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從供應鏈動態能力觀點探討跨組織資訊系統與企業競爭優勢之關連性

Investigating the Relationship between Inter-Organizational Systems Investment and Corporate Competitive Advantage: The Role of Supply Chain Dynamic Capability

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摘要

雖然跨組織資訊系統投資一向在企業策略中被視為創造競爭優勢的利器，但許多企業在建置採用後發現這些跨組織資訊系統並沒有帶來預期的績效。當其他的競爭者也採用相同的跨組織資訊系統時，企業頂多能維持競爭力，而無競爭優勢可言。本研究提出『供應鏈動態能力』概念，並強調跨組織資訊系統必須要結合供應鏈動態能力才能創造組織的競爭優勢。根據流程理論及動態能力觀點，本研究提出兩項供應鏈動態能力，分別為供應鏈整合能力及供應鏈合作能力。本研究並以台灣個人電腦產業之 145 家公司為施測對象，經由線性迴歸分析發現供應鏈動態能力在跨組織資訊系統及組織競爭能力關係上扮演重要的中介角色。此外，本文也發現與供應鏈整合能力相較，供應鏈合作能力具較強之中介效果。

【關鍵字】跨組織資訊系統、供應鏈動態能力、競爭優勢

Abstract

Many companies have developed strategies that include investing heavily in inter-organizational systems (IOS) in order to facilitate information sharing and sustain competitive advantage. These systems, treated as competitive weapons, are expected to provide great business value; however, many of them do not fulfill the expected promises. This study proposes that IOS can be a source of competitive advantage only when combined with supply chain dynamic capabilities (SDC). Built upon the process theory and the view of dynamic capabilities, the author defines two types of SDC－supply chain integration capability and supply chain coordination capability. Conducting linear regression analysis on data collected from managers in 145 companies in the personal computer (PC) industry in Taiwan, the author shows that SDC play a significant role in mediating the effects of IOS investments on the company's competitive advantage. Furthermore, supply chain coordination capability has a greater mediating effect than supply chain integration capability on the relationship between IOS investment and competitive advantage. Thus, these findings confirm the influence of SDC on IOS investment and show which SDC is of primary importance to create competitive advantage for companies.

【Keywords】inter-organizational systems, supply chain dynamic capability, competitive advantage

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1. Introduction

Inter-Organizational Systems (IOS) have been mentioned for its possible role in creating competitive advantage for companies. They are the systems that allow the flow of information automated between organizations in order to facilitate collaboration with suppliers and trading partners (Zhu, Karemer, & Gurbaxani, 2006). Compared with the traditional communication mediums such as phones or faxes, IOS not only cut down on the working hours, but also eliminate manual errors that occur in writing by hand. For example, when Compal Electronics Inc., a leading PC manufacturing OEM in Taiwan, adopted its procurement system, the system has greatly reduced procurement time to 18 minutes per order, improved stock levels from 36 days to 20 days, and reduced the manual errors by 66% on an average each month. The ability to effectively manage the order information helps Compal more responsive to changes in the environment and can result in competitive advantage over slower, ill-informed competitors.

It is therefore not surprising that many companies have determined to spend more on IOS in order to gain competitive advantage. However, it remains unclear how IOS can lead to such advantage. Many IOS investors still find that their spending far outpaces the perceived benefits. A variety of studies on information technology (IT) and competitive advantage have attempted to answer this question. For example, the process theorists have argued that the improved performance of companies due to investments in IT can be achieved only if companies successfully change their processes (Sol & Markus, 1995). They concur that appropriate use is equally important for a well-designed IT, and that in order to play an optimum role, IT should be a good fit for a company's tasks.

While appropriate use and task fit have been widely discussed in studies of IT investment, researchers notice that IT investment alone cannot make companies more effective, unless, they are accompanied by complementary organizational capabilities (Teece, Pisano, & Shuen, 1997; Eisenhardt & Martin, 2000). For instance, to maintain competitiveness, companies require the capability to integrate their IT, learn best practices, and transform the old systems to new ones. Resource-based theorists term these capabilities as dynamic capabilities-a firm's ability to use its internal and external resources to adjust to rapidly-changing environments (Teece et al., 1997).

This approach, however, focuses only on a company's internal capabilities without considering the capabilities that extend beyond its boundaries. Therefore, the objective of this study is to understand dynamic capabilities at supply chain levels. The concept of supply chain dynamic capabilities (SDC) will be defined and how SDC complement IOS to ensure the greatest positive effect on a company's competitive advantage will be explored. This research will further discuss which SDC is most effective in determining the IOS outcome. In the following sections, there will be discussions on the impact of IT investments on a company's competitive advantage. An overview of the process view and dynamic capabilities that form the theoretical basis of this study will also be provided. A research framework highlighting the concept of SDC will then be developed. Following this, hypotheses on the relationships between IOS investment, SDC, and competitive advantage, will be built. The hypotheses will be tested with linear regression models, using data collected from managers in 145 firms in the Taiwan PC industry. A discussion on the results and their implications will conclude this study.

2. Conceptual Background

The body of research that examines the relationship between IT investment and corporate competitive advantage can be summarized into three groups (Figure 1).

