Journal of International Technology and Information Management

Volume 17
Issue 3 *Double Issue 3/4*

Article 6

2008

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ABSTRACT

This study examined how information technology (IT) influences competitive strategies of third-party logistics (3PL) providers in mainland China. First, we examined the influences of IT on the firm's IT advantage over its competitors. Second, the relationship between IT and competitive strategy was examined. The results show that IT has a significant influence on a firm's IT advantage and its competitive strategy.

INTRODUCTION

Information technology (IT) offers opportunities to provide competitive operation advantages like logistical efficiency, effectiveness and flexibility (Sanders & Premus, 2002). Yet, due to the high cost of IT and lack of expertise, the IT adoption rate of logistics users is still low (Sum, Teo, & Ng, 2001). One implication of this low IT adoption rate for firms which use logistics is that there are ample opportunities for third-party logistics (3PL) firms to adopt IT and exploit this aspect of their services (Bhatnagar, Sohal & Millen, 1999). Rapid expansion within a company, coupled with continued growth in logistics requirements, also encourages logistics users to outsource their logistics activities to 3PL firms (Sum *et al*.). Logistics outsourcing, through 3PL firms, has become a rapidly expanding source of competitive advantage and logistics cost savings (Rabinovich, Windle, Dresner & Corsi, 1999). Many Fortune-500 companies have now outsourced transportation, warehouse, and inventory management functions (Burnson, 2000). IT in a 3PL firm plays an essential role in synchronizing and coordinating complex supply chain activities between logistics users and their customers and is therefore an important strategic capability for 3PL firms. Although there are limited studies addressing how 3PL firms build high level IT capability, those that have recognize the inherent difficulties (Lewis & Talalayevski, 2000; Stone, 2001).

Previous studies of IT have mainly focused on the value of IT, such as cost reduction and productivity improvement. Only limited studies have investigated the relationships that may exist between IT and the strategy that a company pursues. We examine these issues within 3PL firms

in China. China's 3PL firms represent a unique opportunity to address issues related to IT and strategy. The entry of China into the World Trade Organization (WTO) has resulted in tremendous growth in business within China, and the logistics industry there is growing. Increased competition in China's logistics industry has forced many 3PLs to review their strategies, and the value propositions they represent to their clients.

Our paper proceeds as follows. We first present a review of the literature, followed by discussion our research methodology. Next we present results of the analysis, and discuss our findings and limitations. Finally, we present our conclusions.

LITERATURE REVIEW AND HYPOTHESE

Within the logistics literature, IT plays an important role and has been promoted as a means to enhance logistics competitiveness (Bowersox & Daugherty, 1995; Daugherty, Ellinger & Rogers, 1995), increase capability, decrease cost, and improve service (Closs, Goldsby & Clinton, 1997). Although IT was considered a key component in future logistics systems (Dawe, 1994) and showed growth trends in logistics, many managers still caution the use of IT, due to high technology cost (e.g., DRP systems and satellite communications systems), risk of organizational damage during implementation, and lack of demonstrated effectiveness (Sum *et al*., 2001). Other reasons for organizations' hesitancy to invest in IT include the expected obsolescence of hardware and software, application redundancy, and irrelevance of applications to a firm's particular industry and information needs (Dawe, 1994). Bowersox, Daugherty, Dröge, Rogers and Wardlow (1989) refers to logistics managers' inability or unwillingness to adopt IT, despite the influence applications may have on firm success/failure, as the "information gap". We are interested in the relationship of those factors to the strategy that a firm pursues, and to perceived IT advantage. The model is presented in Figure 1.

