express, and Toll priority.

### **3. MEASURING LOGISTICS PERFORMANCE**

From the resource-based view (RBV), each firm is a particular bundle of resources and capabilities. Moreover, each firm may have distinct objectives and strategies. Therefore, performance measurement may be different in different companies. In general, performance can be measured in hard (objective) measures and soft (perceptual or responsiveness) measures [Chow, Heaver, and Henriksson, 1994]. Hard measures include raw financial statistics, costs statistics, commissions, and services rendered. In contrast, soft measures include supervisor appraisals and self-perception. *Performance analysis* is the measurement and comparison of actual levels of achievement of specific objectives [Yang, 2012]. When analyzing system performance, it is difficult to use qualitative evaluations that are vague. However, the chosen numerical performance measure may not adequately describe the system's performance [Benita, 1999]. Hudson, Haas, and Uddin [1997] showed that performance measures are the quantities that capture the level to which the system performed and the results achieved in the process. Performance measures also can be used for other business purposes. Such performance measures have to be identified as the first task in risk analysis [Aven, 2012]. The informative performance measures could help companies to prevent the escalation of, and reduce the consequences of, a hazardous situation [Aven, 2012]. Furthermore, performance measures may prevent and monitor the risks in risk analysis [Aven, 2012].

Various indicators and attributes of logistics performance have been discussed in terms of different aspects or purposes. Previously, an aspect such as transportation cost or customer service was measured [Fawcett and Cooper, 1998]. The performance of activity was determined on the basis of costs [Christopher, 1998], whereas a number of empirical studies focused on service and quality [Irene Gil, David Servera, Gloria Berenguer, and María Fuentes, 2008]. Richard and Rein [2004] suggested that logistics performance is a success factor for both logistics service providers and their customers. Although logistics performance measurement has been widely discussed [Chow et al., 1994; Pichet and Shinya, 2008], there are few studies that investigate the logistics

performance of courier firms. This paper provides an empirical analysis of courier firms in Australia.

There are many distinct ways to measure performance in logistics companies. In the current study, logistics performance measures focus on the transport and freight industry in terms of the nature of being a courier, which is transporting express small packages/parcels from point of origin to point of destination (door-to-door service). The dominating logistics performance variable is on-time delivery [Helena, 2012]. Fawcett and Cooper [1998] identified important logistics performance attributes, including cost, productivity, customer service, and logistics quality. The performance indicators in the research are based on the hierarchy framework for evaluating logistics performance [Pichet and Shinya, 2008]. From Pichet and Shinya [2008] and Helena [2012], we extracted four logistics performance variables (on-time delivery, frequency of damaged freight, frequency of operation disruption, and flexibility).

According to the literature review, the measures of logistics performance are drawn and developed from previous studies of logistics and transport industries [Fawcett and Cooper, 1998; Morash, 2001; Najmi and Makui, 2012; Pichet and Shinya, 2008]. The indicators of logistics performance are measured by four aspects: customer service, delivery operations, freight safety, and information accuracy (Table 1).

**Table 1**  
**Logistics Performance Indicators in Previous Studies**

| <b>Logistics Performance</b> | <b>Items</b>  | <b>References</b>   |
|------------------------------|---|---|
| Customer Service             | Customer complaint<br>Customer response time<br>Customer satisfaction<br>Reputation | Fawcett and Cooper [1998]   |
| Delivery Operations          | Operating costs<br>On-time delivery<br>Frequency of disruptions /<br>delays         | Morash [2001]<br>Pichet and Shinya [2008]<br>Najmi and Makui [2012] |
| Freight Safety               | Damages<br>Lost freight   |   |
| Information Accuracy         | Billing / transit /<br>delivery information   |   |

The current study focuses on the actual courier performance of delivering small express parcels/packages, which may influence both courier firms and their customers. The results and generalization may be widely used, however, in the transport and logistics industry.

