Product delivery service provider selection and customer satisfaction in E-commerce: A Chinese e-retailers' perspective

Abstract

In this study we focus on how e-retailers who deal with innovative products in the era of the Internet of Things (IoT) select product delivery service providers to ensure timely and efficient delivery to customers. Based on the Asset-Process-Performance framework, we propose a triadic model that includes e-retailers, delivery service providers and customers to achieve synergy and customer satisfaction in the era of the IoT. We find that substantive selective criteria should include consideration of service provider's hard and soft infrastructure. In addition, flexibility is a key criterion that will strengthen the relationship between e-retailers and delivery service providers to improve the competitiveness of e-retailers as well as to satisfy the customers. We validate the model using data from 148 Taobao e-retailers. Our results indicate that both hard and soft infrastructures have positive influence on flexibility which in turn has a positive impact on customer satisfaction. Indeed, flexibility fully mediates the relationship between hard and soft infrastructures and customer satisfaction. Our theoretical triadic model is one of the first attempts in providing product delivery service provider selection criteria for e-retailers selling innovative products and its influence on customer satisfaction. Our findings provide guidelines for both e-retailers and product delivery service providers to improve their competitiveness.

Keywords: Product delivery service provider, e-commerce, customer satisfaction, triads

1. Introduction

November 11th was never a big day until Taobao, one of the largest e-retailer platforms in China, turned it into a feast for online shoppers. On November 11th 2012, the overall sales volume on Taobao exceeded 19 billion RMB (over 3 billion US dollars), and the total number of transactions exceeded 100 million (Zhang et al., 2013). However, this also turned it into a nightmare for third party logistic (3PL) service providers. On the same day, over 70 million parcels were packed and sent to 3PL service, which was far beyond their processing capability. The avalanche of packages arriving at distribution centers of Chinese 3PL service providers all over China caused huge delay for most of online shoppers. 'Not delivered on

time' is on top of the complaint list from online customers during that period of time. Interestingly, it is the e-retailers on Taobao instead of the 3PL service that bear the brunt of the complaints from customers (Zhou, 2013). Hence, selection of 3PL partners is critical for e-retailers to maintain customer satisfaction.

The relationship between e-retailers and the 3PL service providers is complicated due to the online transaction process. E-retailers and 3PL service providers are partners. Yet e-retailers are service providers in online transactions, and it is they who are evaluated by end customers. End customers satisfaction level is a vital aspect which makes the customer to return to the same e-retailer. However, as e-retailers delegate the delivery service to 3PL service providers, end users' satisfaction level is a combination of both e-retailers' service and 3PL service providers' service. Hence, the service quality level of 3PL service provider is essential to e-retailers. On the other hand, most of the time e-retailers are customers of 3PL service providers as they pay for the delivery service. It is a common promotion method on Chinese e-retailer platforms that e-retailers will cover the delivery fee for the transaction. As a result, it is essential to evaluate 3PL service providers from e-retailers' perspective who are both partners and customers of 3PL service providers.

The two fold relationship between e-retailers and 3PL service provider made 3PL service provider similar to the suppliers of e-retailers. 3PL service providers supply delivery service which is incorporated into the product that customers finally receive from e-retailers. Supply chain management literature suggests cost and efficiency are critical criteria in selecting 3PL service providers for traditional brick and mortar firms. However, very few studies in the past discuss how e-retailers select their 3PL service providers. Fewer explored the context of e-retailers selling fashion and 3C (Computers/Communications/Consumer) innovative products which requires additional customization. We refer to these products as high value and highly customized products. For example, over 60% of sales on Taobao are fashion products and 3C (Computers/Communications/Consumer) products which are generally considered as innovative products (Delafrooz et al., 2010). In addition, the era of Internet of Things (IoT) demands additional or enhanced 3PL capabilities (e.g. tracing and tracking).

IoT products have sensors and actuators that are blended with the surrounding environment to share data across platforms to develop a common operating picture (anything communicates, anything is identified, anything interacts) (Gubbi et al. 2013). In the present era 3PL service providers update static information at different time periods using tracking URLs such as www.tracking.com/findmy. This facility has a major disadvantage such as non-availability of globally unique identifier to deal with the product. However, in IoT era, it is mandatory to connect all physical products with unique identifier sold through e-retailers using global internet based infrastructure to support intelligent identification, location, tracking, monitoring and management (Karakostas, 2013). Evolution of technology and increase in customers' expectation makes product delivery service providers to offer smart services to be successful in the market. Smart logistics refers to set of activities that include identification, locating, sensing, state-of-the art networking and data processing and billing (Uckelmann, 2008).

With these developments in mind, it is obvious that in IoT era e-retailers need to use appropriate criteria to select smart delivery service providers (which will be used interchangeably with 3PL service provider) to improve the customer satisfaction. We attempt to view the selection of 3PL service providers and customer satisfaction through the lens of Asset-Process-Performance framework. Capabilities of 3PL service providers are considered as asset (both hard and soft infrastructure), dynamic capabilities referred as flexibility offered by the 3PL service providers are considered as process and the customer satisfaction refers to the performance.

In this study, by applying the Asset-Process-Performance framework in the context of e-retailing, we expect to provide one of the first triadic theoretical models on product delivery service provider (3PL service provider) selection criteria and customer satisfaction. As we collected data from e-retailers on their evaluations of 3PL service providers, our findings will be helpful to e-retailers to assess their potential partners to provide delivery service. Meanwhile, from 3PL service provider perspective, they should not only try to satisfy the end customers who actually received their service, but also to satisfy e-retailers as they make

selection decisions as well. More specifically we attempted to explore the relationship between the selection of product delivery service provider and its effect on customer satisfaction. Hence, our current research provides suggestions on how to improve product delivery service providers to attract more e-retailers as their customers. Moreover, as our research context is in China, we highlight some insights about Chinese market for International 3PL service provider.

The rest of the paper is organized as follows: Section 2 reviews the studies related to product delivery selection criteria, asset-process-performance framework, flexibility aspects and customer satisfaction. Section 3 describes the conceptual model and hypotheses developed for the study. Section 4 explains the research methodology adopted in this study to validate the conceptual model. Section 5 discusses the major findings and its implication. Section 6 summarizes our study and suggests future directions.

2. Literature review

2.1 Product delivery provider selection criteria

Logistics service provider plays an important role in organizations (Gunasekaran and Sarkis, 2008; Green et al., 2008), because it can improve organizational competitiveness towards the enhancement of information and material flows along the supply chain (Gunasekaran et al., 2008). However, most previous studies discuss the importance of logistics to traditional brick and mortar firms, only few emphasize their needs in the e-commerce context (Yang et al., 2009; Ramanathan, 2010). E-commerce, especially B2C e-commerce, compared with traditional entities, is characterized by small order size, increased daily order volumes and shipments with different kinds of distribution systems (Ramanathan, 2010; Cho et al., 2008; Hsiao, 2009). Thus shipment or delivery becomes an essential part of e-commerce. Graves (2013) states that the development of e-commerce necessitates appropriate selection of 3PL service providers. Therefore, choosing an appropriate 3PL service provider tends to be a significant process for e-commerce firms. Selection of 3PL service provider has traditionally been based on cost and efficiency. Most famous Chinese e-commerce firms have made

contracts with many 3PL service providers, and customers can choose a particular 3PL service provider according to their preferences. Wang and Sang (2005) illustrate that the efficiency of the 3PL service provider is an essential factor considered by e-commerce firms when choosing 3PL service providers. Researchers have pointed out that technological, human and logistical aspects of service quality can impact customer satisfaction and firm competitiveness (Rosteck, 2012; Ramanathan, 2010; Ling et al., 2012). Especially, with the growth of the consumer attention to the quality of service, customer service and logistics service have become more and more important. Recently, the assessments of customer service quality and logistics service quality have been included in the consumer feedback system.

