

Resource-based View of the Inter-organizational Information System Capability: A Field Study in Taiwan PC Industry

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Abstract

Facing today's highly competitive market and changed business environment, whether the company has the capability to implement successful inter-organizational information systems (IOS) becomes a significant issue. To fulfill this need, this research aims to develop a framework for measuring the IOS capability. Founded by the resource-based theory and company interviews, we proposed four IOS resources: (1) physical IT assets, (2) path dependency, (3) relational intangibles (trust and complementary resources), and (4) market power, and argue that firms with these IOS resources can have higher IOS usage, which in turn creates greater IOS performance. A general survey is then conducted in Taiwan PC industry to validate our proposed framework. The results indicate that physical IT assets and relational-specific intangibles are positively related with IOS usage. On the other hand, path dependency and market power do not have significant impact on IOS usage. We further explore the relationships between the IOS usage and firm performance. The result indicates firms with more IOS usage are more likely to achieve better firm performance. These results can further be examined in a more industry-wide survey in the future. The researchers can also build upon this model to further examine the factors that are discovered.

Keyword: Inter-organizational information systems, Resource-based theory, IT capability, IT-enabled supply chains, Business value of IT

1. INTRODUCTION

Confronting today's highly competitive global market, increasing customer power, and changing needs lead to a demand of more efficient supply chain management (SCM). Firms must link their internal activities, such as sales forecasting, product design, inventory management, together with their outside business partners, so all the parties in the supply chain can facilitate their processes, collaborate with each other, and reduce transaction costs, etc. However, to effectively integrate with supply chain partners is not an easy task. Firms need to develop a wide range of IT capabilities, such as speed, accessibility, and visibility, to acquire information among several organizations. These capabilities always center around a successful implementation of interorganizational information systems (IOS), which provide a framework for electronic cooperation between businesses by allowing the processing, sharing and communication of information (Haiwook, 2001; Williamson et al., 2004).

According to Grant (1991), a capability is the capacity for a team of resources to perform some task or activity. Based on that, we define IOS capability as a capacity for a team of resources which organizations own to develop a successful IOS. Many scholars used the resource-based view (RBV) to measure the IT capability and set up a clear link between IT resources and sustained competitive advantage (SCA) (Bharadwaj 2000; Santhanam and Hartono 2003). For instance, Bharadwaj (2000) used RBV to define a firm's IT capability as categories of IT infrastructure, human IT resources, and IT-enabled resources, presenting the linkage between firm's IT capability and financial performance. These scholars treated IT as an internal resource of the firm, and thus their defined IT capability focused only on IT resources within firms. However, an IOS not only interrelates the internal IT or IS resource, but also involves with multiple external resources and varying environment. Therefore, traditional RBV is not sufficient to derive IOS capability.

Some more current resource-based theory studies find that, facing the increasing complex and dynamic environment, the successful market players have rapid and flexible capabilities to respond the changing business environment. They define the ability to achieve new forms of competitive advantage as "dynamic capabilities" (Teece et al. 1997). Besides the dynamic resource-based view, some scholars extended the RBV to relational view while arguing that a firm's critical resources may extend beyond firm boundaries, and the benefits often link to the relational network that the firm is embedded (Dyer and Singh 1998).

Derived from the relational and dynamic RBV mentioned above, IOS capability should involve the maintenance of specific IOS to link with trading partners, so as to reduce transaction and negotiation costs, improve relationships with customers, keep a long-term contracts and stable transaction volumes and so on. In comparison with IT capability, IOS capability need to consider more aspects from internal to external factors. As past IS/IT capability studies using the RBV have not typically looked at dynamic and relational resources (Wade and Hulland 2004), we think they only capture firms' internal IT capability. Therefore, our purpose of this study is to apply different views of RBV, especially the relational and dynamic view, to develop a framework that fully captures the components that form the firm's IOS capability.

This research investigates the IOS capability that today's corporations have to obtain for better IOS usage and performance. The questions addressed can be summarized as follows:

1. What are the important IOS resources that firms need to obtain to improve their IOS performance?
2. How could we measure these IOS resources?

Through answering these questions, the study seeks to better explain:

1. The IOS capability framework from different views of RBV, especially including the dynamic and relation view.
2. The key resources that can lead to significant IOS usage and better IOS performance, so that managers can decide which specific constructs of IOS resources should be taken into more consideration in order to improve their current IOS or to built a better future IOS.

