

Impacts of Information Technology on Competitive Advantages in Third-Party Logistics Firms

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ABSTRACT

In this study, we examined how the Information Technology (IT) in third-part logistic (3PL) firm influences competitive advantages. Based on survey data from 105 3PL firms in China, this study provides empirical evidence that IT can improve 3PL firm's competitive advantage. This study also examined the influence patterns of IT on competitive advantages based on spline regression modeling.

1. INTRODUCTION

Effective IT becomes necessary to support logistics processes (LaLonde and Masters, 1994; Sheombar, 1992). IT has automated many routine logistics activities, enabling managers to focus on strategic issues and core competencies. Intermediate supply chain activities, such as distribution, warehousing, and packaging, are enabled and supported by the use of IT (Lewis and Talalayevsky, 1997). A few studies have reported that IT could improve logistical efficiency, effectiveness, flexibility, cost, and service quality (Bhatnagar et al., 1999, Daugherty et al., 1995).

However, due to high cost of advanced IT and lack of expertise, the IT adoption rate of logistics users is low (Verity, 1991; Sum et al., 2001). An implication of this low IT adoption rate in logistics user firms is that there are ample opportunities for logistics providers to adopt and

exploit IT (Bhatnagar *et al.*, 1999). In fact, today more and more logistics user firms rely on 3PL firms to utilize their advanced ITs. Therefore, as a bridge of connecting logistics users and their customers in supply chain, IT in 3PL firms plays an essential role to synchronize and coordinate complex supply chain activities across logistics users and their customers.

This study examines the relationship between IT and competitive advantages in 3PL firms in China. The findings from this study can help 3PL firm's managers to understand the different influence patterns of IT on different competitive advantages. In the following sections, we review the related literature, discuss the research methodology, present the results, and discuss findings.

2. LITERATURE REVIEW

3PL will be a major feature in the future logistics landscape. The complexity that comes with expansion and growth of logistics requirements might require logistics users to outsource their logistics activities to 3PL (Sum *et al.* 2001). Logistics outsourcing has become a rapidly expanding source of competitive advantage and logistics cost savings (Rabinovich *et al.*, 1999). In 1992, *Fortune* magazine performed a study in the 500 largest USA companies; of the 26 per cent that replied, 37 per cent were subcontracting at least one major logistics activity (Lieb, 1992). Burnson (2000) also reported that many fortune 500 companies have now outsourced transportation, warehouse, and inventory management functions. Lieb *et al.* (1993) reported that some firms routinely have achieved up to 30% to 40% reductions in logistics costs and have been able to greatly streamline global logistics processes as a consequence of outsourcing.

The primary reasons for outsourcing may be summed up as a need for reduced operating cost, coupled with a simultaneous need for improved customer service (Aertsen, 1993), and concentrating more closely on core activities that are critical to competitive edge and leaving the rest to specialist firms (Bhatnagar *et al.*, 1999, Troyer and Copper, 1995). Fuller *et al.* (1993) and Sink and Langley (1997) showed that one important reason of the growth of 3PL services is that companies compete in a number of businesses that are logistically distinct due to varied customer needs. Vowles (1995) and Christopher (1993) reported another reason that the outsourcing of logistics activities to specialized 3PL can help increase the efficiency and effectiveness of a company's logistics function. Other reasons of using 3PL include 1) leveraging on technology, technical expertise, computerized systems and versatility of logistics providers (Trunick, 1989, Watson and Pitt 1989); 2) operational concerns such as cost-efficiency and flexibility (Muller, 1992; Bence, 1995); 3) reduction in capital investment in facilities, equipment, and information technology (Richardson, 1992, 1995; Lacity *et al.*, 1995); 4) improved customer service and delivery (Byrne, 1993); 5) reduction in the complexity of logistics operations (Bradley, 1995).

IT offers a great opportunity to improve logistical efficiency, effectiveness and flexibility and the future will belong to those companies that are successful in harnessing the power of IT for competitive use (Bhatnagar *et al.*, 1999). Generally the most profitable companies are those that are the heaviest users of IT. More and more companies will turn to IT (Bhatnagar *et al.*, 1999), because IT has the overall potential of providing a significant competitive advantage to firms (Sanders and Premus, 2002; Earl, 1993).