It is critical for any business to set reasonable and effective criteria while selecting suppliers or business partners. Researchers in operation management have called for more focus on selection and contract management of 3PLs for building collaborative supply chain partnerships (Sahay and Mohan, 2006). According to Ramanathan (2010), late arrival or non-arrival of the product, accuracy of the order and damage of the product significantly increases customer dissatisfaction.

Based on recent changes 3PL service provider selection parameters include delivery speed and reliability of 3PL service providers. Esper et al. (2003), considered four relevant variables of 3PL service providers that include delivery time, product condition, delivery satisfaction expectations and carrier reliability. However, other studies also consider responsiveness, communication order-handing and distribution (Cho et al., 2008).

Recent work by Tezuka (2011) stressed the specialization of 3PL service provider in terms of scale, know-how, searching ability and/or IT skills of 3PL service provider. With improvement in capabilities of logistics service provider, Buyukozkan et al., (2009) proposed a fourth party logistics (4PL) evaluation model with selection criteria such as service performance (service quality, service cost, service flexibility, value added service), IT performance (IT competency, IT capacity, IT flexibility, IT compatibility) and management

performance (management quality, management competency, management flexibility, management sustainability).

The literature on product delivery for era of IoT and 4PL with soft infrastructure (IT, Human skills and knowledge), hard infrastructure (Tracing and tracking, sophisticated trucks) and flexibility (in both hard and soft infrastructure) is, however, still in its infancy stage. Coltman and Devinney (2013) propose a model with operational capabilities for customized and commoditized services. The operational capabilities include customer engagement, cross-functional coordination, creative solutions, operations improvement, IT infrastructure and professional delivery.

In summary, the review reveals that e-retailers need to change their selection criteria based on soft infrastructure, hard infrastructure and flexibility aspects to satisfy the delivery of innovative products in the era of IoT.

2.2 Asset process performance framework

The Asset-Process-Performance (APP) framework is a theoretical framework to understand competitiveness at the firm level and is a combination of assets, process and performance (Ambastha and Momaya, 2004). This paper uses APP framework to study how asset, process and performance of product delivery service provider satisfies both the ends of the triadic link i.e. upstream e-retailer (seller) and downstream end customer (buyer). Assets can be inherited (natural resources) or created (infrastructure), and process and performance can achieve economic gains from sales to customers toward assets transformation (Subramanian et al., 2014).

Moreover, according to Ambastha et al. (2004) and Subramanian et al. (2014), assets refer to human resources, firm structure, firm culture, technology and other sources. Processes refer to strategic management processes (competency, competitive strategy, flexibility and adaptability), technological processes (innovation, systems, IT), operational processes

(manufacturing, design and quality) and marketing processes (marketing, managing relationships and persuading power) Finally, performance refers to productivity, finance, market share, differentiation, profitability, price, cost, variety, product range, efficiency, value creation, customer satisfaction and new product development.

Based on operation management perspective, this study selects important dimensions for assets, processes and performance to deliver innovative products. Logistic service industry as a classic example of service industry, has transformed from basic transportation to serving the entire logistical needs of customers. As a result, their assets include both hard and soft infrastructure. Hard infrastructure refers to various resources for transportation and storage, such as warehouse and vehicles, while soft infrastructure refers to new "resources" due to the quantum advances in science, technology and communication, such as IT, knowledge and relationship networks (Chapman et al., 2003). We also argue that flexibility is one of the most critical dynamic capability factors in processes to accommodate variations and customer satisfaction is one of the most important performance indicators.

2.3 Flexibility in supply chain management

In operation management studies, flexibility is defined as the process of adapting things based on the customer requirement (Verma et al., 2011). As an important competitive process, the agile supply chain strategy is aimed at achieving flexibility and adaptability in the face of competitive environment through rapid, dynamic and continuous response (Qrunfleh and Tarafdar, 2014). Previous attempts on flexibility focus on internal manufacturing flexibility, and supply chain flexibility depends on manufacturing flexibility (Duclos et al., 2003). However, as the supply chain covers more than one single firm, the supply chain flexibility has to extend beyond the internal manufacturing flexibility. Few suggested examining supply chain flexibility as an integrated aspect with customer perspectives. Based on this logic, five types of flexibilities are suggested and they are product flexibility, volume flexibility, new product flexibility, distribution flexibility and responsiveness flexibility (Vickery et al., 1999). However, this classification fails to recognize the cross-functional and cross-business nature of supply chain management.

In response to this limitation, Duclos et al. (2003) proposed six components of supply chain flexibility: i) Operation system flexibility which is the ability to configure assets and operations to react to emerging customer trends (e.g. product changes and volume) at each node of the supply chain; ii) Market flexibility which is the ability to mass customize and build close relationship with customers; iii) Logistic flexibility which is the ability to send and receive product efficiently according to the change of suppliers and customers; iv) Supply flexibility which is the ability to alter the supply of product in line with customer changing demand; v) Organizational flexibility which is the ability to align employee skills to the needs of customers; and vi) Information systems flexibility which is the ability to align IT architectures and systems to organization information needs in response to the changing demand of customers.

As opposed to analyze flexibility as multi-dimensional, flexibility has also been defined and empirically assessed as a general capability of a firm, especially in the logistic service industry (Hartmann and De Grahl 2011). In this study, we focus on the flexibility of product delivery service providers, which is a general capability to respond quickly and efficiently to changing customer needs in delivery, support, and services (Zhang et al., 2005).

2.4 Customer satisfaction

Oliver (1997) defines satisfaction as "the summary of psychological state resulting when the emotion surrounding disconfirmed expectation is coupled with a consumer's prior feelings about the consumer experience". Lewin (2009) states that customer satisfaction is an important source of competitive advantage and can lead to customer loyalty and repeat purchase. According to Anderson and Srinivasan (2003), there is a direct relationship between customer satisfaction and the performance of e-commerce firms. E-commerce firms believe higher customer satisfaction can bring substantial benefits, such as repeat purchase, good word of mouth, and profit increase (Subramanian et al., 2014). Moreover, Kim and Stoel (2004) illustrate that e-commerce firms need to satisfy the needs of online customers when they are purchasing online, otherwise they will switch to another e-commerce firm. Therefore, it is important for e-commerce firms to meet customer requirements and make efforts to

increase customer satisfaction in e-commerce. Furthermore, Liu et al. (2008) state that online shopping customer satisfaction will be significantly influenced by information quality, web site design, merchandise attributes, transaction capability, security/privacy, payment, delivery and customer service. In addition, they emphasize the importance of delivery and customer services in satisfying Chinese customers.

China is a large country geographically, and customers are widely spread. Hence, the range of the network covered by 3PL service provider is crucial to customer satisfaction. This depends on the number of transportation and the location of the warehouse or distribution center etc. (Du and Evans, 2008). China is also a diversified country culturally, with customers speaking different dialects and having different traditions. Hence, it is also important for 3PL service provider to gain detailed and sufficient knowledge about their customers. As DHL put in their marketing slogan in China: 'We know China better than the others' (DHL) It is clear therefore that the soft side of infrastructure such as well-trained employees, knowledgeable local staff, and tracking system can make a substantial contribution to customer satisfaction.

