The Role of Top Management and Dynamic Capability in Inter-Organizational Information System Assimilation

Shu-Chen Yang[1], Chia-Chun Kang[2*], and Zhong-Yu Chao[3]
Department of Information Management, National University of Kaohsiung, Taiwan[1]
International Chinese College, Rangsit University, Thailand[1]
College of Finance and Banking, National Kaohsiung First University of Science and Technology, Taiwan[2]
Department of Information Management, National University of Kaohsiung, Taiwan[3]
henryyang@nuk.edu.tw[1], u9131024@gmail.com[2], choich0809@hotmail.com[3]
**Corresponding Author*

Received 25 April 2016; received in revised form 1 June 2016; accepted 17 June 2016

Abstract

Inter-organizational information system (IOIS) has already become a crucial way for many companies to strengthen the competitiveness of their supply chain. However, IOIS must be integrated with business practices and processes to generate benefits for the company. A fair amount of past research discussed factors that affected the implementation or assimilation of information technology from the viewpoint of "Technology – Organization – Environment," yet, neglected the role of the top management. This study suggests that pressure from the environment will first change the attitude of the top management, which influences the extent of assimilation of information technology. In addition, the assimilated information technology will not produce benefit directly but does so through two types of dynamic capabilities – supplier responsiveness and manufacturing flexibility. It is with the improvement in these two capabilities can a company generate better performance. Thus, the main purpose of this study is to explore the mediating role of the "top management" and "dynamic capability" in the process of inter-organizational information system assimilation. This study gathered and analyzed 108 valid business questionnaires and the results all supported the above mediating roles.

Keywords: Technology – Organization – Environment, Top Management Support, Information System Assimilation, Inter-Organizational Information System, Dynamic Capability

1. Introduction

Under heightened competition, companies begin to carry out virtual integration with their upstream and downstream trading partners through information technology, which results to collaborative model of business-to-business electronic commerce that can increase the speed of information exchange within the supply chain, enhance the efficiency in production and transportation, etc. The application of inter-organizational information systems (IOIS), such as electronic data exchange (EDI) and supply chain management (SCM), is a common and crucial tool companies rely on to maintain their competitiveness (Chi et al., 2007; Grover & Saeed, 2007; Hartono et al., 2010; Zhang et al., 2016).

Many studies in the past examined the effect of new information technology on businesses and they concluded that information technology could significantly enhance the performance of a company (e.g., Zhu et al., 2004). However, there were also researchers who proposed completely different ideas in terms of whether information technology could generate competitive advantage for a company or not. A familiar case is the financial burden of overspending caused by a company's failed

attempt in implementing an enterprise resource planning system (ERP System), which sent a company into an unrecoverable decline (White &Fortune, 2002). This has made many managers doubtful about the business value of information technology. Because of this, Carr (2003) claimed that information technology does not matter. He believed that there was no direct influence on performance when a company adopted information technology.

Due to the aforementioned contradictions, several researchers started to concentrate on, explore and examine the role of information technology in business operation. In the studies done by Zhu et al. (2006), they claimed that the implementation of information technology had no direct influence on business performance. For an information technology to produce the anticipated benefit, the company must actually continue to use the technology after it has been adopted. Also, the technology must be integrated with business practices and processes in order to accomplish IT assimilation, which would then generate competitive advantage for the company (Mu et al., 2015; Neirotti & Paolucci, 2011). In other words, between the issue of adopting a technology and the issue of whether the adopted information technology is assimilated or not, the latter has greater importance and is worthy of further exploration. Prior literature often employed the perspective of "Technology, Organization and Environment" (TOE) in the discussion of adopting new information technology by companies (e.g., Lian et al., 2014; Zhu et al., 2010). Yet, under this framework with three important dimensions, some studies ignored the role of the top management (an important factor under the organizational dimension) in the process of adopting or assimilating information technology (e.g., Zhu et al., 2006). When a company implements a large-scale information system (e.g., an ERP system), the top management support plays a deciding role in the success of the implementation of such system (Shah& Siddiqui, 2006). The works of Liang et al. (2007) also pointed out that the top management would be influenced by industry environment and change in attitudes toward information technology, which then affect the level of assimilation of the company's information technology. Consequently, this study suggests that top management support is a necessary and critical factor for the assimilation of information technology and worthy of further investigation.