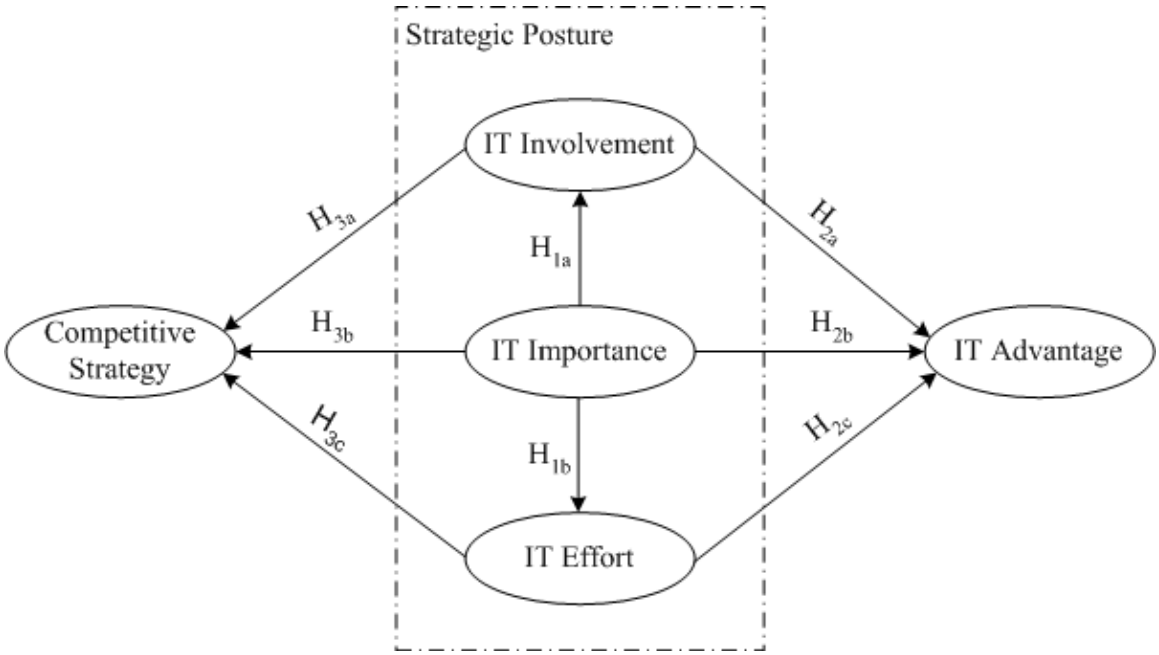
IT Strategic Posture

We represent IT strategic posture as being composed of: the importance placed on IT (*IT Importance* hereafter), the degree of resource effort devoted to IT (*IT Effort* hereafter), and the managerial involvement in the strategic planning (*IT Involvement* hereafter) (c.f., Wang, Lai, & Zhao, 2008; Lai, Wang & Zhao, 2006). The relationships between these three components are not the focus of the present study, which had been examined in Wang et *al.* (2008) and Lai *et al.* (2006). However, to make the model appropriately specified and avoid potential biases of parameter estimations, we still incorporate the relationships into our model. Therefore, we have:

H_{1a}: IT importance has significant and positive influences on IT Efforts

H_{1b}: IT importance has significant and positive influences on IT Involvement

Figure 1: The Research Model.



IT Advantage

IT strategy must be integrated with the overall corporate strategy and united with all the organization's other competitive strategies. All levels of management must develop competitive strategies that emphasize the central role of IT (Mattson, Beheshti & Salehi-Sangari, 2000). Strategy alignment theory emphasizes top management participation for aligning IT strategies and business strategies. An alignment between its IT and business strategies enables an organization to acquire, deploy, and leverage its IT investments and capabilities effectively in pursuit of its business strategies and in support of its business activities (Reich & Benbasat, 2000; Hirschheim & Sabherwal, 2001). This alignment might be facilitated through an understanding of the overall organizational objectives by top management. Lederer and Burky (1989) showed that IT executives who participate more in strategic planning believe that they have a better understanding of top management's objectives than do those who participate less. Zmud (1988) argued that structural mechanisms (e.g., steering committees, technology transfer groups) associated with communications and management systems (e.g., planning and control mechanisms) are needed to build IT-line partnerships for the successful introduction of new technologies. Boynton *et al*. (1994) also suggests that the effective application of IT depends on the interactions and exchanges that bind IT and line managers. Therefore we hypothesize:

H_{2a}: IT involvement has significant and positive influences on IT advantage

Top management championship, including top management beliefs and participation, may also determinately influence IT adoption and assimilation (Chatterjee et al., 2002). Top management championship is a metastructuring action which defines institutional norms and values regarding how managers should engage in structuring actions related to IT (Chatterjee et al., 2002).