The business of 3PLs in China is fluctuating as the volume of packages they are dealing with keeps ebbing and flowing. For example, Shentong Express, a privately owned express with services in most parts of China, has its daily handling capacity of 3.5 million to 3.8 million shipments. However, the actual daily volume during the off-peak season was only 2.8 million. While during the peak season, the package volume can surge up to 4.3 million. The daily package volume in China's entire industry during the peak season has topped 18 million (Zhou, 2013). Under such vibrant circumstances, more flexible 3PL service provider can better serve its customers. It is also evident from the review that there are very few studies available to understand the Chinese e-commerce customer satisfaction.

3. Conceptual model and hypotheses development

It is predicted that in future IoT will link physical and digital entities through appropriate information and communication technologies (Miorandi et al., 2012). It is good to note the

application of IoT in different fields. A recent study looked at linking the IoT perspective with floricultural supply chain virtualization (Verdouw et al., 2013). Similarly, it is interesting to note the delivery difficulties in IoT infrastructure and an attempt to propose a mechanism and architecture to successfully coordinate between IoT and 3rd party service providers (Gubbi et al. 2013). It is obvious from the above that IoT studies within supply chain are limited. Moreover it is very hard to find study in e-commerce that links E-reatilers, product delivery service providers and customer.

3.1e-commerce triads

The triad considered for our study is shown below in figure 1. Three members are involved in our study. They are seller (e-retailer), buyer (customer) and delivery service provider (3PL). The buyer will buy innovative products from the seller, and those innovative products will be delivered through the delivery service provider. Based on infrastructure and flexibility, the seller will identify an appropriate 3PL service provider. Buyers report their feedback on the seller's website which often includes comments on the product delivery. In our study, sellers will evaluate the delivery service provider and customers will express their satisfaction with respect to the product and the delivery service in the seller's website once they receive the product. The major aim of our study is to identify the relationship between selection of delivery service providers and customer satisfaction.

Insert Figure 1 about here

3.2 Conceptual model and hypothesis

Our research model is developed based on the APP framework. We relate innovative product delivery service provider selection based on infrastructure (both hard and soft) and flexibility with customer satisfaction. Asset in this study refers to both soft and hard infrastructure of 3PLs; process refers to the flexibility of 3PLs; and performance refers to the customer satisfaction of the end customers who finally receive products. Our research model is shown in figure 2.

Insert Figure 2 about here

3.2.1 Infrastructure and flexibility

Infrastructure is critical in the logistic industry. Providing advanced logistic services depends on adequate physical infrastructure, in line with technological development, new organizational changes and the requirements for efficient and environmentally friendly transport services. At the national level, the hard infrastructure refers to the connection between cities (roads and railways), ports and airports; while the soft infrastructure refers to laws and regulations (Memedovic et al., 2008). However, at the industrial level, the hard infrastructure refers to warehouse capacities, truck/transportation capacities, number of vessels, and number of cargo-airfreight; while the soft infrastructure refers to technology usage such as RFID, GPS and Enterprise systems, and knowledge such as managerial experiences, skills and capabilities.

Technology facilitates both the horizontal flow of information among business partners and vertical flow of information and goods along shippers and consignees. In recent years, 3PLs have invested money and effort in various systems to gain competitive advantages over their rivals (Lai, 2008).In the IoT era, various technologies have been incorporated into existing enterprise systems to facilitate information sharing and distribution. Such technologies include radio-frequency identification (RFID), sensor technologies, embedded object logic, object ad-hoc networking, and Internet-based information infrastructure.

New skills, new organizational and managerial capabilities, fast and efficient transaction procedures are also fundamental for 3PLs. Knowledge infrastructure refers to all kinds of knowledge that requires in managing and facilitating 3PLs operations.

It is debatable whether technology is hard infrastructure or soft infrastructure. Previous

studies suggest that technology infrastructure should be hard infrastructure as it involves equipment and devices. However, we argue that in the era of IoT, traditional infrastructure ensures the physical transportation of goods, while technology infrastructure supports the virtual transmission of information. As a result, both technology and knowledge perform the similar function for 3PLs in facilitating information flow and sharing. Hence, we categorize these two as soft infrastructure in this study.

Flexibility is the ability of the supplier to manage variation from the buyer firm without significant trade-offs with other competitive priorities. There are two types of flexibility: volume flexibility and mix flexibility in selecting suppliers. Volume flexibility refers to the ability and willingness of the supplier firm to change order volumes without significant penalties. Mix refers to change in product variety.

The positive effect of hard infrastructure on flexibility is straightforward. With better hard infrastructure, the 3PL service provider has more transportation capacity and storage capacity, which serve as buffers in the logistic service. As a result, it is more flexible in serving customers.

Soft infrastructure such as technology and knowledge also help to enhance flexibility. With more IT infrastructure implemented, more accurate and comprehensive information about the shipment as well as the environment (e.g. weather, traffic flow, accident, and emergency) can be collected and shared. This allows the dispatch center to co-ordinate transportation and warehouse. However, technologies do not work on themselves. Previous studies also highlight the importance of IT skills of employees and their harmony with technology. With sufficient training and practice, technology can work more efficiently and be more helpful. Moreover, experience of local market can help in prediction such as the peak time for picking up and collaboration with competitors. For example, when experienced delivery persons from different 3PLs meet in the lift of office buildings, they may exchange their parcels so that they only need to visit some floors respectively. As a result, both technology and knowledge infrastructure collectively enable the 3PL service provider to be more flexible.

Hence, we propose that:

H1: Product delivery service provider's soft infrastructure highly influences their flexibility.

H2: Product delivery service provider's hard infrastructure highly influences their flexibility.

3.2.2 Flexibility and customer satisfaction

Previous researches pointed out that the quality of 3PL service can influence customer loyalty, delivery speed, accuracy and damage of product, which will have significant impact on customer satisfaction (Zhang et al., 2005). Customer needs are changing. Especially for innovative products which are high time-valued (e.g. the latest model of iphone), customers eager to receive them as soon as possible. Under a highly fluctuated situation, if the 3PL service provider is flexible, it can significantly improve the delivery speed and accuracy level as well as reduce the damage rate. Moreover, several previous researches point out that logistics service quality is positively related to e-customer satisfaction (Liu et al., 2008; Wang et al., 2005; Subramanian et al., 2014).

Based on these studies, we propose that:

H3: Product delivery service provider's flexibility improves customer satisfaction.

3.2.3 Flexibility-mediated impact of Infrastructure on Customer Satisfaction

Based on the above discussion, we expect that flexibility of product delivery service provider has a positive influence on customer satisfaction. At the same time, such flexibility is achieved through both hard and soft infrastructure of the product delivery service provider. Starting with simple transaction based services; some of the service providers have developed into a more matured state of providing management oriented services, in addition to providing the physical infrastructure oriented services like warehousing and transportation. Thus, the industry has undergone a phenomenal growth in terms of size and the service offerings. There is very stiff competition in the industry resulting in customers' pressure for more and highly reliable services at lower costs (Power et al., 2007). As a result, demanding

customers are expecting not just improved warehousing and transportation, but also better service in terms of control over the product (e.g. they need to know when and where their packages were delivered to), and experience with delivery agents. These changing demands require product delivery service providers to develop various capabilities (both hard and soft) in order to be flexible.