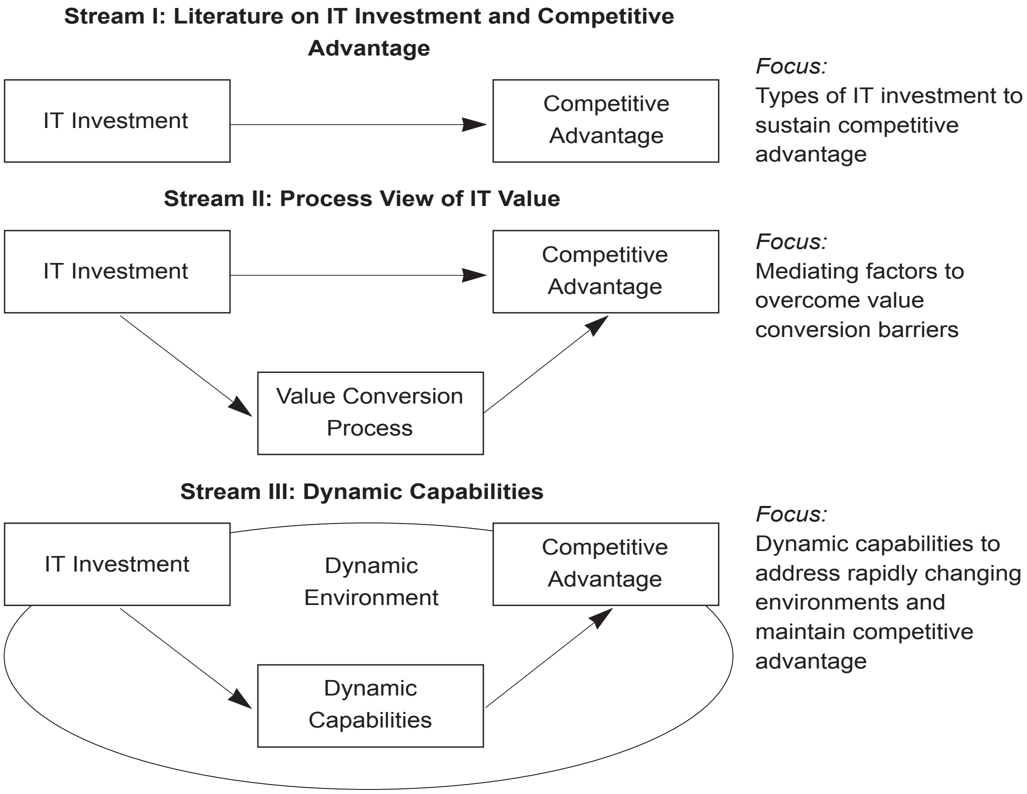

Figure 1 Past literature on IT investment and competitive advantage

The first group focuses on an aggregate level of analysis, in which IT investment is directly related to outcome variables at the firm level. The major discussion is centered upon which type of IT investment can deliver the greatest value. The second group comprises the work attempting to gauge the intermediating variables between IT investment and competitive advantage and puts emphasis on the process of transforming IT investments to business values, the so-called "value conversion process." The third group puts the interests on external factors that may mitigate the business outcome, specifically with regard to exploiting IT capability to deal with competitive dynamics. Each research stream will be discussed in detail in the following sections respectively. Finally, a new concept "supply chain dynamic capability" will be developed and combined with the three research streams to propose the research model.

2.1 IT Investment and Competitive Advantage

Typically, IT is viewed as a critical resource to help companies implement a strategic initiative, such as cost leadership, product differentiation, strategic alliance, and vertical integration (Barney, 1996). According to the resource-based view, IT can be a source of competitive advantage if competitors who do not have the same or substitute IT find it costly and difficult to replicate the strategy (Piccoli & Ives, 2005). An exemplary case is that of the Taiwan Semiconductor Manufacturing Firm (TSMC), the world's largest semiconductor foundry. At the heart of TSMC is its superior supply chain. To foster its agility, TSMC developed a collaborative design strategy so that companies can work together to design or redesign processes, components, and products as well as to prepare backup plans. For this initiative, TSMC shared its proprietary systems, data, and models with its supply chain partners. Competitors with no access to this IT-enabled initiative faced substantial obstacles to replication.

Past literature has argument concerning what type of IT investment can sustain competitive advantage. For example, Mata, Fuerst, and Barney (1995) use the resource-based view to examine four types of IT investment — capital requirements, proprietary technology, technical IT skills, and managerial IT skills — which might be sources of sustained competitive advantage. Their research shows that the managerial IT skill is the only one type of investment that can provide sustainability. Drawing from literature streams in marketing, strategy, and information technology, Tippins and Sohi (2003) propose three types of IT investment that can create market leadership: IT operations (specializing in market and customer information management), IT objects (representing computer-based hardware, software, and support personnel), and the knowledge about IT objects. Bharadwaj (2000) argues that companies with great investments in IT infrastructure, human IT resources, and IT intangibles (e.g., IT knowledge) tend to outperform those with a low IT investment. Piccoli and Ives (2005) posit that a company's investment in IT assets, IT skills, and social links between IT and business can ensure the process of competitive imitation is slow, difficult, and costly, thereby sustaining the competitive advantage.

While there is a widely-held belief that IT is a fundamental source of competitive advantage (Bharadwaj, 2000), some researchers find that investing IT by itself , is ineffective at providing a basis for sustainable competitive advantage, because such investment is too easily duplicated (Tippins & Sohi, 2003). Furthermore, the advantages gained from investing a specific form of IT tend to be short lived, since new IT tools are constantly being developed (Sol & Markus, 1995). These researchers have tended to conceptualize IT as a useful tool that may facilitate competitive advantage only when it affects the specific organizational processes that contribute to improved firm performance (Markus & Soh, 1993; Beath, Goodhue, & Ross, 1994; Barua, Kriebel, & Mukhopadhyay, 1995; Lee, Clark, & Tam, 1999). Research therefore focuses on the value conversion between IT investment and superior firm performance. The findings of their research are summarized in the following section.

2.2 Process View of IT Value

Markus and Soh (1993) have made the earliest attempts to study the barriers to IT value conversion. They find that IT expenditure cannot directly lead to a company's competitive advantage because IT inputs can go waste due to the poor internal IT management. They add IT assets as an intermediate outcome between IT expenditure and firm performance to explain the appropriate use of IT and posit that firm performance is affected by IT assets and other variables. This work is further extended by Beath et al. (1994). They have proposed the concept of "leveraging Information Systems (IS) processes." They argue that IT assets, in terms of human, relationship, and technology, deliver business values because they affect three critical business processes: cycle time of development, productivity of operations, and strategic alignment of planning.

Grounded by the process view indicated above, Barua et al. (1995) have proposed a two-stage valuation model, and demonstrate that IT investment can get converted to critical firm-level performance only if it can bring lower level process improvements first such as capacity utilization, inventory turnover, relatively inferior quality, relative prices, and new products. The idea is applied by Lee et al. (1999) to evaluate the performance of warehouses as a result of adopting the EDI system. This research argues that the EDI system has sustained competitive advantage successfully through its impact on the intermediate inventory process. If the inventory process improves, the system can help the company and its partners forecast better; in which case, the company will not only save on inventory costs, but will also avoid the chances of losses on selling more products, and therefore sustains the competitive advantage of the company.

In summary, the process view of IT value believes that IT investment cannot increase a company's competitive advantage directly. IT investment should fit the firm's tasks and be appropriately used by employees before it delivers business values. When IT improves critical business processes, such as reducing the time to deliver an order or enhancing the innovation of products and services, a company can achieve a better position to sustain the competitive advantage.

2.3 Dynamic Capability

Although the process view of IT value has recognized the significance of IT impacts on organizational processes that play an important role in enhancing a company's competitive advantage, it does not consider the impacts across organizational boundaries (Barua et al., 1995). IOS is one type of IT that involves the management of relationships among organizations. The performance of IOS can be restricted by the surrounding competitive and dynamic environment (Wang, 2006). Resource-based theorists suggest a set of dynamic capabilities that enable companies to cope with complex and volatile environments (Grant, 1996). According to Teece et al. (1997), dynamic capabilities are a company's abilities to integrate, build, and reconfigure internal and external competences to address rapidly changing environments and maintain competitiveness. The definition is further refined by Eisenhardt and Martin (2000) who maintain that dynamic capabilities are a company's processes to integrate, reconfigure, gain, and release resources to match and even create market changes.

Since dynamic capabilities can be seen as a series of innovative processes, according to the process view, it can be argued that IT can contribute to a company's competitive advantage if the company can leverage its IT investment to develop superior dynamic capabilities. Sambamurthy, Bharadwaj, and Grover (2003) have proposed that IT investments influence competitive advantage through three significant organizational capabilities - agility, digital options, and entrepreneurial alertness. Similarly, Barua, Konana, Whinston, and Yin (2004) have shown that IT investment, along with the readiness of customers and suppliers can create online informational capabilities, which then leads to improved firm performance. Additionally, Banker, Bardhan, Chang, and Lin (2006) uses a plant information system as an example to show that companies can enhance their manufacturing capabilities like just-in-time (JIT) manufacturing and customer & supplier participation (CSP) programs through system development. These capabilities maintain and strengthen companies' competitive advantage over time.