2. LITERATURE REVIEW

In this study, we will use the resource-based view to propose a measurement system for evaluating a firm's IOS capability and to examine its association with firm performance. Before describing our proposed model, we introduce the basic concepts of resource-based view as follows.

2.1 The Resource-based Theory

First of all, we focus our attention on the initial RBV in the traditional strategic management field. The initial resource-based theory argued that competitive advantages of a firm resulted from specific resources and capabilities possessed by the firm (Learned et al. 1969; Porter 1981; Barney 1991; Grant 1991). Some researchers viewed capabilities as one of significant firm resources, and others distinguished the capabilities from the resources by arguing that resources were the source of the capabilities, and a capability was the capacity for a team of resources to perform some task or activity (Grant 1991). But all agreed that a firm could appraise its potential of competitive advantages by means of identifying its internal resources and capabilities and selecting a suitable strategy to reduce resource gaps (Grant 1991).

However, identifying and appraising resources and capabilities is a major handicap. One useful way is to classify them by looking for those attributes which have potential of competitive advantages. Overall, Barney (1991) and Grant (1991) classified resources as six categories: financial, physicals, human, technological resources, reputation, and organizational resources.

What we mentioned above concentrates on tangible resources. Hall (1992, 1993) argued intangible resources such as reputation should also play an important role in strategic management process, and therefore he extended the initial RBV model to identify the intangible resources which are the feedstock to the capability differential. He classified intangible resources as assets such as patents, copyright, contracts, trade secrets, etc., or as skills/competencies such as know-how of employees, suppliers, and distributors; and culture.

2.2 The Dynamic View of Resource-based Theory

Some researchers found that the successful market players do have some capabilities that enable them to face complicated and changing environment, such as the capability of timely responsiveness, rapid and flexible product innovation, and the management capability to effectively coordinate and redeploy internal and external competences (Teece et al. 1997). In order to capture these capabilities, researchers extended the traditional RBV, that mostly focused on dealing with internal resources, to define a new set of capabilities, 'dynamic capabilities.' The focal point of dynamic capabilities is to hold the timing and then to adapt, integrate, and reconfigure internal and external resources and competences to respond the rapid technological change and changing business environment.

2.3 The Relational View of Resource-based Theory

The resource-based view (RBV) of the firm argues that differential firm performance is fundamentally due to firm heterogeneity rather than industry structure, and focus on those resources that are housed within the firm. In fact, the advantages and disadvantages of the firm often link to relationship of industry network in which the firm is embedded. So, a firm's critical

resources and capabilities may extend beyond the organization boundaries, or even extend to the interfirm routines and processes (Dyer and Singh 1998).

The ownership of rent-generating resources mentioned above is collective with outside trading partners, contrasting with the RBV focusing on how individual firms generate benefits from resources within firms, and the dynamic view emphasizing on the capabilities to reconfigure resources to response environment. We must appraise relational resources and capabilities as important sources of the competitive advantages of the firm embedded in industry.

3. DEVELOPMENT OF THE IOS CAPABILITY FRAMEWORK

3.1 Research Framework

The past literature summarizes the key resources and capabilities that help firms gain sustained competitive advantages. Combined the RBV with the dynamic and relational view, we summarize twelve resources to form the IOS capability and link it to IOS usages and performance: (1)physical IT assets, (2)financial assets, (3)inter-relation specificity assets, (4)integration, (5)learning, (6)path dependency, (7)contracts, (8)interfirm knowledge sharing, (9)complementary resources, (10)policy, (11)market power, and (12) people skills. The first three address company's tangible IOS resources, the following eight are related with the intangible IOS resources, and the last one are dependent on people skills.

Three criteria have adopted to filter our variables. First, we remove the factors for which data is hard to acquire. Financial investment on IOS is thus dropped as the interviewing firms expressed the difficulty to isolate this information from the overall IT budget. Among the tangible resources, we chose physical assets as our testing variables since our pilot firms all agreed it is the most important tangible resource for IOS development and it can represent general condition on tangible resources.

