Effect of information sharing and process coordination on logistics outsourcing

Chen Liu
School of Management, Xi'an Jiaotong University, Shaanxi, China
Baofeng Huo
School of Management, Zhejiang University, Hangzhou, Zhejiang, China
Shulin Liu
School of Management, Xi'an Jiaotong University, Xi'an, Shaanxi, China, and
Xiande Zhao
Department of Economics and Decision Sciences, China-Europe International Business School (CEIBS), Shanghai, China and Institute of Supply Chain Integration and Service Innovation, College of Business Administration, South China University of Technology, Guangzhou, China

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Abstract

Purpose – The purpose of this paper is to test how integrative mechanisms, including information sharing and process coordination, influence logistics outsourcing, and how logistics outsourcing influence performance from an extended RBV perspective.

Design/methodology/approach – The structural equation modeling (SEM) method is used to examine the proposed model, based on data collected from 361 companies in greater China.

Findings – Integrative mechanisms are helpful for logistics outsourcing (basic, customized, and advanced outsourcing). Specially, information sharing contributes to customized and advanced outsourcing, but has no significant effect on basic outsourcing. In contrast, process coordination improves basic and advanced outsourcing, but insignificantly influences customized outsourcing. Besides, each type of logistics outsourcing has differently effects on 3PL users' performance. This study contributes to 3PL theories and practices.

Originality/value – This study empirically examines the antecedents and the outcomes of logistics outsourcing, contributing to 3PL literature and practices.

Keywords Performance, Information sharing, Logistics outsourcing, Process coordination

Paper type Research paper

1. Introduction

With the development of e-commerce and global competition, logistics outsourcing has received more attentions from academicians and practitioners. Logistics outsourcing enables third-party-logistics (3PL) users to leverage external logistics resources (Dyer and Singh, 1998; Lavie, 2006; Bolumole *et al.*, 2007) that may be difficult or costly to manage in-house (Lieb *et al.*, 1993; Razzaque and Sheng, 1998; Cho *et al.*, 2008). Logistics outsourcing can reduce non-core business investments (Razzaque and Sheng, 1998), improve logistics performance (Chen *et al.*, 2010) and customer service

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(Rabinovich *et al.*, 1999; Skjoett-Larsen, 2000), and support supply chain integration (Harrington, 1995). However, previous 3PL studies have shown that logistics outsourcing is often regarded negatively by 3PL users, as the use of external resources increases uncertainty in operations and customer service. Examples include the inability of 3PL providers to meet specific logistics requirements or future growth needs, incompatibility between the information systems of 3PL providers and users, and security issues (Razzaque and Sheng, 1998; Lau and Zhang, 2006; Ansari and Modarress, 2010). Given this mixed situation, further investigation is needed to understand the critical factors in logistics outsourcing.

Studies have suggested that integrative mechanisms are required to develop network-related resources, and thus leverage external resources (Dyer and Singh, 1998). The operations management literature identifies information sharing and process coordination as two typical integrative mechanisms (Sahin and Robinson, 2002; Sahin and Robinson, 2005; Cai *et al.*, 2010; Wu *et al.*, 2014). They can increase partners' capabilities to absorb benefits from each other. Organizational information processing theory (OIPT) states that information sharing strongly improves information quality and the information processing capabilities of companies (Wong *et al.*, 2011). In particular, with the growth of information technology (IT), information sharing has become increasingly important in 3PL services, and is critical for 3PL users developing logistics outsourcing (Lewis and Talalayevsky, 2000; Lai *et al.*, 2008; Marasco, 2008; Mortensen and Lemoine, 2008). Process coordination is another important enabler, required to effectively transfer specific process- and network-related logistics services from 3PL providers to users (Lai, 2004). Previous 3PL studies have investigated the various resources used for successful logistics outsourcing, but they have failed to explain how 3PL users can gain competitive advantages from external logistics resources (e.g. Lai *et al.*, 2008; Chen *et al.*, 2010; Wong and Karia, 2010). Few studies have distinguished between the effects of information sharing and those of process coordination on outsourcing activities in the 3PL context. A holistic investigation is thus needed to advance knowledge of the joint role of information sharing and process coordination in logistics outsourcing.

Furthermore, logistics outsourcing refers to a wide range of service, including basic functional, special organizational, and advanced supply chain, activities. These may require different integrative mechanisms. However, we know little about the relationships between different integrative mechanisms and specific types of logistics outsourcing. Thus, a comprehensive framework of integrative mechanism-logistics outsourcing-performance is required.

This study addresses two major research questions:

RQ1. How do integrative mechanisms influence logistics outsourcing activities?

RQ2. How do different types of logistics outsourcing improve the performance of 3PL users?

It contributes to the 3PL literature in several ways. First, the study investigates the role of integrative mechanisms in logistics outsourcing, extending our understanding of the enablers of logistics outsourcing. Second, it distinguishes several specific types of logistics activities and clarifies their different roles in improving performance, extending the operationalization of logistics outsourcing in the literature. Third, the holistic integrative mechanism-logistics outsourcing-performance model, proposed

extends our understanding of the mechanism of logistics outsourcing. Practically, this study can help managers improve logistics outsourcing and obtain performance and competitive advantages.

The remainder of this paper is organized as follows. First, the theoretical foundation is outlined and the research hypotheses are developed. Next, the research methodology is presented, followed by the data analyses and their results. The findings are then discussed along with their managerial implications. Finally, conclusions are drawn, and limitations and suggestions for future research are provided.

2. Theoretical background and hypothesis development

In the conceptual model (Figure 1), we propose that information sharing and process coordination, as integrative mechanisms, can facilitate the logistics outsourcing of 3PL users, which in turn, leads to performance improvements.