Although these findings recognize the mediating role of a firm's capabilities between IT investment and competitive advantage, they focus only on the capabilities that are housed within a single firm, namely internal capabilities. Dyer and Singh (1998) have suggested that a firm's critical resources may span firm boundaries and many be embedded in interfirm routines and processes. Competitive advantages become possible when firms in the value chain are able to combine and allocate these resources in a distinctive and superior way. For example, when Cisco and its key suppliers created an e-hub by means of Rosettanet standards, all connected firms were able to elevate operational efficiency to higher level by sharing demand and supply data, diagnosing supply chain fluctuation in real time, and responding collectively. This analysis suggests that a firm's capabilities may be jointly created with trading partners and housed both within and outside firm boundaries. These capabilities, namely external capabilities, become increasingly important in today's supply chain management and therefore, deserve more study (Sahin & Robinson, 2002).

A recent research attempts to study how firms collaborate to create external capabilities to deal with supply chain dynamics. This model proposes a hierarchy of IOS-enabled dynamic capabilities and suggests that leveraging lower-order IT integration capability with higher-order supply chain capabilities can create performance gains for firms (Rai, Patnayakuni, & Seth, 2006). While Rai et al. (2006)'s study has noticed the significance of a firm's external capabilities, their focus is on the interactions between different levels of capabilities in the hierarchy. The relationship among IOS investment, capabilities, and competitive advantage is not discussed. Therefore, the author develops the concept of Supply Chain Dynamic Capabilities (SDC) and proposes that IOS can facilitate competitive advantage only when it can help develop SDC. The details about SDC are discussed in the following section.

2.4 Supply Chain Dynamic Capabilities (SDC)

Drawing from Teece et al. (1997), dynamic capabilities involve both static and dynamic features of problem-solving architecture. The static dimension of problem-solving capability refers to the integration of available resources, focusing on the replication of good practices, a more classical pattern of organizational capabilities. The dynamic dimension refers to the reconfiguration of existing resources to generate new and synergistic resource combinations, focusing on continuous changes to overcome the inherent risk of becoming rigid and trapped. Simply put, the static one emphasizes 'learning before doing' and is effective in stable and moderately dynamic markets while the dynamic one emphasizes 'learning by doing' and is effective in high-velocity markets (Eisenhardt & Martin, 2000).

Table 1 summarizes past research on exploring IT-enabled dynamic capabilities. Some studies stress static component. For example, a firm's IT-enabled enterprise digitization in the form of integrated business processes and knowledge systems are such a dynamic capability (Banker et al., 2006; Barua et al., 2004; Rai et al., 2006; Sambamurthy et al., 2003). These capabilities focus on integrating existing resources and analyzing existing tacit knowledge to effectively execute substantive day-to-day activities such as manufacturing, logistics, and sales. Since they have detail and analytic routines and rely extensively on existing knowledge, they are appropriate for stable to moderately dynamic markets (El Sawy & Pavlou, 2008; Sambamurthy et al., 2003; Eisenhardt & Martin, 2000).

Other studies stress dynamic component. Innovation routines allow a firm to overcome the rigidity trap of organizational capabilities (Hart & Saunders, 1998; Schreyogg & Kliesch-Eberl, 2007). Routines for efficient learning and knowledge creation (Eisenhardt & Martin, 2000; El Sawy & Pavlou, 2008; Tippins & Sohi, 2003) are used by managers to build new knowledge needed to revamp existing organizational capabilities with new knowledge and skills. Agility and enterprise alertness center on routines to spot, interpret, and pursue the need for changing organizational capabilities with speed and surprise (Sambamurthy et al., 2003; El Sawy & Pavlou, 2008). Coordinating activities between customers and suppliers involve the routines by which managers orchestrate and deploy discrete tasks and resources among various parts of the value chain to generate new organizational capabilities (Eisenhardt & Martin, 2000; Banker et al., 2006; El Sawy & Pavlou, 2008). Since these capabilities are relied much less on existing knowledge and much more on rapidly creating situation-specific new knowledge, they are effective in high-velocity markets (Eisenhardt & Martin, 2000).

Although past literature has introduced the two dimensions of dynamic capabilities, few attempt to integrate both dimensions together to offer a complete view of dynamic capabilities. Although Sambamurthy et al. (2003) and Banker et al. (2006) have mentioned both dimensions, their discussion is centered upon a firm's internal capabilities. This research therefore proposes Supply Chain Dynamic Capability (SDC) and conceptualizes it as the process by which a company and its trading partners collectively operate the supply chain network to respond to shifts in the business environment. The process consists of two components: supply chain integration capability and supply chain coordination capability. Based on the past literature, integrating IT and supply chain processes relies on a detailed and well-defined routines (Patnayakuni, Rai, & Seth, 2006) and reliable past experiences (Zhu et al., 2006), therefore capturing the static component of SDC. In contrast, a flexible supply chain coordination relies on sensing and detecting the need for change in product offerings and supply chain partners, designing and planning for changes, and communicating changes to partners (Gosain, Malhotra, & El Sawy, 2004), thus capturing the dynamic component of the SDC. The discussion of each component is as follows.

Table 1 Summary of past literature on dynamic capabilities

Dynamic Capabilities	Static components	Dynamic components
Definitions	Integrating available resources for problem solving, focusing on reliable replication of good practices.	Continuous learning from individuals and firms and transforming existing asset structure to guarantee radical change of organizations.
Hart and Saunders (1998)		✓ Inter-firm continuous innovation
Tippins and Sohi (2003)		✓ Organizational learning
Sambamurthy et al. (2003)	✓ Digital options	✓ Agility ✓ Enterprise Alertness
Barua et al. (2004)	✓ Online-informational capabilitiesgital options	
Rai et al. (2006)	✓ IT integration capability ✓ Supply chain process integration	
Banker et al. (2006)	✓ JIT manufacturing	✓ Customer and supplier participation programs

2.4.1 Supply Chain Integration Capability

Research on dynamic supply chains shows that companies require an integration of processes and IT to counter uncertainties arising from competitive environments (Malhotra, Gosain, & El Sawy, 2006; Rai et al., 2006; Wang, Tai, & Wei, 2006). From the dynamic capability perspective, integrated supply chain processes are the sources for differences in performances in strategic alliances, virtual corporations, and technology collaborations. They are the "routines for gathering, processing, and sharing operational, tactical, and strategic information between a firm and its supply chain partners" (Patnayakuni et al., 2006; Teece et al., 1997). Companies with higher levels of supply chain process integration are expected to be more aware of their environments (Malhotra et al., 2006). This, in turn, increases their capability to respond to supply chain dynamics (Evans & Shiu, 2006).

Supply chain process integration cannot be implemented without the support of a well-integrated IT platform (Zhao & Liu, 2005; Baghdadi, 2006). When a company has established data consistency throughout its supply chain and integrated its function-specific Supply Chain Management (SCM) applications with each other and with related Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) applications (Rai et al., 2006), it will have the ability to interface function-specific supply chain applications with each other in real time and integrate or synthesize information collected from their supply chain partners (Ranganathan, Dhaliwal, & Teo, 2004). IT integration is therefore the foundation for an end-to-end management of a supply chain, and a strategic weapon to deal with today's hyper-competitive supply chain environment (Kalakota & Robinson, 1999). For this study, supply chain integration capability is conceptualized as the extent to which a company establishes data consistency throughout its supply chain and integrates its business processes with those of its supply chain partners. Since supply chain integration relies on a formalized set of procedures for the exchange of information and these procedures are constructed from learning and prior organizational experience (Patnayakuni et al., 2006), the capability captures the static dimension of dynamic capability.