Chatterjee et al. (2002) defined top management championship in terms of managerial beliefs about IT initiatives and participation in those initiatives. In firms where top managers believe that IT offers a strategic opportunity and actively participate in the IT initiatives, their beliefs and participation serve as powerful signals to others in the managerial community about the importance placed on IT adoption and assimilation. Through their beliefs, top management can offer vision and guidelines to managers about the opportunities and risks in assimilating IT innovation. Further, top management can legitimize the willingness and energy of managers to commit their effort to IT adoption (Chatterjee et al., 2002). Studies demonstrated that the top management beliefs and participation significantly influence the web assimilation (e.g. Chatterjee *et al*., 2002). Therefore, we believe that top management beliefs and participation in IT can promote and improve IT advantage and capability.

H_{2b}: IT importance has significant and positive influences on IT advantage.

Goal theory suggests that effort is the most immediate determinant of performance (Locke et al., 1988). Kren (1990) proposes an extended expectancy theory model that combines expectancy theory and goal theory. In this model, greater effort to reach an objective leads to better performance. Meanwhile, higher levels of resource commitment may help a firm to acquire such competitive IT equipments as hardware, software, network, and databases. Together with appropriate strategic integration with business objectives, the competitive IT equipments may facilitate the achievement of IT advantage over competitors. Therefore, we hypothesize:

H_{2c}: IT effort has significant and positive influences on IT advantage.

Competitive Strategy

In Porter's (1980, 1985) view, competitive advantage comes from either being able to reduce costs below the industry average or through differentiating products or services in some way that would entice customers to pay above average prices for the product or service. Porter (1980) referred to these as cost leadership and differentiation strategies. IT can be seen as a tangible resource that is commonly available, which may contribute to the success of a company pursuing either a cost leadership or differentiation strategy (Hill, 1988). IT affects the competitive advantage of a company (Lea, 2005; Evans & Neu, 2008) by influencing the cost drivers or uniqueness drivers of value chain activities (Porter, 1985). Internal processes and activities, as resources, are used by companies as methods of increasing communications, quality, and performance (Fedorowicz et al., 2004; Whitten, 2004).

Although IT may help firms to achieve differentiation and cost leadership, the logistics literature has shown that firms that pursue differentiation leadership achieve better financial performance, higher growth rate, higher market share, and a better return on investment than those that compete solely on cost (Sum and Teo, 1999; Yeung et al., 2006; Wang et al. 2006). That differentiators outperform cost leadership firms may be because of the changing requirements of logistics users who demand more than basic and cheap services. In China's current logistics market, it is very common that logistics users are unable to find 3PL providers that can provide the requested value-added services (like packaging, warehousing, consolidation, etc.), at a high level of quality to supplement their operations and meet customer service requirements, even

though they are willing to pay extra (Wang et al., 2006). On other hand, to maintain cost advantages, firms pursuing cost leadership may limit themselves to offering basic services only. In addition, the pure cost posture presents a lower entry barrier and induces more competition, inevitably resulting in lower profitability (Sum & Teo, 1999). Therefore, it has been suggested that 3PL firms that pursue cost leadership review their current strategies and decide if they should continue the cost leadership strategy with low cost and low profit, or migrate to a differentiation strategy in order to achieve better business performance (Yeung *et al*., 2006).