Second, some variables that do not apply Taiwan PC industry are eliminated. Therefore, the reciprocal investment is dropped because component suppliers in Taiwan PC industry don't have the chance doing that because almost all of them are small and medium sized enterprises (SMEs). We also exclude IOS integration because system integration has been well recognized and justified as an important factor for IOS implementation in those companies. Interfirm knowledge sharing is removed due to a very little practices have done in our sampling pool, although the pilot firms agree that they are a significant driver of IOS usage. Policy is dropped as well, because the data may lack variety in view that our sampling is in the same region which applies the same policy. The pilot firms also indicated that all of suppliers had training courses about using IOS and could use IOS to handle routine work in a short period time. It reveals that the human IT skill differentials are also small in these suppliers. For this reason, we exclude the people-based skills from our model.

The third reason is about questionnaire scope. Learning capabilities include various issues about knowledge management cycle. We decide to test it latter as a future extension. We chose path dependency as our testing variable considering its novelty and conceptual simplicity.

Finally, we propose a simplified research framework that includes four resources to form the IOS capability and link it to IOS usages and performance (Figure 1): (1)physical IT assets, (2)path dependency, (3)relational intangibles, and (4)market power.

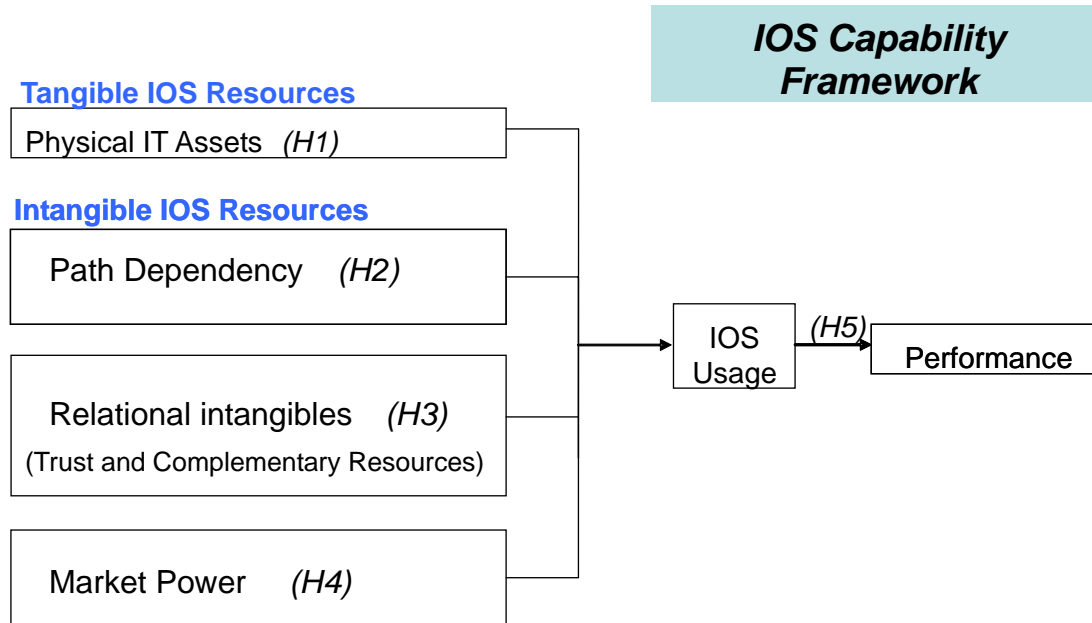


Figure 1. Research Framework

3.2 Hypothesis

3.2.1 Tangible IOS Resources

Physical resources like IT infrastructure are the basic resources of the IOS capability. Many IOS studies argue that firms with more flexible IT infrastructure are more able to develop successful IOS. For instance, Ramamurthy and Premkumar (1995) referred that IS sophistication would be positively related to EDI's internal and external diffusion, and it included hardware and software resources to support IOS systems. Recently, Zhu and Kraemer (2005) had asserted technology competence such as technology resource and IS capability as sources of e-business usage and value. Hence, we have the following hypothesis:

Hypothesis 1. Firms with more physical assets related to IOS technology are more likely to achieve a greater IOS usage.

3.2.2 Intangible IOS Resources

Three intangible IOS resources are discussed here: path dependence, relation-specific intangibles, and market power.

Path dependence. A firm's ability and incentive to adopt newer technology are largely a function of its level of related experience with period technologies (Cohen and Levinthal 1990, Zhu et al. 2006). Previous studies have found that firms with EDI experience can foster the skills

for next generation IOS implementation and develop a better understanding about the economic and organizational impacts of IOS (Lyytinen and Robey 1999, Zhu et al. 2006). These firms may have a lower adoption costs because they tend to have a better understanding of true costs, and they know the difficult of process change while implementing. So we suppose path dependency about IOS technologies leads to successful IOS implementation. The following hypothesis is set forth:

Hypothesis 2. Firms with previous IOS experience are more likely to achieve a greater IOS usage.