2.1 Integrative mechanisms in the 3PL field

The resource-based view (RBV) states that competitive advantage can be gained from value-creating resources owned and controlled by focal firms (Barney, 1991). If 3PL users interact with partners and develop control mechanisms for external resources, they will obtain competitive advantages (Conner, 1991). In particular, integrative mechanisms lead to partnerships, and in turn to network-related resources, which can provide long-term benefits to both parties (Dyer and Singh, 1998; Lavie, 2006). Without integrative mechanisms, companies can only rely on slack logistics resources in the market, leading to high levels of uncertainty and increased holding costs (Huiskonen and Pirttilä, 2002). In fact, integrative mechanisms are a form of relational governance between two parties, and take effect through the investment of a series of resources such as information systems, skilled employees, and other specific assets (Frohlich and Westbrook, 2001; Zhao *et al.*, 2008).

For 3PL services, logistics resources are heterogeneously distributed across and imperfectly transferred between companies (Lai, 2004). To benefit from these resources, an integrated 3PL relationship must be developed (Boyson *et al.*, 1999; Knemeyer *et al.*, 2003), as the competence of 3PL users is related to the level of integration with their

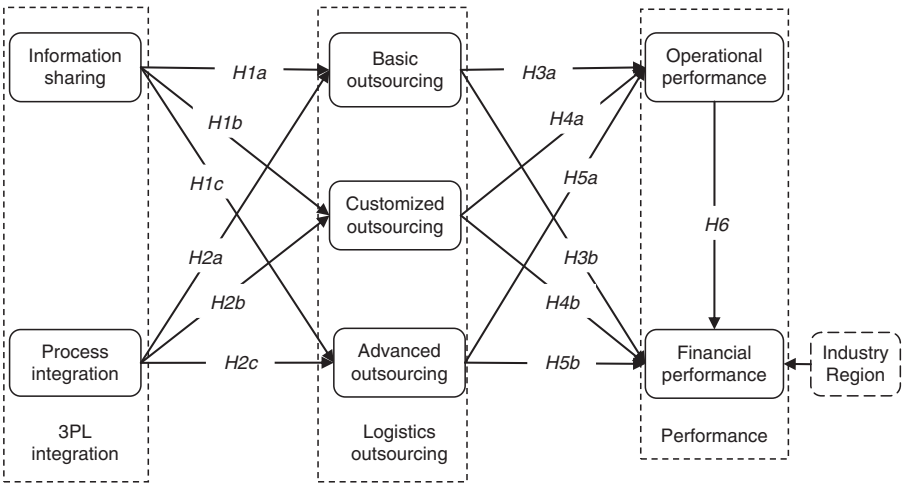

Figure 1.
Conceptual model

providers. The integration process is also critical for users to successfully outsource their logistics services (Han *et al.*, 2008).

Previous studies have identified various integrative behaviors in the 3PL partnership. For example, Rabinovich *et al.* (1999) found that 3PL users may develop integrated functional processes for information and material flow to and from their providers. Huiskonen and Pirttilä (2002) found that lateral coordination, including formal group teams, informal communication, and integrated roles, leads to better logistics processes between 3PL users and providers. Hofer *et al.* (2009) identified five types of integrative behaviors of 3PL users: extendedness, operational information exchange, mutual operating control, shared benefits and burdens, and planning. Although these 3PL studies have identified several integrative behaviors in logistics outsourcing relationships, they failed to explain the effect of these mechanisms on logistics outsourcing. To fill that gap, this study investigates information sharing and process coordination in the 3PL context, exploring the relationship between two integrative mechanisms and logistics outsourcing.

2.1.1 Information sharing. Inter-organizational information sharing is particularly relevant to IT. Huo *et al.* (2013) suggested that system integration can provide a platform to exchange valuable information between partners, and Lai *et al.* (2008) stated that it is critical for 3PL users to consider IT when outsourcing logistics services. In this study, we focus on formal information sharing, where 3PL partners exchange information through IT systems (Huo *et al.*, 2014). According to RBV, formal information sharing is based on investments in tangible resources, such as software and IT systems.

The benefits of information sharing include improving the information quality and information processing capabilities of all partners, which help companies cope with uncertainties around the partnerships and the external environment (Premkumar *et al.*, 2005; Wong *et al.*, 2015). Studies have shown that information sharing has many benefits. For example, Li and Lin (2006) found that by sharing information, supply chain partners are able to access realistic and real-time information from the supply chains. It is widely recognized that information sharing is an effective way to reduce bullwhip effects and improve the lead-time performance in supply chain management (Ward and Zhou, 2006; Agrawal *et al.*, 2009). Wong and Karia (2010) stated that information resources can be particularly important for 3PL logistics outsourcing. Thus, based on our literature review, information sharing has been found to be beneficial to inter-organizational cooperation.

2.1.2 Process coordination. Process coordination refers to the synchronization or integration of business flows between two companies (Rabinovich *et al.*, 1999; Samaddar *et al.*, 2006). Both parties participate in each other's processes, and develop adoptive behaviors to solve any conflicts that may arise (Halldórsson and Skjøtt-Larsen, 2004; Kanda and Deshmukh, 2008). The interactions of the partners and cooperation between teams requires human involvement and managerial investment (Huo *et al.*, 2013). Compared with physical investment, human involvement includes many intangible resources such as knowledge, skills, and experience, which are not easy for competitors to copy. As a result, process coordination can improve integrated parties' problem-solving capabilities and reduce conflicts, leading to competitive advantages for 3PL partners.

Various different outcomes of process coordination have been described. Huo *et al.* (2013) found that process coordination enables suppliers to be involved in various

processes of focal firms, reducing transaction costs and improving financial performance. Joint planning, defined as "collaborations among trading partners to develop various plans such as production planning and scheduling, new product development, inventory replenishment, and promotions and advertisements"(Cai *et al.*, 2010, p. 260), is an effective operational- and strategic-level coordination mechanism for improving performance (Aviv, 2001). Huiskonen and Pirttilä (2002) found that inter-organizational cooperative teams could develop win-win objectives and resolve conflicts between the partners. Certain supportive mechanisms in process coordination also facilitate cooperation. For example, collaborative learning programs usually lead to joint training (Simatupang *et al.*, 2002), which enables both parties to develop new capabilities through knowledge-sharing (Samaddar *et al.*, 2006).