2.4.2 Supply Chain Coordination Capability

Increasing business dynamics, changing customer preferences, and disruptive technological shifts have created a greater need for flexible supply chain coordination. Based on Lee (2000), supply chain coordination refers to routines for redeploying decision rights, work, and resources to the best-positioned supply chain partners. For example, many companies in the grocery industry have aggressively started to pursue CPFR (collaborative planning, forecasting and replenishment) programs, by which manufacturers, rather than retailers, make the ordering decisions based on the POS and inventory information provided by the retailer. Gosain et al. (2004) further classify two types of flexible supply chain coordination: (1) offering flexibility and (2) partnering flexibility. Offering flexibility refers to the ability of a supply chain to quickly modify existing processes or the structure of information sharing in order to support changes in product or service offerings. On the other hand, partnering flexibility refers to the ease of changing supply chain partners in response to changes in the business environment. The theoretical basis of supply chain coordination capability is a learning-based sense-and-adapt paradigm (Haeckel, 1999). To illustrate, sensing and adaptation depends on the ability to continuously monitor the surrounding environment, sense the changes, and adapt to the changes. The efficiency of enterprise learning depends on well defined behavior norm, trust, and coordination-related knowledge, etc. Therefore, companies with good coordination with trading partners can be better aware of new opportunities and more ready to adapt to changes, thereby brining about a positive effect on performance. Furthermore, better coordination between two parties allows them to work out difficulties such as power conflicts and low profitability and quickly achieve consensus on action in a given situation. For this study, supply chain coordination capability is conceptualized as the extent to which a company enables flexible coordination across the supply chain. Since this capability emphasizes continuous changes in both offerings and partnering in response of dynamic supply chain environment, it captures the dynamic dimension of dynamic capabilities.

3. Research Framework

The research framework is shown in Figure 2. IOS investment is the independent variable, which considers all required technical assets and managerial assets for IOS development (Riggins & Mukhopadhyay, 1994; Bensaou & Venkatraman, 1995; Piccoli & Ives, 2005). Technical assets are considered as hardware and software that assist in the acquisition, processing, storage, dissemination, and use of information (Tippins & Sohi, 2003). Hardware comprises personal computers, servers, Internet enablers, and so forth. Software consists of the applications to support the tasks (Riggins & Mukhopadhyay, 1994; Bensaou & Venkatraman, 1995). Managerial assets comprise activities that are undertaken in order to support the IT implementation. They can be considered as the methods, capital, and processes required for developing technical and managerial IT skills (Mata et al., 1995).

Competitive advantage is the dependent variable. According to Brandenburger and Stuart (1996), competitive advantage can be obtained when the value that is created in an IOS-enabled supply chain relationship in which the company partakes is greater than the value that could be created were the company not to participate in the relationship. Consequently, competitive advantage in this paper is conceptualized as the extent to which a company has superior operation, profitability, and buyer-supplier relationships relative to its competitors. SDC are the mediating factors, comprising supply chain integration capability and supply chain coordination capability. Please note that SDC act as partial mediators in this study, because past dynamic capabilities literature (Table 1) has shown that the relationship between IOS investment and competitive advantage can be affected by several other alternative dynamic capabilities in addition to SDC. Further, to account for extraneous sources of variation in competitive advantage, company size is included as a control variable in the model, because large firms usually can exercise market power to gain competitive advantage (Tippins & Sohi, 2003). The focus of this research model is that the effect of IOS investment on competitive advantage is mediated by SDC. Accordingly, three hypotheses are developed and tested (1) the relationship between IOS investment and competitive advantage, (2) the relationship between IOS investment and SDC, and (3) the relationship between SDC and competitive advantage.

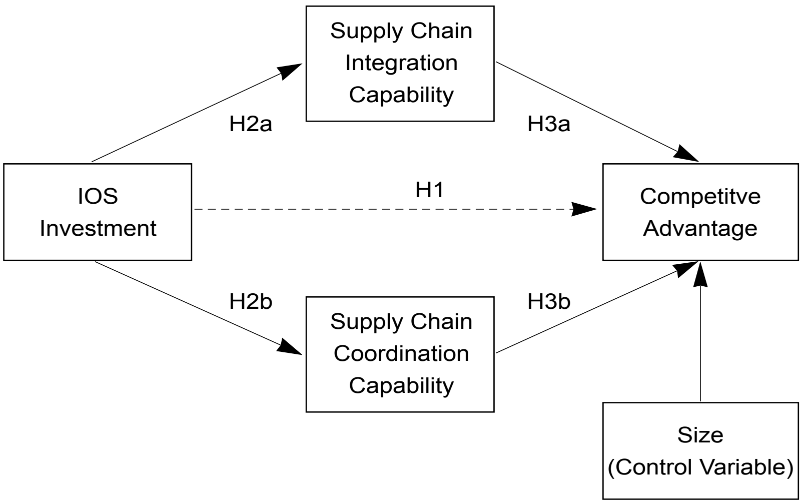

Figure 2 Research Framework

3.1 IOS Investment and Competitive Advantage

IOS investment has been suggested as a source of competitive advantage (Bensaou & Venkatraman, 1995). For example, Riggins and Mukhopadhyay (1994) posit that the great volume of business communications for which the company uses EDI and the high degree to which the company becomes immersed in EDI of doing business as the efficient ways to maintain a superior supply chain. However, the competitive advantage brought by the IOS is usually hard to sustain. The easy access to technical resources nowadays makes companies difficult to protect IOS against imitation (Mata et al., 1995). Furthermore, mobile workforces, reused technology, open technical sources, and formal and informal technical communication all reduce the barriers to imitate. To make IOS more readily defended, Clemons and Row (1992) have suggested that IOS should exploit unique resources of the innovating company so that competitors do not fully benefit from imitations. Thus, it is expected that IOS can not directly lead to competitive advantage, but indirectly affect the advantage through some intervening capabilities. The discussion in Section 2 has indicated that a superior SDC can complement with IOS investment to create the competitive advantage. Therefore the following hypothesis is set forth:

Hypothesis 1: The relationship between IOS investment and competitive advantage is mediated by SDC.