In addition, Teece et al. (1997) believed that the importance of a company's dynamic capability (e.g., manufacturing flexibility and learning capability) would grow under the increased business competition, making it a crucial foundation for a company to create its competitive advantage. They claimed that an information technology could benefit the development of the dynamic capability of a company if it is integrated with its business practices, processes, etc. This eventually improves a company's performance. In other words, dynamic capability plays a vital role in the process of assimilating information technology to improve performance and this is also the focus of this study.

Based on the discussion above, this study serves two purposes: (1) to examine the factors that influence IOIS assimilation from the perspective of TOE and to understand the role of top management support, (2) to probe into the role of a company's dynamic capability in the process of IOIS assimilation leading to performance enhancement.

2. Literature Review and Hypotheses

2.1 IOIS Assimilation

Johnston and Vitale (1988) defined IOIS as a system that is established on information technology, such as computers and communication, and can facilitate functions like creating, storing, exchanging and transmitting information between companies. IOIS is a system that is founded upon information technology and connects multiple companies (Chi et al., 2007). Min and Galle (2003) considered the elec-

tronic connection between businesses as an IOIS application. It could connect upstream and downstream trading partners through the Internet and could also support a company's online trading, information exchange, etc (Grover & Saeed, 2007).

The assimilation of information technology often includes three steps: (1) the company learns about an information technology and begins to evaluate and decide whether to implement it (2) the company begins to implement the information technology and (3) the information technology is accepted within the company, is fully incorporated into the activities of the value chain and has become part of the routine work (Zhu et al., 2006). The definition of IOIS assimilation in this research is when an IOIS becomes a necessary part of the value chain activities after it is adopted, and has influences over most works within the company.

2.2 The Perspective of TOE

In the past, various studies discussed the significant factors that affected IOIS implementation of a company under the framework of "TOE" (e.g., Uchenna, 2008; Zhu et al., 2006). It is clear that this framework serves well as a theoretical viewpoint for the investigation of issues related to information technology. Thus, this research employs this perspective as the fundamental framework.

Tornatzky and Fleischer (1990) believed that the adoption and assimilation of new technologies in a company were under the influences of three major dimensions – "Technology – Organization – Environment." The "technological" dimension referred to a company's capability in possessing and applying new information technology; the "organizational" dimension is the characteristics of a company, such as capital amount, number of employees, or the level of globalization and the structure of management; the "environmental" dimension describes the business environment the company is in, including its industry, its competitors and the pressure it receives from the government.

In order to increase the content validity and to accommodate the research context of interest (IOIS), this study uses the factors from previous studies using the framework of "TOE" as the primary variables. Fifteen mid or top-level managers were interviewed to find out the factors that influenced the extent of IOIS assimilation in their companies. These fifteen respondents were selected through snowball sampling. Each of them participated in a thirty- to sixty-minute face-to-face interview (carried out by one of the authors), asking them to provide all sorts of potential factors. Seven variables were selected from the results of the interviews (the ones that were selected by over 70% of the respondents) to represent the three dimensions of technology, organization and environment. The "technological" dimension is consisted of technology readiness and technology integration; the "organizational" dimension is consisted of globalization level and top management support; the "environmental" dimension is consisted of government pressure, partner pressure and competition intensity. Each of the variables is explained in the following and corresponding hypotheses are proposed. Please note that this study included the variable "top management support," which was often ignored in previous research using the framework of "TOE" under the organizational dimension, hoping to further explore the role of the top management in the process of IOIS assimilation by an organization.

2.2.1 Technological Dimension – Technology Readiness

Technology readiness refers to the basic information technology capability a company possesses, including its sufficiency in software and hardware, and the number of information technology-related employees (Mata et al., 1995). The greater these related capacities are, the easier it is for a company to adapt to new information technology and for the new information technology to become part of the procedure for routine activities in the organization (Zhu & Kraemer, 2005). As for the IOIS

discussed in this study, it is built upon a company's existing electronic system. When a company already possesses a relatively strong foundation in information technology, it implies that its employees are more familiar with the electronic workflow and thinking mode, and thus, the IOIS that is being adopted is more likely to be accepted by the employees and be incorporated into the daily workflow. The more sufficient the company's software, hardware and knowledge in information technology are, the less technical difficulties there will be. These benefit the IOIS implementation, the integration of the system with current workflow and systems, and the advancement of IOIS assimilation. Hence, Hypothesis 1a is as follow:

Hypothesis 1a: Technology readiness positively affects IOIS assimilation.