2.1.3 Considering information sharing and process coordination together. Sahin and Robinson (2005) distinguished information sharing from process coordination in the context of supply chains, stating that information sharing only facilitates the exchange of information between parties, while process coordination enables joint decision-making, leading to optimal solutions for whole systems. Information sharing and process coordination are distinct integrative mechanisms with different capabilities, but they are both important aspects of the integrative relationship (Cai *et al.*, 2010; Huo *et al.*, 2013). Taking the RBV, Lavie (2006) proposed that the resource in an integrative partnership involves shared and non-shared resources, which together constitute complete, integrated resources. Information sharing therefore enables communication based on the shared pool of information, while process coordination enables non-shared resources such as tacit knowledge and capabilities to be linked and exploited, through mutual involvement in activities and decision-making processes. According to Wong *et al.* (2015), information sharing is an important prerequisite for integration, and can facilitate IT-enabled decision making. Similarly, Cai *et al.* (2010) stated that process coordination complements information sharing and completes the integration process. This study simultaneously examines the effect of both information sharing and process coordination on logistics outsourcing.

2.2 Logistics outsourcing

Logistics outsourcing is defined as "multiple logistics services provided by a single vendor on a contractual basis" (Razzaque and Sheng, 1998, p. 90). It leverages external logistics resources to take on the entire logistics process, or selected logistics activities that were traditionally performed in-house (Selviaridis and Spring, 2007; Gadde and Hulthén, 2009). With the development of the 3PL industry and increasing uncertainties of demand, logistics outsourcing covers a broad range of services, such as the planning, implementing and controlling of physical flows, the storage of raw materials, in-process inventories, finished goods, and related information (Hsiao *et al.*, 2010a). Aghazadeh (2003) listed 19 logistics outsourcing practices most frequently used by large American manufacturers between 1997 and 2000, including direct transportation services, warehouse management, shipment consolidation, freight forwarding, freight payment, etc. Rajesh *et al.* (2011) listed 31 practices, including order processing, vendor management, and practices intended to improve customer service and flexibility.

Outsourcing activities can be classified into three types; basic, customized, and advanced, depending on the requirements of 3PL users. Basic outsourcing refers to low-level, value-added logistic services, such as transportation, warehousing, and delivery services (Hsiao *et al.*, 2010b). The focus is generally on the efficiency of the

services, and 3PL users mainly base their outsourcing decisions on price (Halldórsson and Skjøtt-Larsen, 2004). From the RBV perspective, these kind of services are physical and asset based, and usually capacity- or asset-dedicated (Africk and Calkins, 1994). In basic outsourcing, 3PL users are usually provided with a standard set of activities.

Customized outsourcing fulfills special logistics requirements, such as the express delivery of documents, samples, critical components, custom clearance, and consolidation. In general, customized logistics services are not part of the daily operations of 3PL users, but they still require special investments. Outsourcing of these services enables 3PL users to flexibly obtain complementary capabilities (Halldórsson and Skjøtt-Larsen, 2004; Hsiao *et al.*, 2010a). Customized outsourcing requires low- or middle-level specific assets, including tangible resources, such as information processing and decision support systems, and intangible resources, such as professional knowledge and specific programs (Halldórsson and Skjøtt-Larsen, 2004, p. 195). Providers must adjust for the specific requirements of 3PL users, and usually provide modular processes alongside standard activities to achieve economies of scale (Halldórsson and Skjøtt-Larsen, 2004).

Advanced outsourcing can be either the outsourcing of functional activities to professional service providers that were previously operated by 3PL users, or a strategic design for the entire supply chain (Hsiao *et al.*, 2010a). Services include order processing, packaging, labeling, and the improvement and optimization of logistics information systems (Hsiao *et al.*, 2010a; Rajesh *et al.*, 2011). Efficiency and flexibility are the priorities of basic and customized outsourcing, while the main consideration in advanced outsourcing is to improve responsiveness in logistics and supply chain management, providing the best solutions for their customers. Efficiency and flexibility are the basis of this responsiveness, which is primarily concerned with problem solving. Responsiveness requires a high level of tacit knowledge and integrative skills (Halldórsson and Skjøtt-Larsen, 2004). As a result, advanced outsourcing requires high level, complex design, and is usually implemented through packaged logistics solutions (Halldórsson and Skjøtt-Larsen, 2004). Table I illustrates the differences of each type of logistics outsourcing.

2.3 Effects of information sharing on logistics outsourcing

Using OIPT as a basis, Premkumar *et al.* (2005) suggested that information processing capabilities should fit with the specific requirements, to improve inter-organizational decision making. Logistics outsourcing requires complex communication and coordination, as multiple managerial levels with broad responsibilities are involved (Zacharia *et al.*, 2011a; Huiskonen and Pirttilä, 2002). Information sharing increases the capabilities of both 3PL providers and users to deal with uncertainties in their cooperative ventures. Wong *et al.* (2015) suggested that information sharing can help confirm the validity of decisions, and thus supports logistics outsourcing.

Table I. Comparison of different types of logistics outsourcing

Outsourcing type	Target of 3PL user	External resource	Implementation by 3PL provider
Basic outsourcing	Efficiency	Physical assets	Standardized/low level specific skills
Customized outsourcing	Flexibility	Specific assets and special skills	Modular programs/processes
Advanced outsourcing	Responsiveness	Tacit knowledge and integrated capabilities	Packaged solutions

In basic outsourcing, logistics activities involve day-to-day business, such as production, purchasing, and sales, which require 3PL providers to be highly adaptive, supporting the various operational functions required, and ensuring they work smoothly. To effectively coordinate physical logistics resources, they must be aware of the day-to-day requirements of 3PL users, optimizing the accuracy and efficiency of logistics services. Routine information can be massive and tedious to process, so using IT systems to share information can improve task decision quality and efficiency (Lee *et al.*, 2000). For example, in 3PL users' external logistics flow when serving their customers, information sharing facilitates 3PL providers to understand customer requirements through timely communication with them (Maltz and Ellram, 1997). Through the sharing of information, 3PL providers can quickly respond to basic logistics requirements. In dynamic environments, IT-enabled logistics systems and information sharing have been extensively used in cargo tracking, warehousing, and shipping (Wong *et al.*, 2009). Therefore, we propose:

H1a. Information sharing is positively related to basic outsourcing.