However, as the e-commerce triad framework suggested, customers in our study are end customers of e-commerce. The only contact point between them and product delivery service providers may be the delivery person. From the customers' perspective, it is difficult, if not impossible, to evaluate the hard and soft infrastructure of product delivery service providers. They form a general idea on the capability of product delivery service providers based on their direct contact and experience with them. Hence, we propose that:

H4: The effect of infrastructure on customer satisfaction is mediated by flexibility

4. Research methodology

To validate the proposed research model, a questionnaire was designed to investigate how e-retailers select their product delivery service providers based on innovative product selection criteria. The questionnaire contains two parts. Firstly, it captures e-retailer background information, such as location, reputation, years in existence, type of products it sells, whether it has default 3PLs or not. The second part consists of latent constructs measurements mainly adapted from Saurian and Coenders (2002). They are soft infrastructure (a second-order latent variable contains technology and knowledge), hard infrastructure, flexibility and customer satisfaction. All the items except customer satisfaction construct are measured using seven-point Likert scale, with 7 indicating a complete agreement and 1 indicating a complete disagreement. Customer satisfaction has only two items and they are objective measures captured from the e-retailers website based on customers' feedback after the receipt of products. Previous studies suggested using less than 3 items would be appropriate to capture the effect of changes caused by latent construct if the

construct uses secondary objective measures (Hair et al., 2006). The major items in the questionnaire are presented in Appendix. The original version of our questionnaire is in English, since the most of the e-retailers on Taobao are Chinese, we translated our questionnaire into Chinese. We also conducted back-translation to ensure the consistency, accuracy and appropriateness of translation.

A pilot study was conducted with 10 e-retailers on Taobao to verify the face validity of the measurement, appropriateness of the item wording, and clarity of the instructions to the questionnaire. During the survey, we asked the owners or managers of the Taobao e-retailer to answer the questions.

4.1 Sampling and data collection

The respondents of our study are Chinese e-retailers on Taobao. Our sample selection is based on the following guidelines i) e-retailers should have substantial experience and not a not newly set up firm (i.e. must be in existence for at least one year), ii) e-retailers should sell innovative products such as fashion or 3C products, iii) e-retailers should have more than 200 transactions per day on average. In addition to the above guidelines, we narrowed down the search using keywords such as women's fashion, men's fashion and 3C. The search results showed more than 2,000 e-retailers each time. We set the format to "show 20 results per page" and we only use the first 100 pages. On each page, we picked 10th e-retailer in the middle. After three rounds, we finally got the 300 samples. We sent the questionnaire to them through Wangwang (internal instant messaging on Taobao). The data collection process was carried out by 15 research assistants. Each of them approached 20 e-retailers through Wangwang. Our research assistants obtained one response from each e-retailer. Additionally, research assistants visited individual e-retailer's website to capture the objective measurements for customer satisfaction. We finally received 160 responses, out of which 12 had missing data. We had 148 valid responses with a response rate of 49.3% and this is better than similar studies in the Chinese context (Tian et al., 2010). According to Armstrong and Overton (1977), the late respondents can be assumed similar to non-respondents. To assess the non-response bias, we used t-tests on the early and late respondents. The results indicated that

there were no significant differences between early and late responses. Therefore, non-response bias may not be a threat in our study.

It is interesting to notice that around 81.76% of Taobao e-retailers had selected their product delivery service provider such as Shentong, Yuantong, Yunda or SF. Nevertheless, 18.24% of respondents do not have a 3PL service provider partner (see Table 1). According to our research assistants' short interview with them, the Taobao e-retailers usually select the 3PLs based on the price and convenience.

Insert Table 1 about here

4.2 Structural equation modeling (SEM) approach

Fornell (1992) developed the SEM approach during 1990s to estimate customer satisfaction subsequently it became a popular approach. Previous studies used SEM in different industry context such as internet services, manufacturing and technology commercialization success to understand the customer satisfaction levels (Shin et al., 2009; Kim et al., 2007; Yee et al., 2010). Similarly, SEM was used to evaluate both direct and indirect effects of the casual relationship between factors and customer satisfaction with respect to digital content industry to establish content specific marketing plans for customer relationship management (Lin, 2007; Joo and Sohn, 2008). As a result, we use structural equation modeling for investigating the proposed research models in Chinese e-retailers. The theoretical model is subsequently translated to a structure model using conventional SEM notation and illustrated in figure 3 (Koufteros and Marcoulides, 2006). SEM follows a two-step approach constructing the measurement model and testing the structural model (Anderson and Gerbing 1988). This study employs the SPSS 20 package to conduct exploratory factor analysis (EFA) and Amos 20 for SEM analysis.

Insert Figure 3 about here

4.3 Measurement model

We used exploratory factor analysis to determine the number of constructs and to test the factor loadings of each item of each construct. The results of exploratory analysis are shown in Table 2. We considered criteria which have factor loading criteria of greater than 0.70 (Hair et al., 2006) and other items with smaller loadings (below 0.35) were dropped from further analysis. This can also be used to test the validity of the measurement model. According to Campbell and Fiske (1959), validity is the extent to which an item relates to other items consistently. In our study, convergent and discriminant validity of five constructs were examined by the results of EFA. The convergent validity measures the correlations between the indicators underlying the same construct (Li et al., 2009). The high loadings of items suggest that all the items within the construct are valid and related. Table 2 also shows the Cronbach's Alpha, composite reliability, and the average variance extracted (AVE) of each construct. AVE is utilized to assess the discriminant validity, the square root of which should be larger than the correlations between constructs (Chin, 1998). Table 2 indicates that all items meet the requirement. Cronbach's alpha and composite reliability are the measurements used to assess the reliability or internal consistency (Lin et al., 2005). Nunally (1978) suggested that a Cronbach's value larger than 0.7 indicate good reliability for newly developed constructs. Similarly composite reliability value should be higher than 0.5. The values of Cronbach's alpha and composite reliability are shown in table 2 and they are all larger than prescribed values which mean the data has good reliability and internal consistency. Measurement models with factor loadings and significance of all the constructs are shown in Figure 4 and they are summarized in table 3. Figure 4 shows that all our constructs are based on reflective indicators. Conventionally observed indicators are widely used as functions of latent constructs. Changes in latent constructs are reflected in the observed indicators (Hair et al., 2006).

Insert Table 2 about here

Insert Table 3 about here

4.4 Structural equation model testing

We tested the proposed model using confirmatory factor analysis and structural equation model. The fit indices are shown in Table 4. Chi-square, comparative fit index (CFI), incremental fit index (IFI), and root mean square error of approximation (RMSEA) are all within the suggested cut-off as suggested by Shah and Goldstein (2006). According to MacCallum et al. (1996), RMSEA below 0.08 indicates a good fit and RMSEA between 0.08 and 0.10 provides a mediocre fit. As a result, our CFA model shows a mediocre fit while our SEM model shows a good fit.

Insert Table 4 about here

Figure 5 shows the AMOS results of confirmatory factory analysis (CFA) model on product delivery service provider selection. This model is used to explore the inter-relationship among constructs, and we also provide the measurement models for the test.

Figure 6 shows the AMOS results of the path model on product delivery service provider selection. H1, H2 and H3 are supported and accepted. The coefficient between flexibility and customer satisfaction are significant with a value of 0.562. The coefficient between soft-infrastructure and flexibility is significant with the value of 0.354, compared to the coefficient between hard infrastructure and flexibility with the value of 0.731 which is also significant. It is very clear from our analysis that hard infrastructure with flexibility has more influence on customer satisfaction.