2.2.2 Technological Dimension – Technology Integration

Zhu et al. (2006) claimed that technology integration played a crucial role in IOIS implementation while technology integration referred to the connectedness between the internal and external information systems of a company. An IOIS is not only involved with the information flow and value chain within a company, but more importantly, is also connected to the upstream and downstream trading partners outside the company. According to the research by Barua et al. (2004), a company can create competitive advantage (e.g., lower transaction cost, shorten production or service lead time) through information integration, which can be achieved by the company through combining its workflow with that of their upstream and downstream trading partners with the help of information technology. Consequently, when a company is rated high on technology integration, it helps with IOIS implementation. Also, with the company's Intranet and database system that are already highly integrated, it becomes even easier to increase the possibility of incorporating the IOIS into the daily workflow (Zhu & Kraemer, 2005). Thus, Hypothesis 1b is proposed as follow:

Hypothesis 1b: Technology integration positively affects IOIS assimilation.

2.2.3 Organizational Dimension – Globalization Level

In this study, globalization is defined as the extent of a company having worldwide trading partners and offering services such as global delivery (Zhu et al., 2006). When the globalization level is high, a company inevitably has to bear with greater cost in communication. Meanwhile, transaction and transportation expenses will also increase due to the company managing markets in different geographical locations (Zhu et al., 2004). These inefficiencies can actually be reduced with the assistance of electronic systems. Xu et al. (2004) found that higher globalization level would push a company towards automation while communicating with its trading partners through IOIS could benefit the company with information transparency, quick response time, etc., and thus, decrease the costs brought by globalization, such as in communication, transaction and transportation, (Garicano & Kaplan, 2001). Therefore, Hypothesis 2a is as follow:

Hypothesis 2a: Globalization level positively affects IOIS assimilation.

2.2.4 Organizational Dimension – Top Management Support

Top management support refers to the level of devotion and participation of the top management towards IOIS (Bajwa et al., 2008). Several studies have shown that top management support is one of the determinants often responsible for the outcome of the adopted information technology (e.g., Lee et al., 2009; Uchenna, 2008). On many occasions, failed implementation of a large-scale information technology was attributed to the lack of top management support. For example, part of the reason that a company fails in ERP implementation is because the top management does not have sufficient devotion to it (White & Fortune, 2002). At the same time,

if the top management has greater interest in information technology, they could do a better job in strengthening the prospect brought by the adopted information technology and could encourage their employees to utilize the information technology to generate superior performance (Jasperson et al., 2005). Consequently, Hypothesis 2b is then proposed:

Hypothesis 2b: Top management support positively affects IOIS assimilation.

2.2.5 Environmental Dimension – Government Pressure

The government has great influence over companies. For instance, the formulation of related regulations can become limitations or entry barriers for companies' investments. Subsidies can motivate the companies to adopt information technologies or to develop new techniques. The subsidies that the government offers will encourage the companies to accelerate the pace of their introduction of new information technology so that they can improve the condition of their operations and in return, influence the performance of the information technology implemented by the companies (Kraemer et al., 2006). In recent years, the Taiwan government has put forward some projects to aid the implementation of information technology like IOIS in companies. These include the "Promotion of Electronization among Small and Medium Enterprises" in 2002, the "Projects Serving the Application of New Technologies" in 2008 and the "Projects to Reduce Differences in Digitalization across Industries." These subsidiary projects help Taiwanese companies adopt inter-company information systems. Here, government pressure is defined as all sorts of measures and assistances that the government provides to encourage companies to adopt IOIS (Zhu et al., 2006).

2.2.6 Environmental Dimension – Partner Pressure

Hsu et al. (2006) suggested that the external pressure challenging a company mainly came from its upstream and downstream trading partners. This pressure was often one of the important factors that encouraged companies to adopt new information technologies. When all the trading partners used the same information technology, a company is likely to follow suit for the sake of maintaining their business relationships. In other words, for the pursuit of maximum value and the reduction in communication and negotiation costs, companies will prefer trading partners adopting the same system (Riggins et al., 1994). Additionally, it is possible that a company, out of transactional needs, will lure or intimidate its trading counterparts into the use of a particular information technology. And when a company is a leader in its industry, it even has the power to ask all of its partners to employ the same system. These are the things that will affect a company's level of assimilation of information technology. For instance, Wal-Mart asked all its partners to collaborate on the RFID technology and turned RFID into an information technology that was closely integrated into their workflows and was necessary for any commercial activities throughout the supply chain.