Customized outsourcing usually refers to the outsourcing of special and unfamiliar services by 3PL users to providers. Adequate communication and information sharing between 3PL partners can improve users' understanding of customized logistics services, and assist them in choosing appropriate modular services. Standardized information also allows 3PL providers to flexibly organize fixed modular services, and generate customized service patterns, as standardized information can improve visibility between diverse companies, and make communication more efficient (Zacharia *et al.*, 2011b). Information sharing through IT systems, such as electronic data interchange and enterprise resource planning, can provide standardized information, which in turn facilitates customized outsourcing (Larson, 1998; Song *et al.*, 2000). Therefore, we propose:

H1b. Information sharing is positively related to customized outsourcing.

Advanced outsourcing deals with highly diverse and value-added services and involves in-depth, sophisticated knowledge about 3PL users. Information sharing can enhance communication between 3PL partners in the design stage, and help 3PL providers meet complex requirements (Wong and Karia, 2010). Specifically, strategic information sharing can make providers aware of the potential value of certain logistic services, and design appropriate and competitive service solutions. In the implementation stage, information sharing enables 3PL users to track service activity and provide timely feedback, reducing opportunistic behavior in the outsourcing process. Zacharia *et al.* (2011b) suggested that 3PL users are more likely to develop closed partnerships with providers when they outsource strategic-level services. Strategic information sharing is critical to partnerships, as it strengthens the trust between partners and reinforces their commitment to the outsourcing relationship (Tian *et al.*, 2008), and 3PL users are then more likely to outsource advanced logistics services to 3PL providers. Therefore, we propose:

H1c. Information sharing is positively relates to advanced outsourcing.

2.4 Effects of process integration on logistics outsourcing

Logistics outsourcing involves much tacit knowledge and numerous process-related activities, and integrating the processes can be difficult (Maltz and Ellram, 1997).

Process coordination links the non-shared resources and capabilities of two parties (Chen *et al.*, 2010). Besides, logistics outsourcing is in essence a combination of outsourced processes and a series of transactions, and therefore is difficult for 3PL users to measure and control (Maltz and Ellram, 1997; Huiskonen and Pirttilä, 2002). Sufficient human resources in the decision-making process are required to coordinate and control the outsourcing processes. For example, Boyson *et al.* (1999) suggested that it is advantageous for 3PL users to assign internal logistics experts to logistics outsourcing processes. Chen *et al.* (2010) demonstrated that both high-level management and 3PL experts are critical resources in outsourcing relationships. Process coordination thus enables the integration of various capabilities in the 3PL relationship.

For successful basic outsourcing, 3PL partners can invest human resources to directly manage and work together with each other. The transaction-level, day-to-day services handled in basic outsourcing benefit from the involvement of employees from both parties in informal coordination (Huiskonen and Pirttilä, 2002). For example, a 3PL provider's employees can participate in the JIT operations of a 3PL user, resulting in the provider adapting their services to meet the logistics requirements, such as lot size and delivery frequency. Therefore, we propose:

H2a. Process coordination is positively related to basic outsourcing.

The literature has suggested that logistics outsourcing is more likely to face problems when the outsourcing is isolated (Boyson *et al.*, 1999). One effective solution is to invest human resources in building specific links to coordinate isolated functions into a whole. Customized outsourcing is less likely to be related to the normal operational processes of 3PL users, and inter-organizational functions can be built by employees of both 3PL partners in charge of cooperation, so professional procedures, documents, and regulations can be understood and dealt with, while incompatible services or activities are reduced. Meanwhile, the experience and abilities of 3PL providers can help save time, if they participate in outsourcing decisions and quickly identify and organize the best services for the users. Therefore, we propose:

H2b. Process coordination is positively related to customized outsourcing.

Advanced outsourcing involves holistic solutions and includes high-level design for 3PL users. According to RBV, the holistic solutions result from the integration of both parties' knowledge and capabilities. The more varied the services, the more the interaction around tacit knowledge increases. The tacit knowledge embedded in the interaction is difficult to code and transform (Grant, 1996; Cai *et al.*, 2013). As a result, process coordination, as a co-learning mechanism, can lead to a synergy of knowledge and give an advantage over competitors.

Process coordination helps 3PL providers identify potential improvements for 3PL users, through effectively applying their service expertise in the operational processes of the users. Advanced outsourcing enables 3PL users to improve their responsive abilities rather than simply reduce costs. It is difficult to improve these areas through outsourced services, unless users adapt their processes and train employees to effectively interact with providers. Value-added logistics functions are sometimes outsourced by 3PL users, so they can learn from their providers. Once they accumulate enough experience, they may not outsource these functions any more (Boyson *et al.*, 1999).

In this sense, the co-learning paths represent a kind of process coordination of 3PL users in advanced outsourcing. Therefore, we propose:

H2c. Process coordination positively relates to advanced outsourcing.

2.5 Effects of logistics outsourcing on performance

According to the RBV, 3PL users can exploit various external resources to obtain competitive advantages through logistics outsourcing (Dyer and Singh, 1998; Lavie, 2006). Many benefits of logistics outsourcing have been previously investigated, such as profit growth, re-engineering benefits, core competence, flexibility, and market penetration (Lau and Zhang, 2006). Cost reduction and customer service improvement emerge as the principal benefits (Boyson *et al.*, 1999).