#### **4. METHODOLOGY**

Structural equation modeling (SEM) comprises two types of measurement scales: formative and reflective. It is important to understand the distinction between the two, because different types of measurement scales may influence the relationships and results in a study [Loehlin, 2004]. In reflective measurement models, variation in the construct causes variation in the item measures, changes in observed variables or indicators of the latent constructs reflect changes in the latent constructs, and the error item in items can be identified. In contrast, in formative measurement models, variation in item measures causes variation in the construct, latent constructs is determined as a combination of its indicators, and the error term cannot be identified if the formative measurement model is estimated in isolation [Churchill, 1979; Coltman, Devinney, Midgley, and Venaik, 2008]. In this study, we used a reflective scale to assess logistics performance.

##### **4.1. Instrument Design**

Measurement of the logistics performance of couriers in this study was derived from literature review and observation, and, then to ensure content validity, a pilot study was used to test the questionnaire before conducting a comprehensive survey. In the questionnaire survey, the items are structured and presented on a 7-point Likert scale. Likert-type scales are considered reliable and are recommended for obtaining people's attitudes, values, and perceptions [Miller, 1970]. In the 7-point Likert-type scale used in this study, 1 = "strongly disagree," and 7 = "strongly agree."

A multiple-indicator measure of a concept is used to measure logistics performance. The main reason for its use is recognition that there are potential problems with relying on just a single indicator, because one indicator may capture only a portion of the underlying concept or be too general [Bryman and Bell, 2011]. In addition, the SEM requires a minimum number of indicators for a latent variable [Loehlin, 2004]. Multiple-indicator measures may minimize measurement errors and improve the reliability and validity of measures of concepts [Grinnell and Unrau, 2011].

A positive feedback was received from our pilot study of the questionnaire, producing suggestions for minor changes. Nine items were finalized to assess logistics performance in Australian courier firms (see Table 3 in section 5.2). The indicators of logistics performance are validated by both supply chain and logistics academics and practitioners in the Australian courier industry.

#### **4.2. Data Collection**

In this study, we consider the sample size for research using the partial least squares approach for structural equation modeling (PLS-SEM) analysis. One of the advantages of the PLS-SEM approach is the smaller sample size compared with other approaches. A questionnaire survey is a major instrument to collect data. In this study, 98 courier companies in Australia were identified and invited to participate. Empirical data was collected through a web-based survey. A total 162 responses were used to verify the measurement model of structural equation modeling. The approximate response rate was about 20%.

#### **4.2. Data Analysis**

PLS-SEM has become a popular statistical technique in today's business research [Henseler, Ringle, and Sinkovics, 2009]. The IBM SPSS version 21 statistical software package was chosen for the study. This package is widely used for data screening involving data cleaning. Factor analysis involved the initial reliability, validity, and measure of purification in the study.

### **5. RELIABILITY AND VALIDITY OF RESULTS**

To ensure the reliability and validity of the measurement model, a factor analysis is performed for the reflective construct. Reliability is an assessment of the degree of consistency between multiple measurements of a variable [Hair, 2010]. This study applies a reliability coefficient with Cronbach's alpha to test the reliability of the scale. The reliability is demonstrated by Cronbach's alpha greater than 0.7 in SPSS [Hair, 2010].

Validity is another important dimension to indicate the degree of accuracy of measurements. Face or content validity was tested in the pilot study. Convergent validity assesses the degree to which two measures of the same concept are correlated [Hair, 2010]. High correlations are required to ensure convergent validity. A value greater than 0.7 is considered a satisfaction level. In contrast, discriminant validity is the degree to which two conceptually similar concepts are distinct [Hair, 2010]. Factor analysis includes various reliability

and validity tests, Cronbach's alpha KMO, Bartlett's test, communalities, and convergent and discriminant validity.

### 5.1. Factor Analysis

Exploratory factor analysis (EFA) is used to explore the underlying dimensions of construct. Logistics performance is a reflective multi-item construct. The most widely used method in factor analysis is principal axis factoring (PAF). It is a least-squares estimation of the common factor model. It makes no assumption about the type of error and minimizes the unweighted sum of the squares [unweighted least squares (ULS) or ordinary least squares (OLS)] of the residual matrix [Winter and Dodou, 2012]. Promax is used for the factor rotation method. The detailed testing results can be found in Table 2.