2.2.7 Environmental Dimension – Competition Intensity

This study defines competition intensity as the extent a company is influenced by the competitors in the market (Zhu et al., 2004). When a competitor has greater advantage, the company may be forced to enhance its competitiveness by adopting new information technologies in order to steer clear from elimination (Rai & Bajwa, 1997), or to rely on information technologies to avoid falling further behind its competitor. In other words, competition intensity will first affect the company's decision to adopt a new information technology, and since the company will want to maximize the benefit of this implementation, it will facilitate the assimilation of the technology (Zhu et al., 2006).

2.2.8 Top Management as a Mediator

According to the literature review on the environmental dimension as summarized above, one can see that the more appealing the government's assistance is, the more contribution the government can make towards IOIS internalization within a company. Also, when a company takes on the pressure from its partners, it will be motivated to employ IOIS and to integrate the system into its workflow. The greater competition intensity a company experiences from its competitors in the market, the more likely it will increase the level of IOIS assimilation. These viewpoints are also supported by the empirical study of Uchenna (2008). However, the study done by Hsu et al. (2006) had different results. Their conclusion was that the environment would not influence the implementation or assimilation of information technology. It is because of these conflicting empirical results on the relation between environmental factors and the implementation or assimilation of information technology that this study proposes the possibility of previous studies neglecting the role of the top management.

Top management would be affected by external environment and make policy decisions accordingly, which would then influence the resource allocation and employee behaviors both inside and outside the company (Shah & Siddiqui, 2006). The actions and decisions of the top management are determined by its judgment of the situation and its value beliefs. These in return play a part in how the top management outlines ideas for their company, such as their strategy, decision-making and future direction. Institution theory also confirmed that external pressure played a key role in the decision-making process of an organization, while government pressure, partner pressure and competitive environment would foster different kinds of driving forces for a company (Gular et al., 2002). Therefore, Liang et al. (2007) treated the top management as a mediator in their empirical research to explore the relation between institutional forces and the assimilation of information technology. They found that the top management promoted and assimilated the application of the ERP system due to the pressure from the external environment. Based on these findings, this study proposes three hypotheses as follow:

Hypothesis 3a: Government pressure positively affects IOIS assimilation through top management support.

Hypothesis 3b: Partner pressure positively affects IOIS assimilation through top management support.

Hypothesis 3c: Competition intensity positively affects IOIS assimilation through top management support.

2.3 Dynamic Capability and Performance

Researchers have disagreed on the factors that affected the implementation of information technology. So, this study first discussed the influence of TOE on the assimilation of information technology and the role of the top management. Previous research also had different viewpoints on whether or not an assimilated information technology can actually create competitive advantage for a company. Some scholars believed that information technology had a direct contribution to a better performance. For example, Bakos and Treacy (1986) pointed out that information technology could increase trading partner's switching costs. Other studies verified that the implementation of information technology could improve a company's performance and create competitive advantage (e.g., Zhu et al., 2004). However, other scholars suggested that competitors could implement the same kind of information technology, which revealed the fact that the research mentioned above overlooked a characteristic of information technology – the possibility of imitation (Teece et al., 1997). From this point of view, information technology cannot bring long-term competitive advantage to a company.

To resolve this controversy, Teece et al. (1997) proposed the idea that the imple-

mented information technology first needs to be integrated into a company's processes such as practice and workflow, and then create better performance through the improvement in the dynamic capability. Here, dynamic capability refers to the ability to integrate, to learn and to reallocate internal and external resources as a response to environmental changes (Teece et al., 1997). This capability allows a company to utilize its resources according to any change in the market and to systematically adjust its operation and routine work (Chen et al., 2008). Wu (2006) also believed that dynamic capability could generate better performance and bring competitive advantage to a company.