Specifically, basic outsourcing enables 3PL users to leverage the external physical resources of the providers, contributing to investment, cost reduction, and improvements in service quality. For example, 3PL providers can help their users reduce lead-time through faster methods of transport, better transport networks, and less inventories (Hsiao *et al.*, 2010a). Basic outsourcing can also improve the reliability of services for supply chain customers, which leads to a greater market share and an increase in profits. Therefore, we propose:

H3a. Basic outsourcing is positively related to operational performance.

H3b. Basic outsourcing is positively related to financial performance.

Regarding customized outsourcing, 3PL users can invest less in non-core business areas while also obtaining complementary functions, which enable them to resolve specific problems in logistics flows. Therefore, we propose:

H4a. Customized outsourcing is positively related to operational performance.

H4b. Customized outsourcing is positively related to financial performance.

For advanced outsourcing, 3PL users outsource services to achieve greater value through leveraging different services from a range of 3PL providers. Advanced outsourcing improves the logistics capabilities of 3PL users to enhance their operational performance (Bustinza *et al.*, 2010). Various logistics services have become potential sources of profit (Wallenburg, 2009), and as customer demands become increasingly diverse, innovation may bring more competitive advantages for 3PL users. Therefore, we propose:

H5a. Advanced outsourcing is positively related to operational performance.

H5b. Advanced outsourcing is positively related to financial performance.

Operations excellence contributes to better financial performance through cost reduction and service improvement. Huo *et al.* (2008) found that both cost and service improvements can lead to better financial performance. Therefore, we propose:

H6. Operational performance is positively related to financial performance.

2.6 Control variables

The economies of Greater China (Mainland China, Hong Kong, and Taiwan) have differently developed, and 3PL users may achieve a higher levels of company performance in the more developed regions, such as Hong Kong and Taiwan, than in the developing region of Mainland China. The users in different industries may also have different financial performance levels. Consequently, we include region and industry as control variables in this study.

3. Research methodology

3.1 Questionnaire design

We used the survey method to collect data and test the hypotheses. A questionnaire was developed from previous supply chain management and logistics outsourcing scales. Some items were not well documented in the literature, so we developed new measures based on the understanding of the constructs and on observations from interviews with managers. Specifically, information sharing and process coordination measures were mainly taken from Narasimhan and Kim (2002), and Stanley and Wisner (2001). Logistics outsourcing scales were developed based on a number of logistics studies, including Boyson *et al.* (1999), Knemeyer *et al.* (2003), and Stefansson (2006), etc. Operational performance was adapted from the measures of logistics service performance of Stank *et al.* (2003), and the service quality measures of Stanley and Wisner (2001). Financial performance was adopted from Huo *et al.* (2008). We used a seven-point Likert scale to measure each item, where "1" indicated "strongly disagree" and "7" indicated "strongly agree." We also provided brief explanations of the more complex measurements, enabling the respondents to better understand them.

The questionnaire was first written in English, and then translated into simplified Chinese for Mainland China and traditional Chinese for Taiwan by an operations management professor. A bilingual version in both English and traditional Chinese was used for Hong Kong. The back-translated technique was then used by another operations management professor to compare the translated and the original versions for accuracy. The questionnaire was then pilot-tested in 30 companies. We modified, added, and deleted items based on the feedback of the pilot tests, to confirm the reliability and validity of the items.

3.2 Sampling and data collection

Data were strategically sampled from Mainland China, Hong Kong, and Taiwan. We randomly selected a broad range of industries, including food, textiles, electronics, machinery, transportation, and various non-profit industries, to obtain a representative sample (Table I). All samples were collected with the assistance of local professional logistics institutions and three local professors. The sample from Mainland China was drawn from members of the China Federation of Logistics and Purchasing (CFLP), and those from Hong Kong and Taiwan were collected from members of the Hong Kong Logistics Association (HKLA) and the Taiwan Logistics Association (TLA), respectively.

We sent the questionnaire to the key informants, who were middle/senior managers familiar with the logistics and supply chain operations of their companies. Follow-up calls were made to improve the response rate. From the 2000 companies contacted, 361 questionnaires were useful. The total response rate was 18.1 percent, which is acceptable compared with those of previous logistics studies (11.1 percent by Sum *et al.*, 2001 and

12.6 percent by Huo *et al.*, 2008). There were 130 responses from Mainland China, 119 from Hong Kong and 112 from Taiwan (Table II).

As non-response bias is a common concern in empirical studies, we conducted *t*-tests for the early and late respondents and found no significant difference, indicating that non-response bias is not a problem in our study. One informant answered the entire questionnaire, so we used Harman's single-factor test to examine common method bias (Podsakoff and Organ, 1986; Podsakoff *et al.*, 2003; Hochwarter *et al.*, 2004). The results showed several factors, and as the first factor did not explain the majority of the variance, the common method bias does not appear to be an issue in this study.

3.3 Measurement development

3.3.1 Unidimensionality and reliability. We followed a rigorous process to develop and validate instruments. According to Narasimhan and Jayaram (1998), a two-step approach was used to ensure the reliability of the construct. First, exploratory factor analysis (EFA) was conducted to assess unidimensionality. Cronbach's α was then performed to examine reliability. EFA was used with principle component analysis for data reduction and to determine the main constructs measured by each scale, in which Varimax rotation with Kaiser normalization was used to clarify the factors. The EFA results in Tables IV and V indicate that each scale had a high loading on the construct it was intended to measure, with a low loading on those it was not intended to measure, which indicated that unidimensionality was ensured. Cronbach's α was then computed for each construct. The final results presented in Table VI indicate that the Cronbach's α values for all constructs are above the generally agreed limit of 0.60, indicating that reliability was ensured (Flynn *et al.*, 1990; Nunnally and Bernstein, 1994).