**Table 2**  
**The Statistical Criteria of Logistics Performance**

|                              | Logistics Performance | References [Hair, 2010] | Requirement Met (Y/N) |
|------------------------------|-----------------------|-------------------------|-----------------------|
| <i>Cronbach's alpha</i>      | 0.93                  | >0.7                    | Yes                   |
| <i>Communalities</i>         | >0.5                  | >0.5                    | Yes                   |
| <i>KMO</i>                   | 0.92                  | >0.50                   | Yes                   |
| <i>Barlett's test (sig.)</i> | 0                     | 0                       | Yes                   |
| <i>Eigenvalues</i>           | >1                    | >1                      | Yes                   |
| <i>Cumulative %</i>          | 66.3 %                | >60%                    | Yes                   |
| <i>Factor extracted</i>      | 1                     | N/A                     | Yes                   |
| <i>Convergent validity</i>   | 0.79                  | >0.7                    | Yes                   |

Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy and Bartlett's test of sphericity are used to assess the suitability of the respondent data for factor analysis. Interpretive adjectives for the KMO of sampling adequacy include *marvelous* (> 0.90), *meritorious* (> 0.80), *middling* (> 0.70), *mediocre* (> 0.60), *miserable* (> 0.50), and *unacceptable* (below 0.50) [Hair, 2010]. The value of the KMO measure of sampling adequacy for this study is 0.92, which would be labeled as *marvelous*. Bartlett's test of sphericity plays a vital role for accepting the sample adequacy. A general rule for the Bartlett's test of sphericity



must be less than 0.05 [Hair, 2010]. The sig value for this test is 0. Therefore, the validity and suitability of the responses are accepted in this study.

Based on Kaiser's criteria (eigenvalue greater than 1), a cumulative percentage of variance of 66.3% and a total of one component having an eigenvalue >1, one factor was extracted for the construct-logistics performance. No item is removed from the logistics performance measurements during the factor analysis. As Table 2 shows, the construct has high reliability and validity.

### 5.1 Item Reliability and Validity

For reflective indicators, a general rule for item reliability is Cronbach's alpha greater than 0.7 [Hair, Sarstedt, Pieper, and Ringle, 2012]. Cronbach's alpha is a commonly used test of internal reliability. It essentially calculates the average of all possible split-half reliability coefficients [Bryman and Bell, 2011]. The instrument showed good statistical properties as the Cronbach's alpha for logistics performance is 0.93, which is above the threshold of 0.7 (Table 3). Therefore, the reliability of individual items is eligible in the study.

**Table 3**  
**Logistics Performance Factor Analysis**

| Construct                                   | Items                                       | Loadings | Commonalities | Cronbach's Alpha | Compe Reliability | AVE  |
|---|---|----------|---------------|------------------|-------------------|------|
| Logistics Performance                       | LP_6<br>Customer satisfaction               | 0.92     | 0.83          |                  |                   |      |
|   | LP_5 On-time and accurate delivery          | 0.87     | 0.72          |                  |                   |      |
|   | LP_4<br>Customer complaint                  | 0.85     | 0.75          |                  |                   |      |
|   | LP_3<br>Damaged / lost freight              | 0.83     | 0.70          |                  |                   |      |
|   | LP_7<br>Customer response time              | 0.76     | 0.57          | 0.93             | 0.91              | 0.66 |
|   | LP_9 Accurate billing/ delivery information | 0.76     | 0.61          |                  |                   |      |
|   | LP_2 Frequency of disruptions / delays      | 0.73     | 0.58          |                  |                   |      |
|   | LP_8 Reputation in the industry             | 0.70     | 0.51          |                  |                   |      |
|   | LP_1 Operating costs                        | 0.66     | 0.71          |                  |                   |      |
| Extraction Method: Principal Axis Factoring |   |          |               |                  |                   |      |

In the current study, nearly all loadings are above the threshold of 0.7. In practice, items often have loadings below 0.7. It is common to exclude items only if loadings are below 0.4 [Hair, 2010]. Convergent validity is demonstrated by an average loading greater than 0.7, AVE greater than 0.500, and communalities greater than 0.500 (Hair, 2010). Convergent validity for the reflective items shows that all items load with a significant t value and that the AVE score is 0.66 higher than the threshold of 0.5 (Table 3). Discriminant validity is demonstrated by the square root of the AVE being greater than any of the inter-construct correlations (Hair et al., 2012).