Relation-specific intangibles. Two intangibles are discussed here: trust and complementary resources. A contract is a concrete form to create trust and cooperation relationship between IOS partners. Based on Dwyer, Schurr, and Oh (1987), trust is defined as “the belief that a party’s word or promise is reliable and the party will fulfill his/her obligations in an exchange relationship”. Therefore, trust is an important concept in understanding expectations for cooperation and planning in a relational contract. According to Hart and Saunders (1998), trust is an important factor of EDI use because it can mitigate the uncertainty related to these vulnerabilities coming from the increase in the volume of exchanges and diversity of transaction sets for an EDI partner. Besides trust, previous research also recognized the significance of the complementarity of technology. Dyer and Singh (1998) defined complementary resource endowments as distinctive resources of alliance partners that collectively generate greater rents than the sum of those obtained from the individual endowments of each partner. Similarly, Bensaou (1997) argued that compatibility in goals and technological capabilities reduce the uncertainty about the partner’s inclination and potential intentions for opportunistic behavior and therefore invite cooperation. Over and above, firms are looking for complementary partners continuously and then developing and implementing IOS with these partners because firms expect to generate more IOS usage, which cannot be generated by either firm in isolation. Eventually, Tan and Raman (2002) argued that strong complementarity, which is meant to both the firm and the partner have adequate IT sophistication and financial resources to jointly undertake the IOS implementation, has positive impact on IOS adoption. So, the following hypothesis is set forth:

Hypothesis 3. Firms with greater relational intangibles with trading partners are more likely to achieve a greater IOS usage.

Market power. Market power is another important environmental factor to impact the IOS usage. According to Hart and Saunders (1998), relative dependence in a dyadic relationship between customer and supplier is a determinant of power. Power affects EDI use because the transaction or procedures for handling data exchanges frequently required investments that an EDI partners may not want to make (Hart and Saunders 1998), and thus some large customer firms with dominant market share have often exerted their bargaining power to influence the IOS-related decision in initial stage (Son et al. 2005). Prior studies showed that power exercised by large trading partners has a positive effect on initial adoption (Chwelos et al. 2001, Iacovou 1995, Son et al. 2005) and usage (Ramamurthy et al. 1999, Son et al. 2005) of EDI in organizations. Consequently, our hypothesis here is:

Hypothesis 4. Firms with greater market power between IOS trading partners are more likely to achieve a greater IOS usage.

3.2.3 IOS Usage and Firm Performance

It has long been recognized that the high level of IOS usage can contribute the supply chain performance. For example, Bensaou and Venkatraman (1995) proposed that the greater the multiplicity of channels and the frequency of information exchanges, the greater the information processing capabilities of the dyad. Similarly, Riggins and Mukhopadhyay (1994) suggested that the great volume of business communications for which the firm uses EDI and the high degree to which the firm becomes immersed in EDI of doing business as the efficient ways to maintain partner relationship. Recently, Subramani (2004) argued that higher supply chain management systems (IOS) use leads to competitive performance of suppliers. The hypothesis is as follows:

Hypothesis 5. Firms with more IOS usage are more likely to achieve better firm performance.

The operationalization of the dependent and independent variables is shown in Table 1:

Table 1. Item Measures for IOS Capability

Independent Variables		
Items		Measures of Tangible IOS Resources (TR)
Physical Assets	TR1	Degree of technology investment in IOS (Riggins and Mukhopadhyay 1994)
	TR2	Establishment of IT infrastructure (Bensaou and Venkatraman 1995, Iskandar, Kurokawa, and LeBlanc 2001)
	TR3	Establishment of applications to support tasks (Bensaou and Venkatraman 1995)
Items		Measures of organization specific intangibles (OI)
Path Dependency	OI8	Prior use of EDI (Zhu et al. 2006)
Items		Measures of relational specific intangibles (RI)
Trust	RI1	Existed undergoing supply chain collaboration projects (Bensaou 1997)
	RI2	Establishment of clear norms for business behavior (Bensaou 1997, Dyer and Sigh 1998)
	RI3	Sharing confidential or proprietary information (Angeles and Nath 2000, Dyer and Singh 1998, Soliman and Janz 2003)
	RI4	Open and frequent communications (Angeles and Nath 2000)
Complementary Resources	RI7	Similar IT infrastructure (Konsynski and McFarlan 1999, Kumar and van Dissel 1996)