IT has an important impact on the innovation of new products and services (Holland et al., 1992). Responding to customer needs is one way of attaining a differentiation strategy (Porter, 1980; 1985). Within the logistics industry, IT such as EDI, satellite tracking, and onboard computers give companies the ability to know where a shipment is during the shipping process, and accurately communicate the delivery status to customers. Knowing the exact location of a shipment is valuable information to a customer's operation. As suggested above, a cost leader would not be positioned to benefit from the customer responsiveness benefits of these externally oriented information systems in the same way that they would with internally oriented communication and computing systems designed to increase efficiency. Therefore, we expect that the components of the strategic posture of IT will have the following relationships to differentiation strategy:

H_{3a}: Higher level of IT involvement facilitates firms to pursue differentiation leadership.
H_{3b}: Higher IT importance facilitates firms to pursue differentiation leadership.
H_{3c}: Higher level of IT effort facilitates firms to pursue differentiation leadership.

RESEARCH METHODOLOGY

Measures

The survey measures for the study were derived from previously published studies or developed by converting the definitions of constructs into a questionnaire format (Bock et al., 2005). Specifically, the respondents were asked to indicate the importance level of IT/IS, degree of effort devoted to improve IT/IS, degree of executive's involvement into strategic planning, and the company's IT/IS advantage relative to primary competitors (see Appendix). In all these questions, a Likert-type scale of 1 to 7 was used.

The questionnaire also asked which of Porter's competitive strategies the firm was pursuing. Porter's competitive strategy was measured by using a categorical variable. A self-typing measure asked the respondents to evaluate the competitive strategies of their own firms using descriptions of the four generic strategies in Porter's typology (1980, 1985). The descriptions of types were the same as those used in Sum and Teo (1999). The strategic types – industry-wide cost leadership, industry-wide differentiation, segment-cost leadership, and segment-differentiation were labeled accordingly. Although four competitive strategies were included in the questionnaire, in this study we combined industry-wide cost leadership and segment-cost leadership to cost leadership, and industry-wide differentiation and segment-differentiation to

differentiation. The combined cost leadership and differentiation variables were used in the later analyses. The self-reported differentiation strategy was encoded as 1 and cost leadership as 0.

Data Collection

We used mail survey to collect data from logistics companies registered with the Ministry of Communications (MOC) of China and the membership list of the China International Freight Forwarders Association. There are a total of 1245 logistic service companies in the two lists. We first contacted the companies to obtain the name and address of the senior managers and to ask for their agreement to participate our survey. The questionnaire and a covering letter explaining the purpose of the research were mailed to the identified respondents, along with a preaddressed, postage-paid envelope to facilitate the return of the completed questionnaire. A total of 760 questionnaires were sent out and a total 105 completed questionnaires were received. The response rate was 13.8%. The demographic statistics of the responding 3PL firms are shown in Table 1.

Table 1: Characteristics of 3PL firms.

Characteristics	Percent(%)
A. Number of Full-time Employees	
Less than 50	28.0%
50-99	17.0%
100-199	15.0%
200-499	19.0%
500-999	8.0%
1000 or more	13.0%
B. Registered Capital	
Less than RMB$1million	11.0%
RMB$1m to Less than RMB$10m	42.9%
RMB$10m or more	46.1%
B. Ownership	
State-owned company	41.0%
Chinese private company	23.8%
Joint venture company	20.9%
Foreign company	14.3%
D. Number of Years Operating in China	
Less than 3	10.6%
3-8	38.3%
more than 8	51.1%
E. Service Type	
Warehousing	61.9%
Sea Freight	52.4%
Integrated Logistics	50.0%
Land Freight	49.5%
Intermodal Transportation	46.7%
Distribution	39.0%
Consulting	33.3%
Packing/Repackaging	25.7%

DATA ANALYSIS AND RESULTS

Measurement reliability and Validity

We first examined the measurement model. Based on the results of the measurement model, we analyzed the convergent validity, discriminant validity, and reliability following the guidelines in the literature (Fornell & Larker, 1981).

Table 2: Measurement Model.