4.5 Mediation effect analysis

The structural equation modelling analysis results shows that influence of infrastructure (both soft and hard infrastructure) on customer satisfaction is mediated by flexibility. To investigate the mediation effects of flexibility on the relationship between infrastructure and customer satisfaction, the multiple regression procedure was conducted according to Deng and Poole (2010). It is suggested to examine the effects of mediation through four step analysis. First, the relationship between the independent variables (soft-infrastructure and hard-infrastructure) and dependent variable (customer satisfaction) should be significant. Second, the relationships between the independent variables (soft-infrastructure and hard-infrastructure) and the mediating variable (Flexibility) should be significant. Third, the relationship between the mediating variable (Flexibility) and dependent variable (customer satisfaction) should be significant. Finally, the relationship between the independent variables (soft-infrastructure and hard-infrastructure) and dependent variable (customer satisfaction) should become non-significant after controlling for the mediator.

The results of the multiple regression analysis using four steps are shown in Table 5. The regression step 1 shows the independent variables (soft-infrastructure and hard-infrastructure) are significant predictors of the dependent variable. Step 2 indicates that the relationships between the independent variables (soft-infrastructure and hard-infrastructure) and the mediating variable (Flexibility) are significant. Similarly, the relationship between the mediating variable (Flexibility) and dependent variable (customer satisfaction) is found to be significant. Finally, in step 4, the direct effects of soft-infrastructure and hard-infrastructure on customer satisfaction is not significant, while the effect of flexibility on customer satisfaction is still significant. Despite of the poor model fit of step 1 (insignificant F-value), model fit improves in step 2, 3, and 4. This actually suggests that our full-mediation model (normed x^2=1.119) is better than the direct effect model (normed x^2=1.897) and the partial-mediation model (normed x^2=1.123). These results provide a strong basis to infer that the effect of infrastructure on customer satisfaction is mediated by flexibility (Zhao et al., 2010). Hence, H4 is also supported.

Insert Table 5 about here

Insert Figures 4-6about here

5. Discussion and implications

According to Graves (2013), the development of e-commerce has promoted the use of 3PL service provider and choosing an appropriate product delivery service provider tends to be significant process for e-commerce firms. However, in China, most of the e-retailers neglect the significance of logistics when they sell innovative products. When they select product delivery service providers, the main factor they consider tends to be the cost and so they tend to choose the cheapest product delivery service providers most of the time. In addition, despite the increasing research interest in 3PL service providers in recent years, a limited number of studies focus on the role of 3PL service providers in e-commerce, especially, from the retailers' perspective.

We propose the triadic model to depict the relationships among three parties involved in e-commerce, which are e-retailers, customers and product delivery service providers (3PL service provider). In this triadic model, e-retailers provide innovative products for customers, while 3PL service providers deliver products to customers. Meanwhile, e-retailers pay for the delivery service while customers pay for the innovative product. Our model reveals that from the customer's perspective, the role of product delivery service provider is almost transparent in the whole process. However, our empirical analysis suggests that performance of product delivery service providers has significant influence on customer satisfaction on e-retailers. As a result, from the e-retailers' perspective, when they select their delivery service partners, they should also take their customers into consideration. It means that e-retailers should not just choose the cheapest service providers but also evaluate whether their services are satisfying (e.g. get feedback from customers).

In line with the APP framework, our triadic model also suggests that for product delivery

service providers, they should focus on the design and maintenance their asset (both hard and soft infrastructure); and for e-retailers, they should be able to evaluate the process (flexibility) of those product delivery service providers; and for the customers, they provide evidence or feedback on the performance (customer satisfaction) of those product delivery service providers.

Our findings are consistent with practitioners' guidelines in selecting 3PL service providers. Apart from basic criteria such as price, delivery, and service quality, practitioners also believe that infrastructure, and flexibility and management expertise play a vital role in the selection process (Sweeney, 2003). We find that both soft infrastructure and hard infrastructure are important when they are considered along with flexibility. Soft infrastructure has two components: experience and knowledge which refer to the human-related resources (e.g. customer service handling and support, and professionalism of employees), and technology which refers to technology-related resources (e.g. Track and trace system, and RFID). Specifically, whether staff of 3PL service providers can promptly and effectively handle customer requests and questions, and consequently provide solutions promptly and empathetically contribute to the development of soft infrastructure. It requires internal communication, customer service training and managerial coaching for staff (Ellinger et al., 2010).

In the era of IoT, 3PL service providers are facing with dilemma between their limited IT budget and the unlimited choices of emerging technologies. Our findings suggest that they should choose to adopt those technologies that would enable them to achieve higher flexibility first. For example, while combining tracking and routing systems with satellites and local traffic systems, it is possible to predict the optimized delivering schedule under the circumstance of high volatile demand, which in turn achieve higher flexibility for the 3PL service provider. In addition, human-related resources should be coordinated with technology-related resources. This is particularly true when new technology is adopted in the 3PL service provider. Staff should be trained how to effectively use this new technology and accumulated knowledge of existing technologies would make staff advance with innovative

usage.

Hard infrastructure refers to warehouse and transportation capacity. Our findings supports that by providing well designed and planned hard infrastructure, 3PL service provider can be more flexible in serving customers. However, investment in hard infrastructure is very expensive. Expanding the network to a new location requires huge investment such as warehouse space, new trucks/cargo plane and new distribution center. This is also the main reason that most of Chinese leading 3PL service providers choose franchise business model to expand their network in a short period of time.

In summary, our findings suggest that if the 3PL service provider intends to have higher level of flexibility, it not only needs to purchase more vehicles and maintain and expand their warehouse (hard infrastructure), but they are capable to align the need of buyers various information systems and leverage on the IT capability (technology infrastructure), and provide systematic training for its staff and retain experienced staff (knowledge infrastructure). For example, drone as an emerging transportation method in IoT, has been under pilot test by many major international product delivery service providers. However, investment on hard infrastructure alone (e.g. purchasing drones) may not guarantee higher flexibility for those companies. They should also invest in technology (e.g. management systems in dispatching and controlling drones), and knowledge (e.g. training for existing staff or recruiting new staff with technical background) (Eldridge, 2014).

However, the R-square value for the dependent variable – customer satisfaction is comparatively low, which indicates that our proposed model only explains a small percentage of the customer satisfaction. This is because the current study takes an e-retailer's perspective, and as a result, the customers are end customers who purchased the product. According to our e-commerce triad model, they are the customers to both the e-retailer and the product delivery service provider. Consequently, their satisfaction contains both satisfaction on the product they purchased and the delivery service they experienced. Their satisfaction with the delivery service may only account for part of their satisfaction on the overall process. Our

findings actually revealed that for e-retailers, the delivery service plays a small but significant role on their customer satisfactions.

Our study has made various theoretical and practical contributions. First, we integrate the IoT with innovative product delivery service provider supplier selection criteria using APP framework with customer satisfaction. Despite various practitioners' guidelines or rules of thumb have highlighted the importance of infrastructure and flexibility for 3PL service providers, this is one of the first studies that provides theoretical foundations and empirical validations of the general opinions. In addition, our framework proves the suggestions in the previous studies that the combination effect of 'hard assets and 'soft assets' would create substantial synergy in achieving the performance (Memedovic, 2008).