(CR)	RI8	Compatible company culture (Dyer and Singh 1998)
	RI9	Similar decision processes to handle transactions (Kumar and van Dissel 1996)
	RI10	Providing similar support of cooperative firms by top management (Angeles and Nath 2000, Bensaou 1997)
Items		Measures of industry specific intangibles (II)
Market power	II3	To what extent did the target customer influence EDI adoption (Hart and Saunders 1998)
	II4	The force behind company's EDI adoption (Hart and Saunders 1998)
Dependent Variables		
Items		Measures of IOS Usage (IU)
IOS usage	IU1	Percentages of transaction by IOS links (Bensaou and Venkatraman 1995, Riggins and Mukhopadhyay 1994)
Items		Measures of Firm Performance (FP)
Firm performance	FP1	Strategic benefits (Subramani 2004)
	FP2	Operational benefits (Subramani 2004)

4. RESEARCH METHODOLOGY

In preparation for large-scale data collection, the resulting questionnaire was pilot-tested by six executives that are directly responsible of IOS to handle routine work with a focal Taiwan PC OEM during winter 2005. These executives come from the companies that are the upstream trading partners of the OEM. Our resulting questionnaire had been pilot-tested by these executives, and the MIS manager of the OEM reviewed our questionnaire for the final refining. After pilot test, we conducted a general survey in Taiwan PC industry to validate our proposed framework. Data were collected using a questionnaire instrument. We coordinated with six Taiwan PC firms, three of which have participated in our pilot-test. For each firm, a purchasing and/or engineering senior manager at the central division was first asked to select a set of suppliers under his or her responsibility. Then for each of the selected suppliers these senior managers helped identify the purchasing agent and/or engineer to whom we could send the questionnaire. The respondents were asked to answer the questions on a seven point Liker scale. The total data set constitutes a representative sample of $n = 557$. Among all returned questionnaires, 87 were found to be complete and usable; this represented a response rate of 15.619 percent.

A multi-trait/multi-method (MTMM) is used for convergent and discriminant validity of the model (Campbell and Fiske 1959, Mahmood and Soon 1991). The results of convergent and discriminant validity provide sufficient confidence to consider these items as valid measures of the constructs. After convergent and discriminant validity, the reliability of the constructs was assessed using Cronbach's alpha. The results indicate that all the constructs have reasonably good alpha values and therefore can be considered to exhibit sufficient reliability. In summary,

the framework with an overall reliability of 0.825 represents good instrument validity.

5. RESULTS and DISSUCTION

5.1 Results

Multiple linear regression was used for testing the hypotheses. First, we test the impact of various capabilities on IOS usage. The results of the regression analysis are shown in Table 2. The F distribution is used to test the null hypothesis that there is no relationship between the dependent variable and predictors, and the model is significant at $p < 0.001$.

The results indicate that two factors — physical assets and relational intangibles — significantly lead to better IOS usage in organizations (p value is 0.018 and 0.024 respectively), and their standardized coefficients are 0.304 and 0.302, thereby supporting hypothesis 1 and 3. On the other hand, the significant value of path dependency and market power is 0.788 and 0.713 respectively, thereby leading to the rejection of hypothesis 2 and 4.

Table 2. Model Summary and Coefficients: The Impact of Various Capabilities on IOS Usage

Model Summary	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.483(a)	.233	.195	2.03232	.233	6.224	4	82	.000
Coefficients (b)									
Model	Unstandardized Coefficients		Standardized Coefficients		T	Sig.			
	B	Std. Error	Beta						
(常數)	-.977	1.195			-.818	.416			
Physical Assets	.554	.229	.304		2.419	.018			
Path Dependency	-.055	.205	-.037		-.270	.788			
Relational Intangibles	.622	.271	.302		2.294	.024			
Market Power	-.069	.188	-.041		-.369	.713			

a Predictors: (Constant), Market Power, Physical Assets, Relational Intangibles, Path Dependency

b Dependent Variable: IOS Usage

Second, we examine the relationship between IOS usage and IOS performance, and the result is shown in Table 3. The F test shows the model is significant at $p < 0.001$. The results also indicate that IOS usage significantly leads to better firm performance (the p value is less than 0.001), thereby supporting hypotheses 5.