Construct	Item	Loading	Standard error	T-Statistics*	Cronbach Alpha	AVE
IT Importance	IMP01	0.873	0.035	24.924	0.830	0.779
	IMP02	0.892	0.027	33.421		
IT Effort	EFF01	0.892	0.037	23.900	0.804	0.823
	EFF02	0.922	0.017	54.743		
IT Involvement	INV01	0.933	0.022	42.052	0.858	0.780
	INV02	0.830	0.087	9.535		
IT Advantage	ADV01	0.926	0.020	47.022	0.846	0.859
	ADV02	0.928	0.023	40.773		
Competitive Strategy	STR01	1.000	0.000	0.000	N/A	N/A

*Note: * all p < 0.01; N/A: Not applicable for single items;*

Table 3: Correlations of latent variables.

	Importance	Involvement	Effort	Advantage	Strategy
Importance	**0.883*** (0.779)**				
Involvement	0.492***	**0.883** (0.779)			
Effort	0.603	0.215	**0.907** (0.823)		
Advantage	0.490	0.319	0.310	**0.927** (0.859)	
Strategy	0.373	0.165	0.171	0.378	**N/A** (N/A)

*Note: * Square root of Average Variance Extracted (AVE), shown on the diagonal of the matrix in bold;*

*** AVE, shown in parentheses on the diagonal of the matrix;*

**** Inter-construct correlation, shown off the diagonal; N/A: Not applicable for single item.*

Item reliability was examined by means of factor loadings of the items of the construct. It is widely accepted that items with loadings of 0.7 or higher have adequate item reliability (Fornell & Larker, 1981). As shown in Table 2, all loadings were above the 0.7 threshold. In addition, t-

values of all loadings were higher than the cutoff value of 1.96, providing supplemental support for the item reliability. Cronbach's alpha values were used to assess construct reliability, which ranged from 0.804 to 0.858, which are higher than the recommended cutoff value of 0.7 (Nunnally & Bernstein, 1994), suggesting reasonable construct reliability.

The convergent validity was assessed in terms of average variance extracted (AVE). Convergent validity requires an AVE of no less than 0.50 (Fornell & Larcker, 1981). As shown in Table 3, all of the AVE values are above the recommended value of 0.50 (ranging from 0.779 to 0.859), demonstrating adequate convergent validity.

Discriminant validity was assessed by comparing the AVE of each individual construct with the shared variances between the individual construct and all of the other constructs. Table 3 shows that the square roots of the AVEs on the diagonal are larger than all of the correlations off the diagonal (in the corresponding rows and columns), suggesting adequate discriminant validity (Fornell & Larcker, 1981).

Seemingly Unrelated Regression (SUR) Analysis

To examine the interrelationship between IT importance, IT effort, IT involvement, and their associations with IT advantage, the following set of equations were built:

$$(1)\quad \text{Effort} = \beta_{10} + \beta_{11}*\text{Importance} + \varepsilon_1$$

$$(2)\quad \text{Involvement} = \beta_{20} + \beta_{21}*\text{Importance} + \varepsilon_2$$

$$(3)\quad \text{Advantage} = \beta_{30} + \beta_{31}*\text{Importance} + \beta_{32}*\text{Effort} + \beta_{33}*\text{Involvement} + \varepsilon_3$$

Here, ε_i represents an error term. Each construct was represented by its summary score.

The model shown above is a triangular system of three simultaneous equations. The error terms across the three equations are most likely correlated. In this case, Lahiri and Schmidt (1978) and Johnson and DiNardo (1997) showed that a seeming unrelated regression (SUR) is the appropriate estimation approach for a triangular system. SUR uses the correlation of errors across equations to yield more efficient regression estimates of error variances, which is necessary for parameter estimates to be consistent (Greene, 2003; Johnson & DiNardo, 1997). A number of studies in the literature have applied SUR method to model triangular systems (e.g., Wu et al., 2003; Corsten & Kumar, 2005; Christen et al., 2006). We conducted the SUR analyses using SAS *Syslin* procedure with *SUR* option. The results are shown in Table 4.

Table 4: Seemingly Unrelated Regression (SUR) Results.