Though IT was considered a key component in future logistics systems (Dawe, 1994) and showed growth trends in logistics (Mentzer *et al.* 1992, LaLonde and Auker 1995), many managers still caution the use of IT, due to high technology cost (e.g. DRP systems, satellite communications systems), risk of organizational damage during implementation, and lack of demonstrated effectiveness (Verity, 1991; Sum *et al.* 2001). This is why currently logistics user has a low adoption rate for the more advanced IT. Other reasons for organizations' hesitancy to invest in information technology 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 *et al.* (1989) refer to logistics managers' inability or unwillingness to adopt IT despite the influence applications may have on firm success/failure as the "information gap".

Research to date has shown that IT has the overall potential of providing significant competitive advantages to firms (Earl, 1993; Ives and Jarvenpaa, 1991). However, there has been very little empirical and quantitative evidence regarding this position. Because the unique characteristics of IT in 3PL firms, the position needs also to be reexamined. The review also notes that the literature on logistics and IT is mainly from the perspective of the logistics users, but very limited investigations addressed the relationship 3PL firm's competitive advantages and IT.

3. RESEARCH METHODOLOGY

3.1. Data Collection

The methodology used in this study was mail survey. The questionnaire included questions on the demographic profile of the company and the types of services it provides. It also included questions relating to the company's competitive position relative to the primary competitor, the importance of their business and operations objectives, the major areas of emphasis for the next two years, and the major issues that will affect logistics management in the future. In all these questions, a Likert scale of 1 to 7 was used.

3.2 Reliability and validity of the constructs

To determine underlying dimensions of competitive priorities, a principal component factor analysis with oblimin rotation in SPSS 12 was used. The oblimin rotation was used since the competitive priorities are not assumed to be orthogonal, but may actually be mutually supportive of each other. To ensure that a given item represented the construct underlying each factor, a two-stage rule was used (Nunnally, 1978). First, a factor weight of 0.50 was used as the minimum cutoff. Second, if an item loaded on more than one factor, with difference between weights less than 0.10 across factors, the item would be deleted from the final scale. Next, the internal consistency of the competitive priority scales was assessed using Cronbach's alpha coefficients. Finally, the scores for each scale were determined by adding up the individual scores for the corresponding measures and then dividing by the number of measures.

Based on tests, we found competitive advantages in 3PL firms can be conceptually grouped into 1) cost advantage; 2) service variety advantage; and 3) service quality advantage. The analyses below will be based on these three new factors. Three IT items – IT Importance, IT Emphasis,

and IT Advantage have one underlying latent trait. We labeled it as IT Focus. IT Focus describes the overall IT position in the firm, including the strategic role and technological sophistication.

4. ANALYSIS AND RESULTS

Although literatures support that IT has influence on competitive advantage (Earl, 1993; Ives and Jarvenpaa, 1991), there is no support that the influence is linear. Therefore, we employed spline regression to model the influence patterns between IT Focus and competitive advantage. Using spline regression instead of traditional ordinary least squared regression is because spline regression can check if the effects of independent variables are linear or nonlinear, and it can provide more precise model estimates. The spline regression results are shown in Tables 1, 2, and 3.

Dependent Variable: <i>Cost Advantage</i>					
Factor	d.f.	Partial SS	MS	F	P
IT	4	57.6422	14.4106	1665.31	<.0001
Nonlinear	3	1.5622	0.5207	60.18	<.0001
Regression	4	57.6422	14.4106	1665.31	<.0001
Error	95	0.8221	0.0087		
Sample Size (N)=100; degree of freedom (d.f.) = 4; $R^2 = 0.6129$; Adjusted $R^2 (R_{adj}^2) = 0.5853$;					