3.2 IOS Investment and SDC

IOS accelerates the speed at which information is exchanged between companies. The greater the frequency of information exchange, the greater the information processing capabilities of the dyad (Bensaou & Venkatraman, 1995). Companies and their supply chain partners become more active in the information management process, enabling the information flow across companies' boundaries. Due to IT-enhanced connectivity, supply chain members can more easily share individual interpretations of the information (Tippins & Sohi, 2003), making the development of integrated IT infrastructure more efficient. Moreover, by accumulating organizational learning through continuous IOS investment, companies are more able to share information with their partners, optimize the flow of materials, and streamline financial operations. IOS therefore can be blended with inter-organizational processes to develop higher-order capabilities for demand sensing, operations and workflow coordination, and global optimization of resources (Rai et al., 2006). Given the potential impact that IOS investment has on the supply chain integration capability, the following hypothesis is set forth:

Hypothesis 2a: IOS investment is positively related to supply chain integration capability

The role of IOS in responding to and shaping business options with agility is recognized as critical (Sambamurthy et al., 2003). When there are more and more IOS investments adopt flexible markup formats and ubiquitous and low-cost connectivity, companies and their trading partners are more likely to develop robust and reconfigurable linkages that can deal with changes in the business environment. Moreover, since IOS often involves joint development efforts between companies and their trading partners, companies that coordinate with trading partners are able to benefit from their experiences with IOS, enhancing their ability to sense the needs of the partners and communicate their own needs to the partners (Sanchez & Perez, 2005). In addition, by sharing high-quality forecasts and order information with existing trading partners via IOS, companies are able to quickly react to unanticipated change and get ready for potential partners (Angeles & Nath, 2000; Soliman & Janz, 2004). Furthermore, organizational memory of past change can be augmented by IOS investment through support for knowledge acquisition, retention, maintenance, search, and retrieval functionality (Gosain et al., 2004). The existence of organizational memory of past experiences allows companies to work effectively with current partners for offerings changes, make better partnering decisions, and adjust processes and contents for new partners, and therefore is important to flexible supply chain coordination. The following hypothesis is set forth:

Hypothesis 2b: IOS investment is positively related to supply chain coordination capability

3.3 SDC and Competitive Advantage

Supply chain integration enables real-time sharing of sales data, which can avoid distortion of demand information as it travels upstream across the supply chain. Reduced information distortion enhances partner performance and increases a company's awareness of opportunities which it would otherwise be unaware, thus placing it in a better position to take more targeted competitive actions (Chi, Holsapple, & Srinivasan, 2007). Supply chain integration has also been considered to be a critical factor for a company to align supply with demand (Patnayakuni et al., 2006). Integration of distinct business function, messages, tasks, and operations enhances a company's ability to seize market opportunities earlier than its competitors. The following hypothesis is set forth:

Hypothesis 3a: Supply chain integration capability is positively related to competitive advantage.

Flexible offerings and partnering can help companies maintain their competitiveness by continually orchestrating new sources for value creation. In addition, information sharing in a broad range of areas allows companies to monitor potential risks from the surrounding environment and detect new opportunities in a speedy way (Clemons & Row, 1992, 1993; Chang, Wang, & Chiu, 2008). Moreover, supply chain coordination can help companies create a shared past and a projected future with trading partners, enhancing trust among a string of partners that have a mutual economic interest in satisfying end consumers. A trusting relationship enables the company to place itself in a privileged position of the supply chain network to gather market information on competitors, and thus be able to take prompt and effective actions (Day, 1994). Therefore, the following hypothesis is set forth:

Hypothesis 3b: Supply chain coordination capability is positively related to competitive advantage.

4. Research Methodology

4.1 Measures

The measures are shown in the Appendix A. Seven-point Likert scales are used to operationalize the constructs. IOS investment is measured by five items (IOS1 to IOS5), reflecting technical assets (IOS1 and IOS2) and managerial assets (IOS3 to IOS5). These scale items are based on Riggins and Mukhopadhyay (1994), Bensaou and Venkatraman (1995), and Iskandar, Kurokawa, and LeBlanc (2001). Supply chain integration capability is measured by four items (SCI1 to SCI4) to capture the degree of process automation in four major business processes: material management (SCI1), account management (SCI2), product design (SCI3), and procurement (SCI4). Similar measures have been used in prior IOS research (Riggins & Mukhopadhyay, 1994; Bensaou & Venkatraman, 1995; Rai et al., 2006). Supply chain coordination capability is operationalized by looking at whether the company is capable to develop mechanisms to enable flexible coordination across the supply chain (SCC1 to SCC5). Items used to measure this construct are adapted from Clemons and Row (1993), Angeles and Nath (2000), and Gosain et al. (2004). Furthermore, competitive advantage is measured by asking how well the company performs relative to all other direct competitors in terms of operation (CA1 to CA3), profitability (CA4), and buyer-supplier relationships (CA5 and CA6). Similar measures have been used by Tippins and Sohi (2003) and Rai et al. (2006). Finally, the control variable (SIZE) assesses the total number of full-time employees in the company (Rai et al., 2006).

4.2 Data Collection

To empirically test the hypotheses formulated above, a general survey was conducted in the Taiwanese PC industry. Starting from July 1999, the Taiwan government initiated a series of "Demonstration Projects" named Project A and Project B. Project A was designed to build a strong and agile e-procurement network between IBM, Compaq, and HP and first-tier Taiwanese OEMs (Original Equipment Manufacturers). The hope was that the success of Project A would further diffuse to the supply network of these OEMs and their second-tier suppliers. With the success of Project A, Project B effectively linked more than 1,800 suppliers through the underlying e-procurement systems (EP) hosted by the fifteen major OEMs. Supported by the Institute for Information Industry and with the help of the sponsorship of MOEA (Ministry of Economic Affairs), Republic of China, this research coordinated six of the fifteen Taiwanese PC OEMs who participated in Project B.

The Chief Operational Officer (COO) of these six OEM was asked to identify major trading partners who used the EP to process orders. Seven categories of trading partners were identified, including six types of PC component suppliers (motherboard, chips, mechanisms, cables, packages/labels, and passive components) and distributors. Then, these COOs were asked to identify one sales representative at each supplier and distributor company to whom the questionnaire could be sent. The website linkage to the Web questionnaire was then e-mailed to 825 representative professionals. The period for collecting data lasted a month, and 160 questionnaires were returned. After deleting the ones without sufficient data, 145 complete and usable questionnaires have been considered. Therefore, the response rate is 17.57%. Table 2 summarizes the sample characteristics.

Table 2 Characteristics of the study sample

Characteristics of Respondents		
Average number of years worked in the company		8.475
Characteristics of the Companies		
Average numbers of years the company established		10.725
Average number of employees (thousand)		0.343
Average capital (N.T. billion dollars)		$ 0.63
Average annual sales (N.T. billion dollars)		$1.451475
Industry group		
Electronics	20%	
Electrical machinery	1%	
Information technology	17%	
Semiconductor	34%	
Import-export business	5%	
Communication	1%	
Logistics	2%	
Others	20%	

4.3 Measurement Assessment

According to the criteria set down by Jarvis, Mackenzie, and Podsakoff (2003), four constructs (IOS investment, SCI, SCC, and competitive advantage) are modeled as formative for the reason that the direction of causality is from indicators to constructs and items within a construct are *not necessarily* interchangeable and covariational. Factor analysis is then conducted to assess the construct validity (Molla & Licker, 2005). A minimum eigenvalue of 1 is set as a cutoff value. Principle component analysis and the Varimax rotation method have been used to extract the factors. The factor loadings of the four factors are presented in Appendix A. Each item loads with its hypothesized factor. There is no item with a factor loading less than 0.5 on all factors or factor loading greater than 0.5 on two or more factors. The result shows that the theorized constructs have a satisfactory validity.