Independent Variable	Dependent Variable		
	Effort	**Involvement**	**Advantage**
Intercept	1.252^{**}	1.926^{**}	1.013^{ns}
Importance	0.561^{**}	0.427^{**}	0.437^{**}
Effort	--	--	0.298^{*}
Involvement	--	--	0.258^{**}
R^2	0.292	0.174	0.372
Adjusted R^2	0.283	0.171	0.364

**p<0.001; *p<0.050; ns: not significant at 0.050 level.

Table 4 shows that IT importance has significant and positive influences on IT effort ($\beta_{11}=0.561$; $p<0.001$), and explains 29.2% variance of IT effort. Similarly, IT importance also significantly positively influences IT involvement ($\beta_{21}=0.427$; $p<0.001$). However, IT importance explains only 17.4% variance of IT involvement. Therefore, hypotheses H_{1a} and H_{1b} are supported.

As shown in Table 4, all IT behaviors (IT importance, IT effort and IT involvement) significantly positively influence IT advantage. This result confirms our theoretical expectations and provides support for H_{2a}, H_{2b} and H_{2c}. Among these IT behaviors, IT importance has the strongest influences on IT advantage ($\beta_{31}=0.437$; $p<0.001$). The influences of IT effort and IT involvement on IT advantage are roughly the same ($\beta_{32}=0.298$, $p<0.050$ *and* $\beta_{33}=0.258$, $p<0.001$, respectively). These three variables explain 37.2% of the variance of IT advantage.

Logistic Regression Analysis

Because competitive strategy is a binary variable of either differentiation or cost leadership, a logistic regression is required to examine the relationship between IT importance, effort, and involvement and competitive strategy, as represented in equation (4):

$$(4)\quad \log\left(\frac{p(Differentiation)}{p(Cost)}\right) = \beta_0 + \beta_1 * \text{Importance} + \beta_2 * \text{Effort} + \beta_3 * \text{Involvement} + \varepsilon$$

Here, *log(•)* is natural logarithm; *p(•)* is the possibility of pursuing differentiation or cost leadership as the firm's competitive strategy; ε represents the error term. The SAS *logistic* procedure was used to conduct this logistic regression. Results of the logistic analysis are reported in Table 5.

Table 5: Logistic Regression Results.

Dependent variable: Competitive Strategy (1= differentiation; 0= cost)				
	β (Coefficient)	**Wald**	**Sig.**	**Exp(β)**
Intercept	-2.946	1.796	0.180	0.053
Importance	0.955	6.315	0.012	2.599
Effort	0.485	4.855	0.028	1.624
Involvement	0.355	4.499	0.034	1.426
Model Fit: -2 Log Likelihood = 62.382; Omnibus test: χ^2 = 12.678, df=3, p < 0.005; Nagelkerke R^2 = 0.346				

The model with three independent variables achieved -2 Log Likelihood of *62.382*, which is reduced by *12.678* (see χ^2 in Omnibus test) from the model with intercept only. With the Nagelkerke (1991) R^2 of *0.346,* the incorporation of the three variables into the model is significant (χ^2*=12.678, df = 3, p<0.005*).

The coefficients of IT importance, IT effort and IT involvement are positive and significant (β_1*=0.955, p=0.012;* β_2*=0.485, p=0.028;* β_3*=0.355, p=0.034*, respectively). This is consistent with our theoretical expectation that the components of IT strategic posture have positive and significant influences on IT advantage, providing support for H_{3a}, H_{3b}, and H_{3c}.

By checking Exp(β) in Table 5, we can find that the odds of pursuing differentiation as the firm's competitive strategy are 2.599 times higher than pursuing cost leadership when the firm values IT higher by 1 unit. Similarly, the odds of pursuing differentiation are 1.624 and 1.426 times higher than pursuing cost leadership when the firm devotes effort more by 1 unit and involves in IT planning higher by 1 unit, respectively. These results indicate that higher IT importance, IT effort and IT involvement may facilitate the firm to pursue differentiation as its competitive strategy. Among these variables, IT importance has the strongest influences on the firm's pursuing a differentiation strategy.