Table 1: Spline regression for Cost Advantage

Dependent Variable: <i>Service Variety Advantage</i>					
Factor	d.f.	Partial SS	MS	F	P
IT	4	69.1168	17.2792	1557.75	<.0001
Nonlinear	3	3.7107	1.2369	111.51	<.0001
Regression	4	69.1168	17.2792	1557.75	<.0001
Error	95	1.0538	0.0111		
Sample size (N) = 100; degree of freedom (d.f.) = 4; $R^2 = 0.7357$; Adjusted $R^2 (R_{adj}^2) = 0.7244$					

Table 2: Spline regression for Service Variety Advantage

Dependent Variable = <i>Service Quality Advantage</i>					
Factor	d.f.	Partial SS	MS	F	P
IT	4	166.2053	41.5513	13083.98	<.0001
Nonlinear	3	8.6857	2.8952	911.67	<.0001
Regression	4	166.2053	41.5513	13083.98	<.0001
Error	95	0.3017	0.0032		
Sample size (N) = 100; degree of freedom (d.f.) = 4; $R^2 = 0.8127$ Adjusted $R^2 (R_{adj}^2) = 0.7981$					

Table 3: Spline regression for Service Quality Advantage

From tables 1 through 3, we can see that the impacts of IT Focus on all competitive advantages are significant (P-value < 0.0001) and nonlinear (p-value < 0.0001). The R^2 values are higher than 0.5, which are acceptable.

According to the spline regressions, we have Figure 1, which depicts the influence patterns of IT on competitive advantages. From Figure 1, we can further confirm that the influence patterns of IT Focus on competitive advantages are nonlinear.

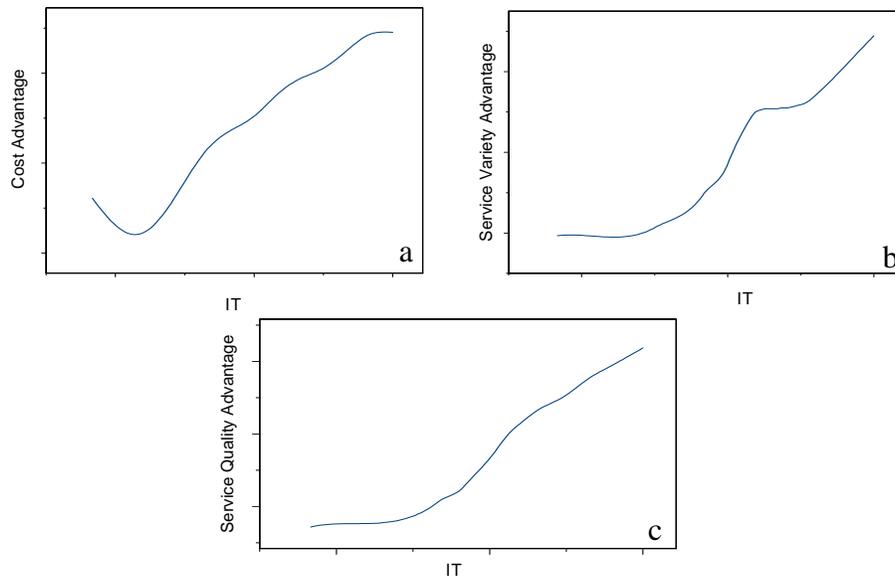


Figure 1: Influence patterns of IT Focus on competitive advantage

5. MANAGERIAL IMPLICATIONS

From the results of spline regression presented above, we can interpret how IT influences competitive advantage in 3PL firms. These managerial implications are discussed below.

5.1. Cost advantage

Two items --low service cost and low service charge are used to measure cost advantage. The influence pattern of IT Focus on cost advantage is shown in Figure 1-a. From Figure 1-a, we can find that there is a Turning Threshold Point (TTP) in the relationship between IT Focus and cost advantage. When IT Focus level is lower than TTP, higher IT Focus level may deteriorate cost advantage. In contrast, when IT Focus level is higher than TTP, higher IT Focus may achieve better cost advantage.