Construct reliability assesses the consistency across multiple operationalizations (Zhu, Kraemer, & Xu, 2003). Cronbach's alpha has been used to assess reliability. The alpha values in Appendix A range from 0.814 to 0.911, indicating an adequate reliability. Convergent validity is assessed by observing the extent to which the correlations of within-factors (items of the same factor) are significantly different from zero and large enough to encourage further tests of discriminant validity. The correlation matrix in Appendix B shows that the smallest within-factor correlation for IOS investment, supply chain integration capability, supply chain coordination capability, and competitive advantage is 0.39, 0.48, 0.44, and 0.47, respectively. These correlations are significantly higher than zero and large enough to proceed with a discriminant validity analysis.

To claim discriminant validity, the correlations between theoretically different factors should be low. For each item, its smallest within-factor correlation is observed. Then, this value is compared with its correlation with items of all other factors and the number of times (K) that the value is lower in the comparison are counted. The value of K should be less than one-half of the potential comparisons. Table 3 summarizes the values of K from all the comparisons. The result provides sufficient evidence of both convergent and divergent validity and therefore the instrument can be considered to generate quality data.

Table 3 Summary of K-count to test discriminant validity

Items	Smallest within-factor correlation	Total comparisons	Maximum acceptable K	Instances of violations
IOS1	0.39	15	7	5
IOS2	0.43	15	7	2
IOS3	0.39	15	7	6
IOS4	0.43	15	7	6
IOS5	0.49	15	7	5
SCI1	0.48	16	8	0
SCI2	0.49	16	8	0
SCI3	0.51	16	8	0
SCI4	0.48	16	8	8
SCC1	0.44	15	7	6
SCC2	0.57	15	7	0
SCC3	0.44	15	7	6
SCC4	0.54	15	7	1
SCC5	0.59	15	7	0
CA1	0.49	14	7	1
CA2	0.62	14	7	0
CA3	0.47	14	7	0
CA4	0.58	14	7	0
CA5	0.47	14	7	4
CA6	0.56	14	7	0

4.4 Common Method Variance

Since the respondent providing the measure of the predictor and criterion variable is the same person, there is a potential for the occurrence of common method variance problem (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Two methods have been suggested to control for this problem. One is Harmon's single-factor test (Podsakoff & Organ, 1986; Carlson & Kacmar, 2000) and the other is single-common-method-factor approach (Podsakoff et al., 2003; Williams, Cote, & Buckley, 1989). Harmon's single-factor test suggests a factor analysis of all variables of interest and assumes that a substantial amount of common method variance is present, either when (a) a single factor emerges from the analysis, or (b) one "general" factor accounts for the majority of the covariance in the independent and criterion variables (Podsakoff & Organ, 1986). Appendix A shows the presence of four factors in this model, indicating that common method effects are not a likely contaminant of the results. Single-common-method-factor approach is then conducted to confirm these results. Following the procedure recommended by Williams et al. (1989), the three-factor measurement model (IOS, SCI, and SCC) is tested and then the model with an additional method factor is examined. Results from these analyses indicate that the fit of the model did not improve significantly with the addition of method factor. The R^2 for the three-factor model is 0.491 (p=0.00), while for the three-factor with methods factor model is 0.495 (p=0.00). Although the method factor does improve model fit, it accounts for only small portion (0.4%) of the total variance, indicating that method effects are insignificant. Further, the three factors remain significant even after the method effects are removed (p= 0.00 for IOS, p=0.022 for SCI, and p=0.00 for SCC). In sum, this suggests that the respondents do differentiate between the variables and that the results obtained in the correlation and regression analyses are indicative of the true relationships among the variables (Elangovan & Xie, 1999). The common method variance is therefore not a pervasive problem in this study.

5. Results and Discussion

5.1 Mediation Analysis

Adopting the approach used by MacKinnon (1994), a mediated effect exists when (1) the direct effect between IOS investment and competitive advantage is statistically significant, due to the fact that if the direct effect does not exist, there is no effect to mediate (Judd & Kenny, 1981). (2) There is a statistically significant relationship between IOS investment and SDC (McCaul & Glasgow, 1985). (3) The effect of SDC on competitive advantage must be statistically significant when controlling for the effect of IOS investment. (4) The IOS effect without the SDC variables should be larger than the effect with the SDC (Baron & Kenny, 1986). Accordingly, four regression models are developed to test the mediation effect:

$$CA = c_1 * IOS + c_2 * SIZE + \varepsilon_1 \quad (1)$$

$$SCI = p_{1a} * IOS + \varepsilon_2 \quad (2)$$

$$SCC = p_{2a} * IOS + \varepsilon_3 \quad (3)$$

$$CA = p_{3a} * IOS + p_{31} * SCI + p_{32} * SCC + p_{3s} * SIZE + \varepsilon_4 \quad (4)$$

The first equation (direct effects) examines the direct relationship between IOS investment and competitive advantage, while the remaining equations (partial mediation) examine the same relationship with SDC acting as mediators. The symbols in the equations are the following: CA denotes competitive advantage; IOS denotes IOS investment; SCI denotes supply chain integration capability; SCC denotes supply chain coordination capability; SIZE denotes the control variable 'company size'; c_1 codes the relationship between IOS investment and competitive advantage; c_2 is the regression coefficient of control variable SIZE; p_{1a} and p_{2a} are the regression coefficients relating the IOS investment to the mediators-supply chain integration capability (SCI) and supply chain coordination capability (SCC), respectively; p_{3a} is the regression coefficient relating the IOS investment to competitive advantage, adjusted for the effects of the mediators; p_{31} and p_{32} are the coefficients relating the mediators, SCI and SCC, to competitive advantage, adjusted for the independent variable, IOS investment; p_{3s} is the coefficient relating the control variable SIZE, and ε_1, ε_2, ε_3, and ε_4 code unexplained variability; and the intercept is assumed to be zero. The regression results for the four models are presented in Table 4.

Table 4 Regression results of partial mediation effect: The mediating role of SDC on the relationship between IOS investment and competitive advantage

	Direct effect	**Partial mediation**		
Model (Hypothesis)	1 (H1)	2 (H2a)	3 (H2b)	4 (H3a, H3b)
Parameter	(D.V. = CA)	(D.V. = SCI)	(D.V. = SCC)	(D.V. = CA)
IOS	0.657***	0.514***	0.614***	0.360***
SCI	—	—	—	0.167**
SCC	—	—	—	0.302***
SIZE	-0.100	—	—	-0.056
Adjusted R^2	0.405	0.259	0.373	0.497

The results show that SCI and SCC mediate the relationship between IOS investment and competitive advantage. First, the direct effect of IOS on competitive advantage is positive and significant (c=0.657, p=0.000), indicating the potential for testing the mediation effects. Second, there are positive and significant relationships between IOS investment and SCI (H2a: p_{1a}=0.514, p=0.000) and between IOS investment and SCC (H2b: p_{2a}=0.614, p= 0.000). Third, the effect of SCI and SCC on the outcome variable, competitive advantage, is statistically significant even when controlling for IOS investment (H3a: p_{31}=0.167, p=0.032; H3b: p_{32}=0.302, p=0.001). At last, the direct effect of IOS on competitive advantage is reduced when SDC is included. That is, the regression coefficient of IOS in Model 4 (p_{32}=

0.360) is less than the coefficient of IOS in Model 1 (c_1=0.657). According to MacKinnon (1994), the direct effect is *partially* mediated by the mediators. Using the approach suggested by Alwin and Hauser (1975), the model can further derive that 14% of IOS direct effect is mediated by SCI while 29% is mediated by SCC[1].