Table 3. Model Summary and Coefficients: The Impact of IOS Usage on Performance

Model Summary	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.376(a)	.142	.131	1.147	.142	13.869	1	84	.000
Coefficients (b)									
Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.			
	B	Std. Error	Beta						
(常數)	4.240	.278			15.278	.000			
IOS Usage	.206	.055	.376		3.724	.000			

a Predictors: (Constant), IOS Usage

b Dependent Variable: Performance

5.2 Summary of Findings

Several findings are derived from the results and discussed below.

Finding 1

Path dependency didn't have a significant impact on IOS usage. Company's high IT staff turnover might be an intervening factor.

Path dependency was not significant in our regression model. It means that prior experience of IOS implementation is not an IOS usage differentiator for both suppliers and original equipment manufacturers (OEMs) in Taiwan PC industry. The possible reason is that, although most respondents consider previous experience in developing IOS can help implement other IOS in the future, there are still 40% of surveying companies had low level of successful experience (lower than 4 point of 7 scales). Most of them are small suppliers who don't have real implementation experience to help more advanced IOS implementation. Also, we find that the turnover of IT staff is high from the information of our interview pool. It means that important IOS experience maybe lost accompanied with fast employee turnover. However, the result may have bias. Because this survey doesn't distinguish failure implementation experience from no experience, but failure experience may improve IOS usage as well.

Finding 2

The impact of market power is significant at IOS adoption stage, but not at IOS post-adoption stage.

Market power is not significant in our regression model. The possible reason is that most of the suppliers in Taiwan PC industry are small and medium-sized enterprises (SMEs), and their trading and negotiation power are small contrasted with focal companies. The result shows that over 60% of our respondents considered their decision to implement IOS was impacted by the trading partners (over 5 point of 7 scales). Another test also shows that most of the companies rely heavily on their own key trading partners. Besides, although most literature mentioned that

market power impacts IOS adoption at initial implementation stage, our result shows its impact is not so significant at IOS post-implementation stage. It means the influence of market power maybe decreased with the system development time. Focal companies can force the suppliers to adopt the IOS, but cannot exercise the same power to coerce the following usage. This finding is consistent with the industry observation that a buyer-biased IOS often has a high adoption rate initially, but fails with a low usage rate.

Finding 3

A well development of physical IT assets leads to better IOS usage.

Our study confirms the resource-based view that IT assets play a significant role in IOS usage. Firms that have developed better IT assets in terms of IT infrastructure, IT investment, and IT applications are more able to conduct transactions via IOS.

Finding 4

With mutual trust and complementary resources, firms are more able to have high IOS usage.

Besides physical IT assets, relational intangibles are important IOS resources as well. Our study shows that companies are more willing to use more IOS with their trading partners if there is an open and frequent communication channel in which confidential information can be stably shared. The result also points out, similar IT infrastructure in terms of the IT availability, maturity, compatibility, and reliability, compatible company culture (e.g., business mission or value), and similar decision processes to handle transactions (e.g. having similar procedures to handle order change) would support the IOS usage.

6: CONCLUSION

This thesis seeks to uncover the critical company-owning resources that can contribute to the IOS implementation and firm performance. Founded by resource-based theory, we propose four IOS resources that are most related with Taiwan PC industry environment: (1) physical assets, (2) path dependency, (3) relational intangibles, and (4) market power. To further test the model, we conduct a general survey with main Taiwanese PC firms during spring 2006. After checking the validity and reliability, we empirically validate the relationship between the IOS capabilities, IOS usage, and firm performance by a regression analysis. The result shows that path dependency and market power didn't appear an effective impact on IOS usage, but IT infrastructure and relational specific intangibles are significant resources which can positively affect IOS usage. Therefore, we can conclude that a successful inter-organizational electronic collaboration needs long-term relationship, mutual trust and resemblance between firm's process, and supportive IT assets indeed.

The factors of IOS capability and the measurement instrument developed in this study through RBV framework provide a good starting point for further investigations of the IOS capability. Validated IOS capability measures can help managers better gauge the characteristics of the collaborations. IT researchers can build upon the model developed in this study through further examination of the factors that are discovered. The survey data utilized in this study are

collected from firms in the Taiwan PC industry; further research can be conducted by the cross-industry or cross-country survey in the future to verify these results.

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