In this study, factor analysis is conducted to explore and investigate the nature of the variable – logistics performance in the Australian courier industry. The results demonstrate the reliability and validity of the scale of logistics performance in the Australian courier industry. Factor analysis has become an important tool for both quantitative and qualitative researchers to explore and generate dimensions. In EFA, researchers normally do not have expectations. This would help researchers to develop a theory. In addition, EFA is an important factor analysis approach to reduce a large number of variables into a smaller set of factors. We have used the approach to determine the factor of logistics performance and to develop an empirically supported scale of logistics performance in the Australian courier industry.

## **6. DISCUSSION**

With the rapid development of e-business, couriers have become more and more popular, but there are very few studies on the courier industry. The objective of our study is to verify a measurement model of logistics performance in the 3PLs. In this study, we focus on business logistics performance measurement based on the Australian courier industry. We use factor analysis for measurement model development. Although items are adopted from the literature review, all items are used to assess the logistics performance of courier firm for the first time. This paper contributes to business performance literature. Logistics performance is assessed from four aspects: customer service, delivery operations, freight safety, and information accuracy. A total of 9 items were identified and tested to measure the logistics performance of the 3PLs. The factor analysis revealed one underlying factor of logistics performance in the Australian courier industry. Based on the results of factor analysis, the measurements of logistics performance have a high level of reliability and accuracy.

Based on our empirical data analysis, we identified the following top five problems, based on mean value:

“Company maintains low operating costs” [mean value 5.15]

“Company has low frequency of disruptions/delays” [mean value 5.53]

“Company has low rate of customer complaint” [mean value 5.60]

“Company has less damaged/lost freight” [mean value 5.73]

“Company has on-time and accurate delivery” [mean value 5.73]

These findings may draw attention to operations issues. Based on RBV, each company is distinct, and the courier companies may have different customers, networks, and services in Australia. Managers, therefore, must convert their ideas into solutions based on the different firms.

Logistics performance is one of the important parameters in many businesses. It may affect both internal and external stakeholders/customers. This paper provides insight into assessing logistics performance in the postal/courier industry. It may help managers, particularly in the postal/courier industry, to identify operations issues and monitor business operations in order to achieve sustainable development.

## **7. CONCLUSION**

The primary contribution of this paper is that we found empirical support for a measurement model of logistics performance in the Australian courier industry. The scale of logistics performance was verified empirically. Our findings can be widely used for further research and/or measurement of logistics performance in the transport and logistics industry. We used IBM SPSS version 21 for data analysis. The results indicated a high level of reliability and validity. During the measurement refinement process, we did not delete any item. In other words, the 9 items were found to well represent the logistics performance of the 3PLs.

The current paper provides, for the first time, an empirically validated measurement model of logistics performance for Australian courier firms. The results have important implications for both academics and practitioners. Logistics performance is an important concept in business discipline. Measuring business logistics performance is one of the key tasks in understanding and developing the concept. Our measurement model makes a contribution to the literature. For managers, operating costs may be a problem in many Australian courier firms. From our research, we identified problems relating to delays,

customer complaint and damaged/ lost freight. We suggest that the scale could be used to assess logistics performance in other industries. Therefore, an important implication of the study is that future empirical studies should test logistics performance measurement in different countries and/or sectors.

Although the results show a high degree of reliability and validity, it must be remembered that the empirical data was collected from Australian courier firms only and that any generalization to other countries or sectors should be made with caution. The logistics performance measurement model of structural equation modeling can be used for a structural model. Further research may be conducted to investigate the relationships between logistics performance and other constructs.

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