5.2 Discussion

Some recent studies have suggested that IOS investment may not create competitive advantage due to competitive dynamics (Gnyawali & Madhavan, 2001). While IOS can bring bottom line technological and business process improvements to supply chains, these benefits may not have enough durability to produce competitive advantage when a company faces an environment of fierce competition. Competitors may make an investment in comparable IT solutions and reap certain benefits from business operation improvements. Another competitive dynamics can come from rapid changing customer needs (Sabath & Fontanella, 2002). A company that fails to recognize customer needs may therefore choose improper technology and focus on incorrect customer segments. Any improvement of underlying IT in collaborative relationships is thus temporary.

This study proposes that SDC can help overcome these competitive uncertainties. Two underlying components: supply chain integration capability and supply chain coordination capability are suggested as the principal source of sustainable competitive advantage in unstable market conditions. With a great supply chain integration capability, companies can easily integrate any new IOS with current enterprise systems and automate daily operational activities, such as procurement, material management, and collaborative design. On the other hand, with flexible supply chain coordination mechanism, a company and its supply chain partners can better sense and adapt to the changes. Furthermore, they can orchestrate their supply chain structure with high flexibility to best fit their customer needs, and therefore achieve better performance.

The statistical results of this study confirm that IOS effect on a company's competitive advantage can be indirect. Both SDCs are mediators between IOS investment and competitive advantage. In other words, IOS can create competitive advantage if it can help develop supply chain integration capability and coordination capability. The results of this study also indicates that supply chain coordination capability can explain more mediation

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1 Based on Alwin and Hauser (1975), the proportion of the direct IOS effects mediated by SCI is calculated by [1− (p_{3a}+ p_{32} p_{2a}) / (p_{3a}+p_{1a} p_{31}+ p_{2a} p_{32})]; the proportion of the direct IOS effects mediated by SCC is calculated by (p_{32} p_{2a}) / (p_{3a}+ p_{1a} p_{31}+ p_{2a} p_{32}).

effects, and thereby is more effective to create competitive advantage than supply chain integration capability. The reasons may be that, although a good supply chain integration capability can complement IOS investment to enhance the degree of automation, the resulting competitive advantage may be undercut if there is no flexible supply chain coordination to deal with business dynamics. Furthermore, while supply chain integration capability enables the real-time sharing of information across supply chain, how much competitive advantage can be gained depends on the information that partners are willing to share. If there is no well-designed coordination mechanism to facilitate trust-building among trading partners, many partners maybe reluctant to share information due to the fact that sensitive information such as the specification for the product design may be leaked to rivals through the marketplace. In this context, supply chain coordination capability, which can build trust through real-time sharing of data, is more powerful to help create competitive advantage. The findings of this research support Lee's argument that having a fast and cost-effective supply chain is insufficient, companies that can stay ahead of the competition are the ones that can build an agile supply chain, in which the company and its supply chain partners can work together in response to customer demand (Lee, 2004).

This study makes a contribution to the past literature on IT and competitive advantage by arguing that a firm's IOS resources are usually imitable and have limitations in gaining competitive advantage. Further, by showing that SDC can mediate the effect of IOS investment on competitive advantage, this research provides evidence that the usefulness of IOS resources depends on the processes of integrating and coordinating these resources for problem solving (Teece et al., 1997; Eisenhardt & Martin, 2000).

The second related contribution of this study is to the process view of IT value, which posits that IT delivers value through process change within the firm (Sol & Markus, 1995; Barua et al., 1995). The quality of process re-engineering along with the strategic fitness of IT constitutes the sources of competitive advantage (Beath et al., 1994; Lee et al., 1999). While the importance of internal business process improvement has been recognized in the IT literature (Banker et al., 2006), empirical work on external business process improvement and its impact on firm outcomes is relatively limited. Developed upon dynamic capability literature, this research identifies two critical external process improvements: supply chain integration and supply chain coordination and conducts empirical study to find that both processes significantly determine the contribution of IOS investment. As discussed earlier, although Rai et al. (2006) have recognized the significance of supply chain integration capability in creating competitive advantage, their study focuses on the capability itself, not on its impact on the relationship between IOS and competitive advantage. In addition, while the role of integration mechanisms as a source of competitive advantage has received a great deal of interest from IS researchers (Baghdadi, 2006; Barua et al., 2004; Banker et al., 2006; Rai et al., 2006; Zhao & Liu, 2005), the role of coordination as a source of competitive advantage is less discussed.

The third contribution of this study is to the dynamic capabilities of the firm, which suggests that dynamic capabilities are a function of static and dynamic resources that are embedded in a firm's problem solving architecture to deal with competitive dynamics (Teece et al., 1997). As discussed earlier, the few empirical studies that have examined the role of IT-enabled dynamic capabilities have looked at either static or dynamic features of capabilities, but not both (Table 1). This study attempts to fill the gap by proposing SDC that capture both dimensions of dynamic capability. Further, while prior scales have focused on supply chain integration (Barua et al., 2004; Rai et al., 2006) and most studies on supply chain coordination have been conceptual (Hart & Saunders, 1998), this research offers a more comprehensive measure of SDC.

6. Conclusion

Earlier researchers have asserted that IT investment is the source of a company's competitive advantage. Other studies, however, find it difficult to create competitive advantage directly from IT investment. Such a conflicting view of IT value motivates an investigation into the relationship between IT investments and competitive advantage. The process view suggests that a well-designed IT should fit a company's tasks, and be used appropriately. Barua et al. (1995) propose that IT investment has a positive influence at the operational level first, bringing in a better market share and ROA through operational improvements latter. Inspired by the process view, this study aims to find out how IOS can help companies sustain their competitive advantage in a fast-changing environment. Built upon the dynamic view of the resource-based theory, two dynamic capabilities in supply chain management — supply chain integration capability and coordination capability — are proposed and their impact on the relationship between IOS investment and competitive advantage are explored.

Data from 145 manufacturers in the PC industry in Taiwan has been collected because this industry has a higher IOS adopting rate as compared to other industries. Through data analysis, this study proves that the relationship between IOS investments and a company's competitive advantage is significantly mediated by supply chain integration capability and supply chain coordination capability. More specifically, IOS investment can be a source of competitive advantage when it can leverage a company's supply chain integration and coordination capability. The result of the findings also implies that in order to obtain better IOS performance, companies have to integrate the IOS with current information systems and business processes and ensure that they are embedded well. Besides, to realize the IOS value, it is important for firms to enable flexible coordination with their trading partners, providing a mechanism for sensing and adapting business changes quickly. This study also shows that building a coordination mechanism is more effective to create competitive advantage than building an integration mechanism. The findings, however, can be further justified in future studies.

This research model provides future investigators with a threshold to explore the dynamic capability concept in IOS investment. In addition to supply chain integration and supply chain coordination, there are some other important dynamic capabilities such as learning (Tippins & Sohi, 2003). Besides, the data collection in this study focuses on manufacturers in the Taiwan PC industry. Cross-industries and cross-country surveys can be pursued to verify the results further.