Teece et al. (1997) considered the dynamic capability in three parts. They are: processes which is a company's method of operation and problem-solving techniques; positions which refer to all kinds of disposable assets that a company owns; and paths which are the developmental course and strategy of a company in the past. In fact, dynamic capability is a company's ability to adapt to changes in the environment. Related research that explored a company's implementation of projects or information technology from the perspective of dynamic capability often focused on the process dimension of dynamic capability. For example, in the just-in-time manufacturing, the customer and supplier participation programs proposed by Banker et al. (2006) in their empirical research and the knowledge-based dynamic capability discussed by Wang et al. (2007) were all about companies generating better performance after improvements were made to their processes due to changes in the environment.

This study is concerned on two types of dynamic capabilities that can coordinate, integrate and reallocate internal and external resources, namely, supplier responsiveness and manufacturing flexibility. Supplier responsiveness is about the supplier's ability to fulfill the demand of a company (Carr & Smeltzer, 2000) while manufacturing flexibility is a company's ability to adapt to uncertainty in the environment (Correa & Slack, 1996).

Performance evaluation reflects the results of an organization's business activities. Countless research was done to find out whether or not the implementation of an information system could enhance performance (e.g., Zhu et al., 2004). Traditionally, financial results such as return of investment were used to evaluate a company's performance. Nonetheless, the effect of an implemented information technology might not be reflected completely on the finance of a company, because often times, financial information only conveys short-term outcomes and cannot reveal the long-term performance of a company (Ghalayini et al., 1997) like its long-term market share and innovations.

2.3.1 Dynamic Capability as a Mediator

Per earlier discussion, the viewpoint that information technology can generate competitive advantage for a company directly usually ignores the fact that information technology can be easily imitated by competitors within the industry. Thus, Teece et al. (1997) proposed the idea of dynamic capability. Although information technology cannot bring competitive advantage to a company by itself, the abilities, such as short response time and quick adaptation to market change (Zaheer & Zaheer, 1997), resulted from the connectedness between companies through the use of information technology are important bases for a company to develop competitive advantage. Sambamurthy et al. (2003) also found that a company's effective application of information technology could foster closer relationships with its trading partners while increasing the manufacturing flexibility of the company. In addition, Banker et al. (2006) showed that companies were able to create unique processes that generated better performance with the application of information technology that was integrated into a company's processes. For example, Dell was connected with its suppliers through the application of infor-

mation technology so that its suppliers could receive order information from Dell in real time. The suppliers relied on this system to grasp and predict the change in demand and to fulfill the delivery requests (Banker et al., 2006). In other words, information technology improved the responsiveness of Dell's suppliers and allowed Dell to deliver excellent performance (e.g., 983, 98% of the orders were fulfilled within three days), while the suppliers also developed greater flexibility. This study believes that after a company is connected with its upstream and downstream partners through IOIS, the system can enhance its dynamic capabilities, such as supplier responsiveness and manufacturing flexibility, once it assimilates this system and integrates it into its practices and processes, which then leads to improved performance. Thus, Hypothesis 4a and 4b are as follow:

Hypothesis 4a: IOIS assimilation positively affects a company's performance through supplier responsiveness.

Hypothesis 4b: IOIS assimilation positively affects a company's performance through manufacturing flexibility.

The framework of this study is shown in Figure 1.