Secondly, the triadic model represents the three participants in e-business process: sellers, customers and 3PL service providers. As a result, it provides insights for both sellers and 3PL service providers. From the sellers' perspective, they want to meet customers' needs and make them happy, which is to achieve higher customer satisfaction level. Our findings suggest that instead of evaluating various aspects of 3PL service providers, they need to pay particular attention to aspects of flexibility level of 3PL service providers. Moreover, from 3PL service providers' perspective, in order to satisfy their immediate upstream customer (e-retailers) and the downstream customer (buyer), they have to achieve higher level of flexibility, through improving both their soft and hard infrastructure. Hence, the 3PL service providers should focus on enhancing their soft and hard infrastructure through measures such as training their staff to be more knowledgeable, upgrading their enterprise systems to be more efficient and acquiring more trucks and distribution centers.

Thirdly, we extend the traditional supplier selection criteria into the new era of IoT. In the IoT, sensors and actuators embedded in physical objects are linked through wired or wireless network. Consequently, huge volumes of information about these physical objects are generated and shared. Customers are exposed to this information and as a result, their requirements or desires keep changing constantly. Innovative products, in the sense of

individuation and customization, are getting more and more popular in e-commerce. Our findings are consistent with previous studies on traditional supplier selection criteria that flexibility is an important criterion. It is suggested that Taobao innovative products e-retailers should focus on the flexibility of their 3PL partners rather than the cost.

Finally, our research context is based on the Chinese market. The international 3PL service providers such as DHL or FedEx failed to provide domestic services. This is particularly true for the Chinese market as domestic 3PL service providers dominates the market and out-performed international 3PL service providers within ten years. However, this is not because of protectionism or nationalism. Since 2005, it has been a free market and now it is dominated by several private owned local companies such as SF and Shentong, most of them are in existence for the last 10-20 years history. The key for them is their knowledge about the domestic market. Domestic 3PL service providers recruit local staff who are familiar with local area and speak local dialects enabling them to better communicate with customers. They also have significant experience in local market. This suggests that in order to expand their business in China, International 3PL service providers should learn from domestic 3PL service providers in terms of enhancing their soft infrastructure, especially their knowledge of the local market.

6. Conclusion

Our analysis reveals that the influence of infrastructure on customer satisfaction is fully mediated by flexibility. We found that both hard and soft infrastructure along with their flexibility improves customer satisfaction. However, neither hard infrastructure nor soft infrastructure can improve customer satisfaction directly or alone. Our findings suggest that for Chinese e-retailers, they can select 3PL service providers with the high level of flexibility with enhanced soft and hard infrastructure to attract more Chinese customers. However, there are some limitations that could be addressed in future studies. First of all, we used objective measurement of customer satisfaction by secondary data. Future studies could collect subjective data from customers of Taobao to directly measure customers' satisfaction levels. We asked the product delivery service provider about seller and customer. If we could view

the triads into three dyads then it's possible to get complete views about each other's perception about effectiveness of asset-process-performance. It would also be possible to focus on a specific innovative product and conduct longitudinal qualitative and quantitative studies. From such in-depth analysis, we may be able to understand how the three parties in the triad harmonize their actions towards common goals by addressing their alignment and adaptable issues. Finally, we only collected data from the Chinese market, the generalizability of the result into different countries remains uncertain.

Appendix: Measurement scale

Knowledge

Know1: The Experience and knowledge (e.g.: customer service) of 3PL service provider is timely updated.

Know2: The Experience and knowledge (e.g.: customer service) of 3PL service provider is visually appealing.

Know3: The information for Experience and knowledge (e.g.: customer service) of 3PL service provider is clear (e.g.: pamphlets or statements on the website).

Technology

Tech1: The Technology (e.g.: tracking system, RFID and website) of 3PL service provider helps you to keep your records accurately.

Tech2: The Technology (e.g.: tracking system, RFID and website) of 3PL service provider gives prompt service.

Tech3: The Technology (e.g.: tracking system, RFID and website) of 3PL service providers is promising.

Tech4: The Technology (e.g.: tracking system, RFID and website) of 3PL service provider has operating hours convenient to you.

Infrastructure

Infra1: The Infrastructure (e.g.: network, warehouse and trucks) of 3PL service provider always keeps your best interests in mind.

Infra2: The Infrastructure (e.g.: network, warehouse and trucks) of 3PL service provider is upto your understanding of specific needs.

Infra3: The Infrastructure (e.g.: network, warehouse and trucks) of 3PL service provider has operating hours convenient to you.

Flexibility

Flex1: The Technology (e.g.: tracking system, RFID and website) of 3PL service provider is flexible enough to handle unforeseen problems.

Flex2: The Infrastructure (e.g.: network, warehouse and trucks) of 3PL service provider can readily make adjustments to meet changes in your needs.

Flex3: The Infrastructure (e.g.: network, warehouse and trucks) of 3PL service provider is flexible in response

to requests you make.

Flex4: The Technology (e.g.: tracking system, RFID and website) of 3PL service provider is flexible in response to requests you make.

Flex5: The Experience and knowledge (e.g.: customer service) of 3PL service provider is flexible in response to requests you make.