DISCUSSIONS AND CONCLUSION

Limitations

We note that our findings must be interpreted in light of the study's limitations. Our first, and most limiting concern, is that self-reported IT advantage may be inflated due to a cultural response style. Yates et al. (1997) reported that overconfidence was typically stronger among Asian than among Western respondent groups. Therefore, the respondents in this study might overestimate IT advantage relative to its competitors. It is strongly encouraged to use more objective constructs to measure IT advantage in future research.

Other limitations are related to sample size and generalizability. The relatively small sample size and low response rate may hurt the generalizability of our findings. The cultural and industrial contexts also may limit the generalizability; however a cross-national study was beyond the scope of this study and is left for future research.

Implications

The analyses showed that 3PL firms with a high level of IT Importance, IT Effort and IT Involvement generally have a high level of IT Advantage. To achieve IT advantage, the top management may have to champion the strategic importance of IT, which further guides the resource commitment and managerial involvement in the management community. The resource and managerial commitment may result in improved IT advantage and capability. In addition, the analyses showed that the top management beliefs regarding IT importance, resource commitment, and managerial commitment can facilitate a firm's pursuit of differentiation as its competitive strategy. Therefore, IT could be an enabler and paver for companies to pursue differentiation strategy, which is what more and more have to pursue (Wang et al., 2006)

CONCLUSION

This study investigated the link between IT strategic posture and competitive advantage and IT competency, based on survey data from 105 3PL firms in mainland China. The findings are summarized as follows:

- In order to achieve higher IT advantage over competitors, top management of 3PL providers may have to formulate strong beliefs about IT innovation initiatives and actively participate in these initiatives. In addition, resource commitment for IT improvement is also imperative.

- Higher strategic IT posture may facilitate a 3PL firm to pursue differentiation as its competitive strategy.

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APPENDIX

INSTRUMENT

Company characteristics: Number of full-time employees, ownership, years of operation in China, service types, service areas.

IT Importance: Indicate the degree to which the following areas are important for your company. Scale: 1–7. 1: Totally unimportant; 2: Unimportant; …; 6: Much important; 7: Very much important

- (IMP01) Having modern information systems.
- (IMP02) Having advanced information technologies.

IT Effort: Indicate the degree to which your company commits effort, like budget, equipments, and personnel in following areas. Scale: 1–7. 1: Not at all; 2: Very little; …; 6: Much; 7: Very much

- (EFF01) Improving information systems.
- (EFF02) Improving information technologies and their application to business operations.

IT Involvement: Indicate the degree of the involvement in the following areas. Scale: 1–7. 1: Not at all; 2: Very little; …; 6: Much; 7: Very much

- (INV01) The managers at IT-related departments are involved in company-wide strategic planning.
- (INV02) The managers at other departments (operations, financial, human resource, etc.) are involved in company-wide IT strategic planning.

IT Advantage: Indicate the degree to which the company has advantage compared with major competitors in the following aspects. Scale 1–7. 1: Much worse; 2: Moderately worse; 3: Little worse; 4: Neutral; 5: Little better; 6: Moderately better; 7: Much better

- (ADV01) Modern information systems
- (ADV02) Advanced information technologies, like satellite tracking, and electronic tag.

Competitive Strategy: (STR01) Indicate which competitive strategy the company is pursuing:

- Industry-wide cost leadership: The company competes on being the lowest cost service provider. The strategic target market is the whole industry.
- Industry-wide differentiation: The company differentiates its services from its competitors' services in areas such as quality, speed, variety, etc. Cost is not the major strategic focus. The strategic target market is the whole industry
- Segment-cost leadership: The company competes on being the lowest cost service provider. The strategic target market is a narrow segment or niche of the industry.
- Segment-differentiation: The company differentiates its services from its competitors' services in areas such as quality, speed, variety, etc. The strategic target market is a narrow segment or niche of the industry