In addition, we followed the suggestions of Jarvis *et al.* (2003) and Petter *et al.* (2007), and measured logistics outsourcing as reflective scales. First, each latent construct of logistics outsourcing was drawn from items with common attributes, because the theoretical analysis found that they were the most important determinants for the construct (Petter *et al.*, 2007). Second, the results of EFA show three constructs with eigenvalues of more than 1.0, and each item is unidimensional without significant cross-loadings. The Cronbach's α of each construct is more than 0.60, ensuring good internal consistency for each construct. Diamantopoulos and Siguaw (2006) suggest

	Total	Mainland China	Hong Kong	Taiwan
Industry	($n = 361$)	($n = 130$)	($n = 119$)	($n = 112$)
Manufacturing	188 (52.1%)	77 (59.2%)	50 (42.0%)	61 (54.5%)
Retailing	38 (10.5)	16 (12.3)	9 (7.6)	13 (11.6)
Distributor	61 (16.9)	21 (16.2)	21 (17.6)	19 (17.0)
Government or NGO	13 (3.6)	1 (0.8)	4 (3.4)	8 (7.1)
Others	61 (16.9)	15 (11.5)	35 (29.4)	11 (9.8)
Sales	($n = 361$)	($n = 130$)	($n = 119$)	($n = 112$)
< HK$1 m	6.8%	4.8%	14.5%	1.0%
HK$1-5 m	12.4	11.9	9.1	16.3
HK$5-10 m	12.6	16.7	6.4	14.4
HK$10-50 m HK$	15.6	23.0	9.1	13.5
HK$50-100 m	9.4	12.7	6.4	8.7
HK$100-300 m	10.0	7.9	10.9	11.5
HK$300 m or more	33.2	23.0	43.6	34.6

Table II. Profile of respondents

that the multicollinerity score is above the limit of 3.3 for formative measures, and therefore our results show that it is not appropriate to deem constructs of logistics outsourcing as formative measures in our study. In conclusion, three logistics outsourcing constructs were used as reflective measurements in this study (Tables III-VI).

3.3.2 Validity. We included convergent and discriminant validity in our test of construct validity. The confirmatory factor analysis (CFA) model suggested by O'Leary-Kelly and Vokurka (1998) was used to estimate convergent validity. In the

	IS	PC	BS	CS	AS	OP	FP
Information sharing	0.79[a]						
Process coordination	0.64**	0.80					
Basic outsourcing	0.29**	0.39**	0.63				
Customized outsourcing	0.26**	0.22**	0.47**	0.66			
Advanced outsourcing	0.40**	0.50**	0.60**	0.52**	0.77		
Operational performance	0.27**	0.32**	0.16**	0.07	0.16**	0.73	
Financial performance	0.19**	0.24**	0.13*	0.15**	0.14**	0.51**	0.86
Mean	4.11	3.96	3.54	2.82	1.95	5.09	4.91
SD	1.525	1.459	1.819	1.949	1.82	0.974	1.144

Table III.
Descriptive analysis

Notes: [a]The square root of average variance extracted (AVE) value, *$p < 0.05$; **$p < 0.01$

	Factor loadings			
	Process coordination	Operational performance	Financial performance	Information sharing
PC5	*0.851*	0.160	0.088	0.221
PC3	*0.830*	0.108	0.047	0.217
PC6	*0.818*	0.164	0.100	0.224
PC7	*0.808*	0.088	0.107	0.113
PC1	*0.804*	0.031	0.097	0.120
PC2	*0.791*	0.132	0.012	−0.005
PC3	*0.707*	0.105	0.121	0.204
OP5	0.199	*0.803*	0.068	−0.086
OP3	0.025	*0.791*	0.172	0.092
OP4	0.105	*0.782*	0.245	0.009
OP6	0.184	*0.744*	0.222	0.028
OP2	0.078	*0.740*	0.152	0.149
OP1	0.112	*0.564*	0.344	0.197
FP3	0.055	0.194	*0.891*	0.099
FP2	0.104	0.245	*0.874*	0.037
FP1	0.155	0.256	*0.852*	−0.003
FP4	0.080	0.236	*0.809*	0.023
IS2	0.246	0.053	0.068	*0.861*
IS3	0.526	0.080	0.063	*0.700*
IS1	0.522	0.188	0.028	*0.635*
Eigenvalue	5.27	3.67	3.29	1.94
Total variance explained	70.791%			

Table IV.
EFA analysis of integrative mechanisms and performance

	Factor loadings		
	Advanced outsourcing	Basic outsourcing	Customized outsourcing
AS4	*0.823*	−0.070	0.195
AS5	*0.800*	0.059	0.264
AS3	*0.798*	0.275	0.248
AS6	*0.734*	0.281	0.275
AS1	*0.675*	0.490	−0.026
AS2	*0.624*	0.466	0.173
BS2	0.268	*0.778*	0.066
BS1	−0.125	*0.643*	0.415
BS3	0.528	*0.598*	0.017
CS2	0.199	0.185	*0.746*
CS1	0.228	−0.065	*0.702*
CS3	0.223	0.450	*0.645*
Eigenvalue	3.846	2.237	1.919
Total variance explained	66.689%		

Table V.
EFA analysis of logistics outsourcing

Constructs	No. of items	Cronbach's α
Information sharing	3	0.883
Process coordination	7	0.924
Basic outsourcing	3	0.630
Customized outsourcing	3	0.674
Advanced outsourcing	6	0.894
Operational performance	6	0.869
Financial performance	4	0.917

Table VI.
Reliability

model, each item is linked to its corresponding construct and the covariances among those constructs are freely estimated. The model fit indices are $\chi^2 = 1305.09$ with degrees of freedom = 593, a root mean square error of approximation (RMSEA) = 0.059, a non-normed fit index (NNFI) = 0.95, a comparative fit index (CFI) = 0.96, and a standardized RMR = 0.048, indicating that the model is acceptable (Hu *et al.*, 1992; Hu and Bentler, 1999) and convergent validity is ensured.

We used average variance extracted (AVE) values to assess discriminant validity. The results shown in Table II indicate square roots of AVE are higher than the correlations, indicating the acceptable discriminant validity (Fornell and Larcker, 1981).