This phenomenal is reasonable because the cost of deploying IT in 3PL is very high. If the firm cannot achieve higher IT level than its competitor (before TTP), the 3PL firms cannot attract more customers via better service quality from IT advantage. Therefore the overhead of high IT investment will be high, and the investment of IT will boost the firm's cost and price

correspondingly. This finding can explain the observation that there is a low adoption rate for the more advanced IT such as AS/RS, DRP, voice input interfaces, and satellite and fiber optics communications technology (Bhatnagar *et al* 1999). However, generally the most profitable companies are those that are the heaviest users of IT (beyond TTP). Therefore companies that have not explored seriously the strategic role of advanced IT should do quickly and integrate all advanced IT, but should not invest to low-level IT, or isolate various advanced IT. Low-level IT and isolated advanced IT cannot help 3PL firms to gain cost reduction, even deteriorate the cost. When the firm adopts advanced IT, and the IT adoption is beyond TTP, IT Focus can affect the production/service cost advantage of markets by changing production economics, such as economies of scale. IT can affect the transaction cost advantage of markets through an impact on transaction costs (Bakos and Treacy 1986). This why the cost advantage increase when IT level is beyond the TTP.

5.2. Service variety advantage

Service variety advantage can be described as the ability to provide ample services and meet particular service requirements from customers. Service variety advantage can be viewed as the capacity of service innovation and service customization.

Figure 1-b shows that the change of the service variety advantage is very flat when IT Focus is at low level, and then the service variety advantage begins to increase very sharply along IT Focus increases. However, there is a “plateau” which flattens the increasing trend of service advantage. After the plateau, the service variety advantage increases sharply again.

5.3. Service quality advantage

The service quality advantage is described as the capacity of fast and reliable delivery, order accuracy, and response to customer inquiry, complaint, and claim.

From Figure 1-c, we can see that the service quality advantage shares the same increasing pattern as service variety advantage, except that there is no plateau in the increasing trend. It is not surprising that IT Focus can improve service quality, with a large amount of literature support (Bradley *et al.* 1993, Cash *et al.* 1992, Krishnan *et al.* 1999, and Furey 1991).

However, from Figure 1-c, we can see that the higher IT Focus level cannot improve service quality when IT is at low level. The flatness when IT Focus is at low level can be explained by degree of IT complexity and integration. When IT is at low level, only simple ITs are used in the firm, such as e-mail, web presence, bar code, etc. These simple ITs cannot give firms any advantages, just make firms stay in the business, because all of these simple ITs are “strategic necessity”.

6. DISCUSSION AND CONCLUSIONS

In this study, we examined the relations between IT Focus and competitive advantages in third-party logistic firms in China. Through application of spline regressions, we found that the IT

Focus significantly influences 3PL firm's competitive advantages, and these influences are nonlinear. The influence patterns are summarized below.

- (1) Higher level of IT Focus can lead to higher cost advantage when IT Focus is not at low level. When IT Focus is at low level, higher level IT Focus can deteriorate cost advantage.
- (2) The improvement of service variety is slight when IT Focus is at low level. Customized services and more services types can be offered as advanced and distinctive ITs are deployed in the firm. However, the effect of IT Focus has a "plateau" region in which the service variety advantage does not change as much as the level of IT Focus increases. In "plateau" region, the firm is in learning stage, in which the firm integrates its internal technologies and coordinates its partners. Once ITs are integrated and partners are coordinated in the learning stage, the firm goes beyond the "plateau" region, and a new wave of higher advantage will be achieved with higher IT level.
- (3) IT Focus can also help to improve delivery speed and reliability, customer relations, and order accuracy. However the effect of IT Focus on improvement of service quality is much higher when IT Focus is at high level. When IT Focus is at low level, the effect is slight.

This study adds to our knowledge of relationship between IT Focus and competitive advantage in third-party logistic firms. The findings in this study are based on data from China, which may not necessarily hold in other countries. Although this study is exploratory in nature, country studies provide illuminating information that can prove helpful prior to any IT investment in third-party logistic firm. In order to further understand the relationship between IT Focus and competitive advantages in different cultural environment, more cross-cultural studies are needed. This study does not consider IT strategy which may moderate the relationship between Information technology itself and competitive advantage.

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