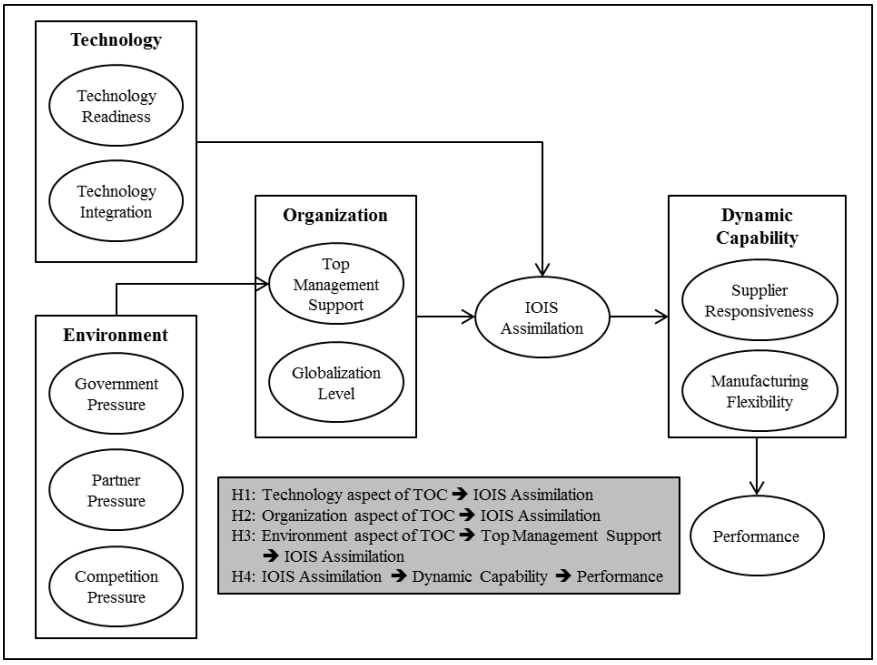

Figure 1: Research Model

3. Methodology

This study intends to explore the mediating roles of top management support and dynamic capability in how companies are using IOIS to deliver performance.

3.1 Measurement Items

The questionnaire contained six parts where parts five and six consisted of personal and company information collected for classification purposes. As for the first four parts, they consisted of 47 items to assess all the variables. Among these, seven questions were designed to evaluate the technology readiness in which five of them were yes/no questions used to measure level of information regarding various aspects of a respondent's company, such as e-mail, company's website, Intranet and the Internet. This level of information was calculated by adding up the points with 5 as the maximum value, and along with two

other items became the formative indicator for technology readiness. Other than the five items just mentioned, the rest of the questions were all measured with a 5-point Likert scale where 1 stood for strongly disagree and 5 meant strongly agree. All the questions were adapted from past studies related to company's performance and the implementation and assimilation of information system.

3.2 Respondents

Respondents of this study were all from Taiwanese manufacturers. Considering the fact that most median to small companies were likely to rate low on information due to the high cost of establishing information technology, the sample was selected from the top 1,000 manufacturers published by the Commonwealth magazine in 2014. Additionally, the respondents needed to be familiar with the market, IOIS and the process of communicating with trading partners. So this study surveyed managers or the person in charge who had good understanding of IOIS from departments such as manufacturing, sales, information, research and development, and finance. In order to confirm the respondents' willingness to fill out the questionnaires, 300 companies were randomly selected from the top 1,000 manufacturers mentioned above and phone calls were made to the managers of the manufacturing or sales departments to inquire on their willingness to participate. Questionnaires were emailed or mailed to the respondents after they expressed their willingness to collaborate.

4. Analyses

This study received 108 valid questionnaires. When it comes to company attributes, the industries of computer accessories and parts, semiconductor, and photoelectricity each accounted for 10% of the valid surveys and the remaining 70% came from other industries. Among these companies surveyed, 75% of them have been in the business for over 15 years. As for the number of employees, it was uniformly distributed with around 25% for each of the following categories: under 500 employees, 500 to 1,000 employees, 1,000 to 5,000 employees and more than 5,000 employees. Finally, over half of the companies have turnover of more than NT$10 billion. In terms of the attributes of the respondents, they mainly came from the information and sales departments, taking up 38.0% and 23.1%, respectively. Over half of them have been with the company for more than 10 years, and almost 70% of them were managers, which mean that most of our respondents had enough knowledge about his or her company, and thus, the information they provided were highly reliable.

4.1 Reliability and Validity

This study tested the research model and hypotheses with structural equation modeling (SEM). Since technology readiness and competition intensity are formative indicators, and our sample size is relatively small, Smart PLS 2.0 (Ringle et al., 2005) was used for follow-up analysis. Moreover, Hypotheses 3 and 4 were about mediating effects, so this study tested them according to the method proposed by Baron and Kenny (1986). First, the mediator was excluded from the model to examine whether the independent variable had any direct effect on the dependent variable, and then the mediator was added into the model to test the validity of its effect.

The analysis started out from testing the reliability and validity of the measurement model, and then analyzed the structural model so as to test the proposed hypotheses. The measurement model of this study contained 11 variables with technology readiness and competition intensity being the formative indicators, thus, reliability and validity analyses were performed on the 36 questions regarding the remaining 9 variables. All the factor loadings of the 36 questions were over the threshold value of 0.6 and ranged between 0.66 and 0.97, which meant the scales used in the study had good convergent validity. Also, according to Table 1, our scales had composite reliabilities all larger than the

threshold value of 0.7, average variance extracted (AVE) all greater than the 0.5 standard, and the square root value of each average variance extracted were all larger than the correlated coefficient of their corresponding variables. Thus, this study has good reliability, convergent validity and discriminant validity.