To test the influence of industries and regions in our model, we used dummy variables to control these factors. For industry, we set "manufacturing," "retailing," "distributor," and "government or NGO" to be "1," and set "others" to be "0." For region, we set Hong Kong as the basic group, and tested the control effect of "Mainland China" and "Taiwan."

3.3.3 Structural equation modeling (SEM) and results. We employed the SEM method using LISREL 8.54 along with the maximum likelihood estimation method to estimate the proposed relationships among constructs. The fit indices are $\chi^2 = 1621.31$ with df = 624, RMSEA = 0.067, NNFI = 0.94, CFI = 0.95, and standardized RMR = 0.089. According to the threshold values suggested by Hu *et al.* (1992) and

Hu and Bentler (1999), our model can be accepted. Figure 2 shows the structural model with standardized coefficients for the significant paths. The results of hypothesis tests are presented in Table VII. It is indicated that the control variable "distributor" has a significant effect on financial performance, while the others do not. Further analyses also show that customized outsourcing mediates the relationships between integrative mechanisms and financial performance.

4. Discussion and managerial implications

4.1 Improving logistics outsourcing through information sharing and process coordination

The results show that information sharing and process coordination have different effects on different types of logistics outsourcing. Specifically, information sharing

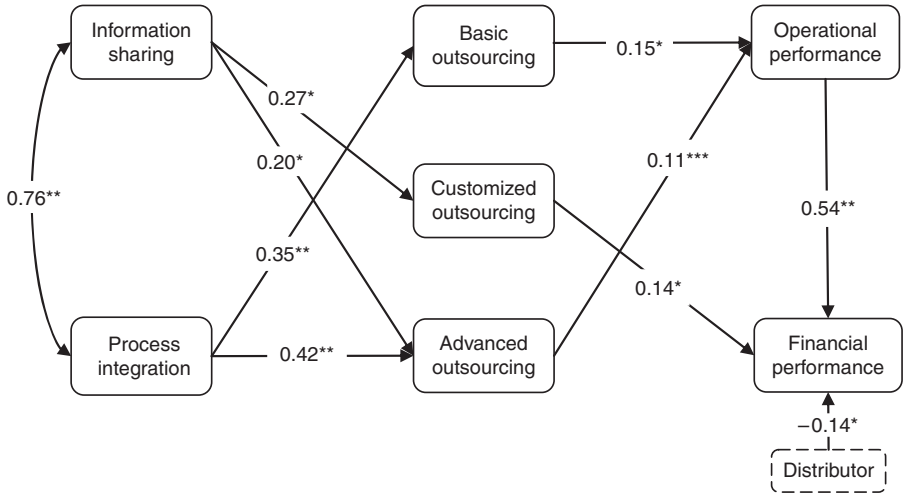

Figure 2.
SEM model

Notes: ***$p<0.10$; **$p<0.05$; *$p<0.01$

Hypothesis	Outcome
H1a: Information sharing→Basic outsourcing	Rejected
H1b: Information sharing→Customized outsourcing	Supported
H1c: Information sharing→Advanced outsourcing	Supported
H2a: Process coordination→Basic outsourcing	Supported
H2b: Process coordination→Customized outsourcing	Rejected
H2c: Process coordination→Advanced outsourcing	Supported
H3a: Basic outsourcing→Operational performance	Supported
H3b: Basic outsourcing→Financial performance	Rejected
H4a: Customized outsourcing→Operational performance	Rejected
H4b: Customized outsourcing→Financial performance	Supported
H5a: Advanced outsourcing→Operational performance	Supported
H5b: Advanced outsourcing→Financial performance	Rejected

Table VII.
Hypotheses results

improves customized and advanced outsourcing, supporting *H1b* and *H1c*, but has no significant influence on basic outsourcing, rejecting *H1a*. Some services include complex activities, so 3PL partners require high-level information processing capabilities to monitor uncertainties and quickly take corresponding actions, according to OIPT. Information sharing saves time in complex coordination, which improves the flexibility and responsiveness of outsourcing. Information sharing is therefore important in customized and advanced logistics outsourcing. Low value-added and standard services are readily available in the 3PL market, and 3PL users with limited resources may use basic outsourcing for these non-core services, where full communication with 3PL providers is unnecessary, reducing their costs and enhancing efficiency.

In contrast, process coordination positively influences basic and advanced outsourcing, supporting *H2a* and *H2c*, but has no significant effect on customized outsourcing, rejecting *H2b*. Outsourced basic and advanced services are closely related to the day-to-day processes of 3PL users, so investment in human resources is required on both sides to improve efficiency and responsiveness through reducing costs and conflicts in the partnership. Specifically, process coordination across boundaries can cope with time-consuming interactions and improve potential co-learning activities. Therefore, process coordination positively influences basic and customized outsourcing. However, it does not effectively enable 3PL users to gain unfamiliar customized outsourcing-related knowledge. A possible reason is that process standardization in customized outsourcing reduces potential conflicts, thus lessening the need for human resources.

It is interesting to compare information sharing and process coordination. Information sharing can improve information processing capabilities in complex and uncertain situations. In logistics outsourcing, information sharing increases information resources between 3PL partners, improving the visibility of the cooperation process, which leads to flexibility and responsiveness in logistics outsourcing. In contrast, process coordination requires more human interactions, to reduce conflicts. Process coordination enhances these interactions between 3PL partners, leveraging the non-shared resources in the coordination, which leads to efficiency and responsiveness in logistics outsourcing.