Customer Satisfaction

CS1: The accords with the description and product is satisfying

CS2: Speed of product delivery is satisfying

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Figures

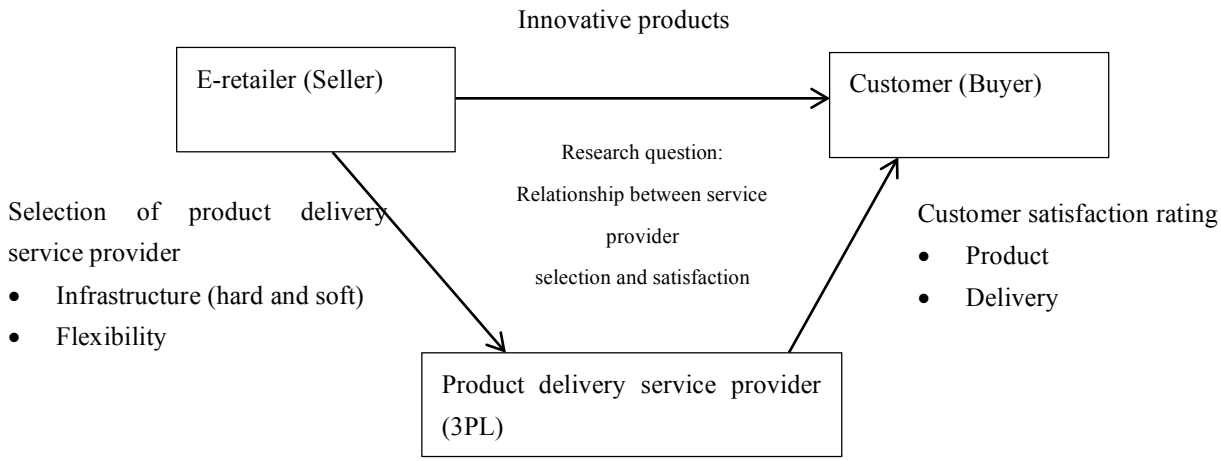


Figure 1: e-commerce triads

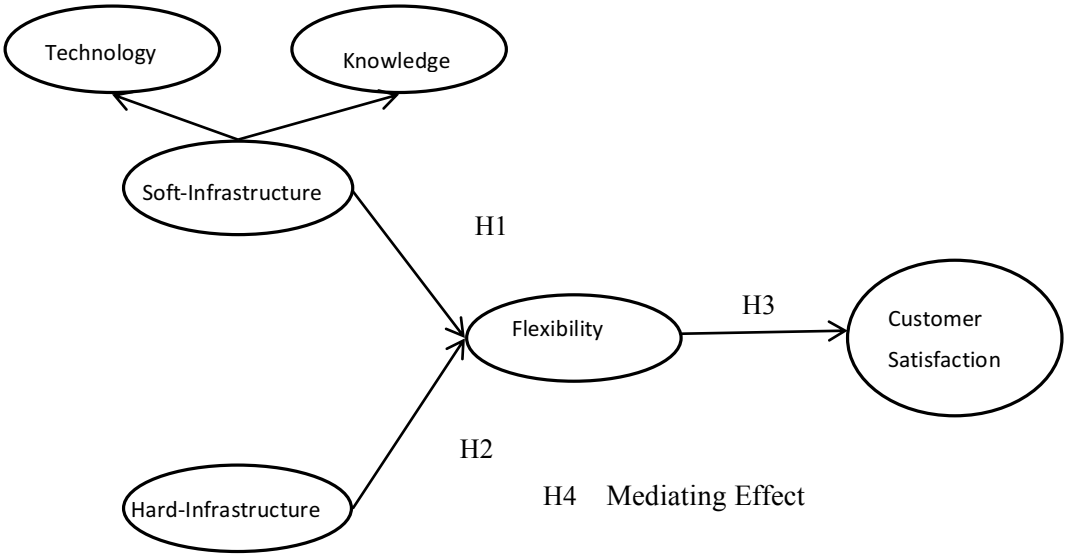
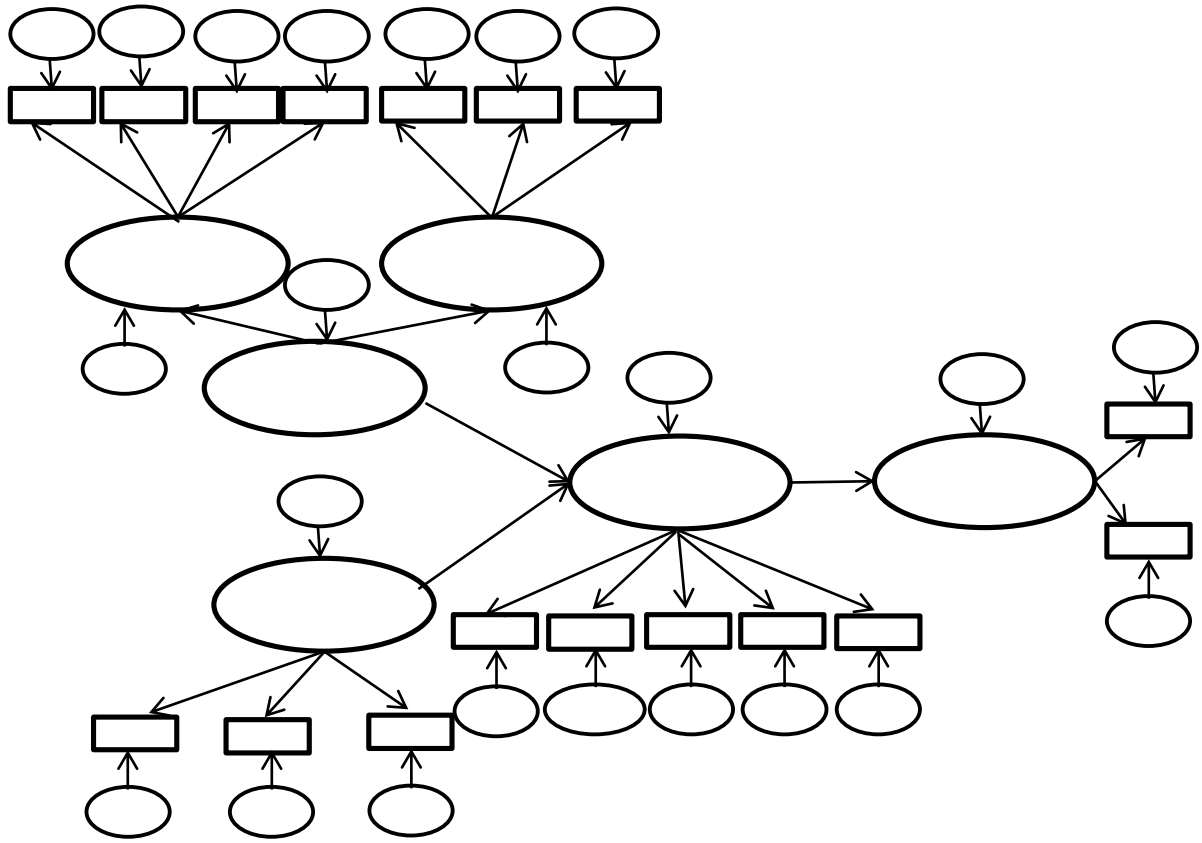
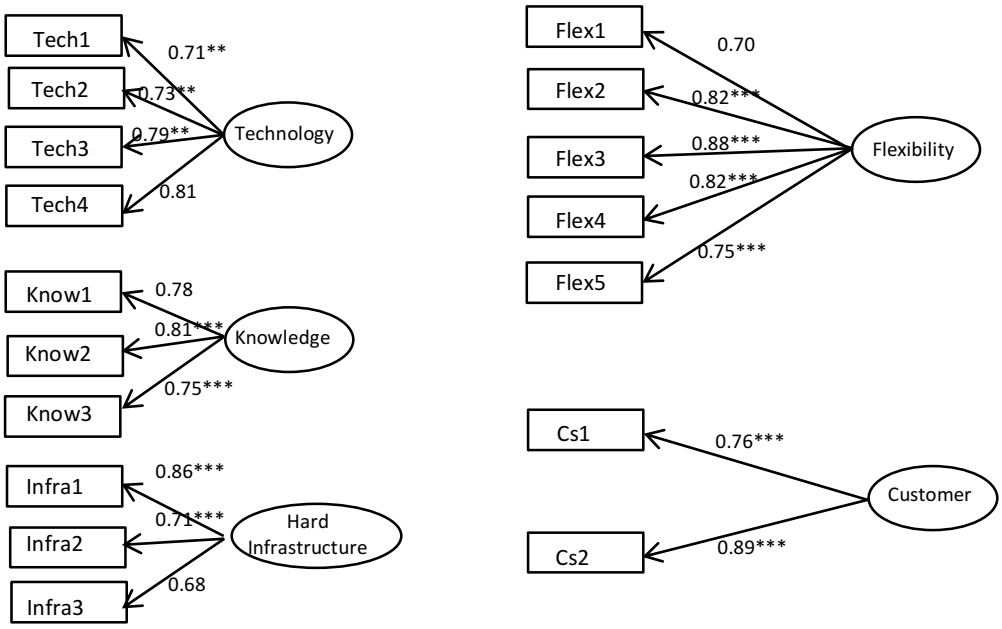