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Appendix A: Details of measurement items[i]

Measurement Items[ii]		Factor Loadings			
		IOS Investment	SC Integration Capability	SC Coordination Capability	Competitive Advantage
IOS Investment (Cronbach's alpha = 0.832)[iii]					
IOS1	Your company has a good telecommunications infrastructure. (e.g., E-mail, Internet, or Intranet).	**0.654**	**-0.031**	**0.407**	**0.132**
IOS2	Your company has integrated IS applications (e.g., ERP) encompassing different business areas.	**0.709**	**-0.029**	**0.290**	**0.196**
IOS3	You company assigns a great budget for implementing the IOS.	**0.709**	**0.270**	**-0.043**	**0.303**
IOS4	The senior executives greatly support the IOS.	**0.644**	**0.298**	**0.216**	**0.319**
IOS5	For implementing the IOS successfully, your company gives the IT professionals sufficient education and training.	**0.638**	**0.227**	**0.359**	**0.284**
Supply Chain Integration Capability (Cronbach's alpha = 0.814)[iv]					
SCI1	The material management process between you and your partners is highly automated.	**0.332**	**0.760**	**0.113**	**0.113**
SCI2	The account management process between you and your partners is highly automated.	**0.116**	**0.853**	**0.074**	**0158**
SCI3	The product design process between you and your partners is highly automated.	**-0.082**	**0.797**	**0.347**	**0.163**
SCI4	The procurement process between you and your partners is highly automated.	**0.306**	**0.591**	**0.360**	**0.243**
Supply Chain Coordination Capability (Cronbach's alpha = 0.878)[v]					
SCC1	You and your partners regularly exchange information related to the surrounding supply chain environment (e.g., exchanging dynamic information to forecast the customer's demand).	**0.181**	**0.231**	**0.647**	**0.292**
SCC2	You and your partners have established clear norms for business behaviors.	**0.053**	**0.157**	**0.787**	**0.348**
SCC3	Your company trusts that confidential/proprietary information shared with your partners will be kept strictly confidential.	**0.271**	**-0.016**	**0.713**	**0.176**

SCC4	You and your partners are undergoing some supply chain collaboration projects (e.g., product design, quality control, as well as forecasting and inventory management).	**0.237**	**0.180**	**0.786**	**0.197**
SCC5	You and your partners usually send the timely, accurate, and complete information to each other.	**0.266**	**0.292**	**0.727**	**0.172**
Competitive Advantage (Cronbach's alpha = 0.911)[vi]					
CA1	Your company is better than your competitors in reducing operating costs.	**0.093**	**0.209**	**0.237**	**0.791**
CA2	Your company is better than your competitors in improving labor productivity.	**0.236**	**0.128**	**0.211**	**0.821**
CA3	Your company is better than you competitors in lead time reduction.	**0.185**	**0.132**	**0.072**	**0.855**
CA4	Your company is better than you competitors in customer service.	**0.243**	**0.239**	**0.262**	**0.695**
CA5	Your company has stronger bond with supply chain partners than your competitors.	**0.235**	**0.069**	**0.393**	**0.652**
CA6	Your company has better communication with supply chain partners than your competitors.	**0.296**	**-0.008**	**0.264**	**0.712**

i All items are measured using a 7-point Likert scale with 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neither agree nor disagree, 5 = Somewhat agree, 6 = Agree, 7 = Strongly agree.

ii The control variable 'Company Size' is measured using a 7-point Likert scale with 1 = less than 5 people, 2 = 6 - 20 people, 3 = 21 - 50 people, 4 = 51 - 200 people, 5 = 201 - 1,000 people, 6 = 2,000 - 10,000 people, 7 = more than 10,000 people.

iii Adopted from Riggins and Mukhopadhyay (1994), Bensaou and Venkatraman (1995), and Iskandar et al. (2001).

iV Adopted from Riggins and Mukhopadhyay (1994); Bensaou and Venkatraman (1995), and Rai et al. (2006).

V Adopted from Clemons and Row (1993), Angeles and Nath (2000), and Gosain et al. (2004).

Vi Adopted from Tippins and Sohi (2003) and Rai et al. (2006).

Appendix B: Correlation matrix

	IOS1	IOS2	IOS3	IOS4	IOS5	SCI1	SCI2	SCI3	SCI4	SCC1	SCC2	SCC3	SCC4	SCC5	CA1	CA2	CA3	CA4	CA5	CA6
IOS1	**1.00**																			
IOS2	**0.67**	**1.00**																		
IOS3	**0.39**	**0.46**	**1.00**																	
IOS4	**0.42**	**0.43**	**0.57**	**1.00**																
IOS5	**0.50**	**0.49**	**0.54**	**0.82**	**1.00**															
SCI1	0.33	0.30	0.41	0.41	0.37	**1.00**														
SCI2	0.17	0.19	0.27	0.36	0.29	**0.64**	**1.00**													
SCI3	0.13	0.09	0.24	0.28	0.31	**0.56**	**0.64**	**1.00**												
SCI4	0.35	0.47	0.45	0.49	0.48	**0.48**	**0.49**	**0.51**	**1.00**											
SCC1	0.40	0.33	0.24	0.45	0.50	0.39	0.23	0.39	0.50	**1.00**										
SCC2	0.38	0.34	0.19	0.42	0.47	0.28	0.25	0.43	0.45	**0.57**	**1.00**									
SCC3	0.49	0.40	0.28	0.37	0.38	0.19	0.18	0.23	0.39	**0.44**	**0.61**	**1.00**								
SCC4	0.42	0.45	0.28	0.43	0.57	0.29	0.25	0.45	0.53	**0.54**	**0.74**	**0.54**	**1.00**							
SCC5	0.44	0.38	0.34	0.43	0.54	0.42	0.37	0.42	0.50	**0.62**	**0.63**	**0.59**	**0.66**	**1.00**						
CA1	0.38	0.35	0.33	0.39	0.35	0.34	0.31	0.37	0.57	0.46	0.50	0.35	0.37	0.41	**1.00**					
CA2	0.40	0.40	0.41	0.46	0.48	0.34	0.31	0.27	0.51	0.42	0.49	0.42	0.36	0.44	**0.73**	**1.00**				
CA3	0.29	0.37	0.43	0.41	0.40	0.27	0.32	0.22	0.46	0.32	0.45	0.29	0.32	0.32	**0.79**	**0.80**	**1.00**			
CA4	0.33	0.33	0.40	0.57	0.52	0.38	0.36	0.35	0.55	0.49	0.48	0.37	0.45	0.41	**0.58**	**0.63**	**0.61**	**1.00**		
CA5	0.31	0.38	0.38	0.48	0.53	0.24	0.19	0.35	0.52	0.53	0.47	0.42	0.50	0.44	**0.49**	**0.62**	**0.47**	**0.70**	**1.00**	
CA6	0.39	0.39	0.40	0.45	0.49	0.23	0.17	0.23	0.45	0.42	0.42	0.31	0.46	0.41	**0.56**	**0.63**	**0.57**	**0.60**	**0.74**	**1.00**

Biographical Notes

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