According to the RBV, different types of logistics outsourcing obtain different resource supports from these two integrative mechanisms. This has several important implications for managers. For example, basic outsourcing is simple and low value-added, but it is still beneficial to invest human resources in managing the outsourcing activities. Process coordination ensures that 3PL users devote resources to managerial decisions (i.e. focal logistics experts), concerning external physical assets, to effectively handle day-to-day operations. The information resources available to 3PL users increase through information sharing, allowing them to flexibly monitor and coordinate the standardized services of customized outsourcing. Advanced outsourcing is conducted differently, with more effort needed. Here, both managerial and information resources are involved in coordinating sophisticated interactions for the outsourcing of advanced value-added services. It is thus necessary for managers to analyze the conditions and features of each service, and devote appropriate resources in 3PL relationships to effectively and efficiently outsource logistics services.

4.2 Enhancing performance through logistics outsourcing

Figure 2 shows the different effects of logistics outsourcing on performance. Basic outsourcing positively improves operational performance, while insignificantly

influencing financial performance, supporting *H3a*, but rejecting *H3b*. The main reason for this may be that good basic outsourcing can directly improve logistics performance, which in turn reduces cost and lead-time, and enhances flexibility. However, basic outsourcing cannot increase the market share or sales of 3PL users.

In contrast, customized outsourcing has no effect on operational performance, but has a positive effect on financial performance, rejecting *H4a*, but supporting *H4b*. The main reason for this may be that customized outsourcing reduces the investments in non-core businesses, which leads to a high-level of return on assets. Customized outsourcing is relatively independent from other operational areas, adding supporting functions for 3PL users but not contributing directly to operational performance. We also found that customized outsourcing mediates the relationships between integrative mechanisms and financial performance, indicating that customized outsourcing can help transform integrative resources and capabilities into financial gains. Managers should be aware that customized outsourcing can lead to financial gain and market advantages through information sharing and process coordination.

Advanced outsourcing has a positive influence on operational performance, but no significant effect on financial performance, supporting *H5a*, but rejecting *H5b*. The main reason for this may be that advanced outsourcing can improve performance by enhancing the capabilities of 3PL users, such as flexibility and reliable logistics in customer services (Bhatnagar and Teo, 2009). However, different services require specific investments and sophisticated coordination, which are expensive, leading to no direct financial benefits.

As expected, the results show operational performance is positively related to financial performance, supporting *H6*. The relationships between logistics outsourcing and performance are complex, and our findings have managerial implications. When making outsourcing decisions, it is better for 3PL users to consider the "fit" between the service type and the expected performance targets.

5. Conclusions and limitations

Based on the RBV perspective, this study develops a holistic model to examine two antecedents, information sharing and process coordination, and two consequences, operational and financial performance, of logistics outsourcing. Furthermore, we empirically test the antecedents and consequences of three types of outsourcing simultaneously, which further enriches our understanding of different logistics outsourcing activities. Our findings show that information sharing and process coordination should be considered when companies exploit external resources, because integrative mechanisms, as controls between companies, can leverage resources to create capabilities across boundaries.

This study makes significant contributions to 3PL literature and practices by systematically examining the antecedents and outcomes of logistics outsourcing. Our findings indicate that process coordination is helpful for basic outsourcing, while information sharing is helpful for customized outsourcing. In addition, both process coordination and information sharing are required for advanced outsourcing. This implies that the more diverse services involved in logistics outsourcing are, the more sophisticate mechanisms must be developed. This study also provides guidelines to develop appropriate types of logistics outsourcing to achieve different performance measures. It is demonstrated that basic and advanced outsourcing strongly improve operational performance, while customized outsourcing enhances

financial performance, providing evidence for the strategic roles of logistics outsourcing for 3PL users.

This study has several limitations, which open up venues for further research. First, it examines the importance of two integrative mechanisms (information sharing and process coordination) in logistics outsourcing. Future studies could investigate more integrative mechanisms and their effects on logistics outsourcing. Second, the study used cross-section data to test the proposed model, so conducting longitudinal analyses to test the model can be of benefit. Third, though this study examined logistics outsourcing in greater China, future studies can collect data in other countries and test cross-country differences. Finally, considering the differences in economic development in Greater China (Mainland China, Hong Kong, and Taiwan), future research into the differences of logistics issues in these three regions will improve our understanding of them in the Greater China context.

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Appendix 1. Construct measurement

Information sharing

IS1. There is a high level of information exchange with our major 3PL provider through information network.

IS2. We can use our major 3PL provider's information systems to trace the status of our cargo.

IS3. Our major 3PL provider shares service schedule and capacity with us.

Process coordination

PC1. We hold meetings with our major 3PL provider on a regular basis to solve problems.

PC2. We and our major 3PL provider work together as a team.

PC3. We conduct the joint planning to anticipate and resolve operational problems with our major 3PL provider.

PC4. We develop a mutual understanding of responsibilities with our major 3PL provider.

PC5. We make joint decisions with our major 3PL provider about ways to improve overall cost efficiency.

PC6. We and our major 3PL provider achieve goals collectively.

PC7. We and our major 3PL provider design customized ordering processes collectively.

Basic outsourcing

BS1. Transportation (simple use of transportation tools only).

BS2. Distribution/delivery (include the planning and scheduling in addition to transportation).

BS3. Inventory/warehouse management.

Customized outsourcing

CS1. Express delivery of document, samples, critical components, etc.

CS2. Custom clearance.

CS3. Consolidation.

Advanced outsourcing

AS1. Order processing.

AS2. Packaging, labeling, and other customized services.

AS3. Improvement and optimization of supply chains.

AS4. Purchasing.

AS5. Financial services such as collection, financing, etc.

AS6. Improvement and integration of logistics information systems.

Operational performance

OP1. Customer service.

OP2. Speed of delivery.

OP3. Reliability of delivery.

OP4. Product volume flexibility.

OP5. Product mix flexibility.

OP6. New product flexibility.

Financial performance
FP1. Percentage growth in return of sales (net profit over sales) over past two years.
FP2. Percentage growth in return of assets (net profit over assets) over past two years.
FP3. Percentage growth in sales over past two years.
FP4. Percentage growth in profit over past two years.

Corresponding author
Dr Baofeng Huo can be contacted at: baofeng@zju.edu.cn