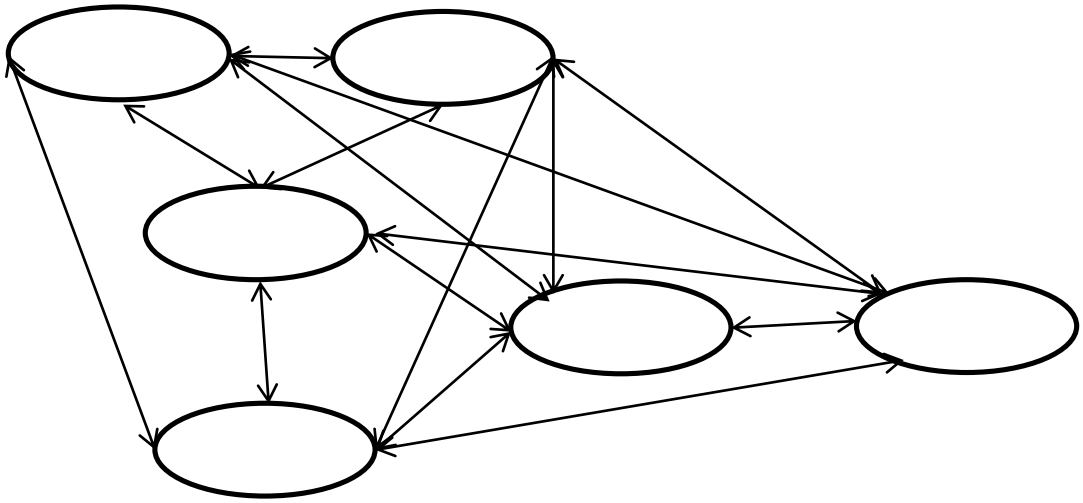
Figure 2: Conceptual model





***p<0.05; **p<0.01; ***p<0.001**

Figure 4: Measurement models



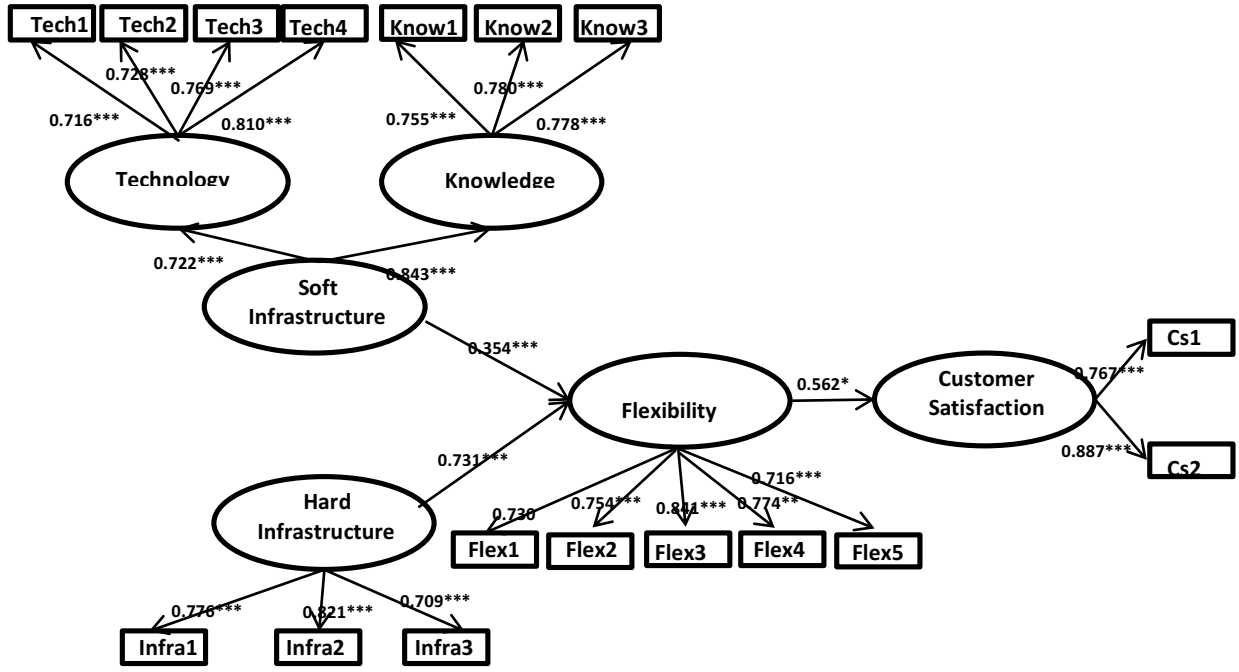


Figure 6: Structural equation path model

Tables

Table 1: Default product delivery service provider

Have a default delivery company	Frequency	Percentage (%)
Yes	121	81.76%
No	27	18.24%

Table 2: Exploratory factor analysis

Constructs	Constructs	Variables	Factor loadings	Cronbach's Alpha	Composite reliability	AVE
Soft-Infrastructure	Technology (Tech)	Tech1	0.759	0.841	0.8424	0.5725
		Tech2	0.732			
		Tech3	0.787			
		Tech4	0.872			
	Knowledge (Know)	Know1	0.794	0.823	0.8148	0.5946
		Know2	0.805			
		Know3	0.827			
Hard Infrastructure (Infra)		Infra1	0.804	0.791	0.8133	0.5930
		Infra2	0.809			
		Infra3	0.847			
Flexibility (Flex)		Flex1	0.839	0.895	0.8750	0.5841
		Flex2	0.842			
		Flex3	0.902			
		Flex5	0.855			
		Flex5	0.812			
Customer satisfaction (CS)		Cs1	0.918	0.809	0.8140	0.6875
		Cs2	0.795			

Table 3: Measurement models results summary

Constructs	Variables	Relationship	St.β	t	p-value	
Soft-infrastructure	Technology (Tech)	Tech1— Technology	0.709	5.748	<0.001	accepted
		Tech2— Technology	0.733	5.406	<0.001	accepted
		Tech3— Technology	0.785	5.229	<0.001	accepted
		Tech4— Technology	0.795			accepted
	Knowledge (Know)	Know1—Knowledge	0.783			
		Know2—Knowledge	0.809	5.309	<0.001	accepted
		Know3—Knowledge	0.750	5.194	<0.001	accepted
Hard Infrastructure (Infra)		Infra1—Infrastructure	0.863			
		Infra2—Infrastructure	0.708	4.492	<0.001	accepted
		Infra3—Infrastructure	0.682	4.419	<0.001	accepted
Flexibility (Flex)		Flex1— Flexibility	0.701			
		Flex2— Flexibility	0.817	5.758	<0.001	accepted
		Flex3— Flexibility	0.879	6.130	<0.001	accepted
		Flex4— Flexibility	0.821	5.784	<0.001	accepted
		Flex5— Flexibility	0.751	5.326	<0.001	accepted
Customer satisfaction (CS)		Cs1—CS	0.897	5.923	<0.001	accepted
		Cs2—CS	0.770	5.726	<0.001	accepted

Table 4: Fit indices of models

	x^2(df)	Normed x^2	CFI	RMSEA(%)	TLI
Confirmatory factor analysis Model	203.2(106)	1.917	0.905	0.082	0.903
Path Model	122.043(109)	1.119	0.972	0.046	0.965

Table 5 : Multiple regressions analysis for the mediating effects of flexibility

Multiple regression steps		1	2	3	4
		Beta (Standardised co-efficeint)			
Dependent variables		CS	Flexibility	CS	CS
Independent variables	Soft-infrastructure	0.321**	0.379*	-	-0.21
	Hard-infrastructure	0.286***	0.735***	-	-0.39
	Flexibility	-	-	0.466**	0.562*
F value		0.868	63.450***	3.703**	2.20**
DF		2/145	2/145	1/146	3/144
R-Square		0.03	0.59	0.03	0.06

**p<0.05 ; **p<0.01; ***p<0.001