Table 1: Correlation, Composite Reliability and Average Variance Extracted

	Variables	1	2	3	4	5	6	7	8	9	CR	AVE
1	Manufacturing Flexibility	**0.85**									0.93	0.73
2	Globalization Level	0.25	**0.75**								0.83	0.56
3	Government Pressure	0.40	0.16	**0.91**							0.91	0.83
4	IOIS Assimilation	0.34	0.41	0.27	**0.94**						0.97	0.88
5	Performance	0.56	0.05	0.29	0.24	**0.87**					0.94	0.75
6	Partner Pressure	0.27	0.40	0.15	0.46	0.12	**0.89**				0.92	0.79
7	Supplier Responsiveness	0.58	0.13	0.25	0.37	0.63	0.16	**0.91**			0.95	0.83
8	Technology Integration	0.31	0.33	0.15	0.49	0.10	0.31	0.16	**0.86**		0.85	0.74
9	Top Management Support	0.24	0.20	0.28	0.49	0.23	0.36	0.13	0.37	**0.93**	0.98	0.87

4.2 Hypothesis Testing

Hypotheses 1 and 2 in this study were about the direct influences between variables. They explored the effects of technological and organizational aspect of TOE perspective on IOIS assimilation. This study also included number of employees and company's turnover as control variables that each influenced performance and IOIS assimilation. Based on the analytical results of the structural model as shown in Figure 2, only technology readiness had an insignificant influence. This meant that Hypothesis 1a was not supported by the data while Hypotheses 1b, 2a and 2b were. Meanwhile, the technological and environmental dimensions accounted for 41% of the variance within IOIS assimilation, implying that they are major determinants of the assimilation of information technology. As for performance, the independent variables also explained 46% of its variance. This reflected the fact that variables were adequately chosen in this research model and should be able to properly investigate our research questions.

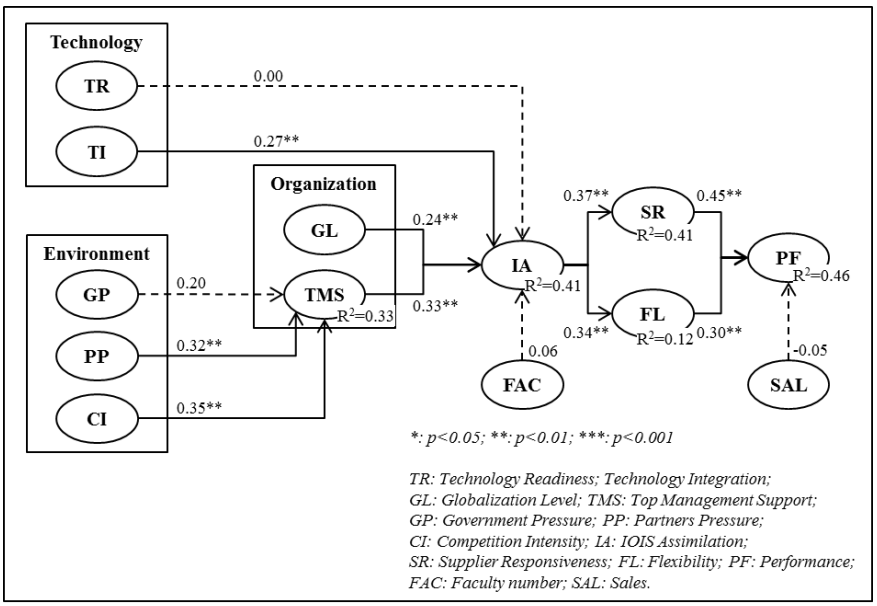

Figure 2: Direct Effect Test Results

The analysis of mediating effect was divided into two parts. First of all, this study tested whether the three factors under the environmental dimension would affect IOIS assimilation through top management support. Since the relationship between "Government Pressure" (GP) and "Top Management Support" did not receive statistical support, Hypothesis 3a was not supported. In order to test the direct effect of "Government Support" (GP) on "IOIS assimilation" (IA), this study did another round of analysis on the structural model by adding the relation between these two variables into the model. The relationship was still statistically insignificant (coefficient = 0.12, t-value = 1.43). As for "Partner Pressure" (PP), this study also included a direct path between "Partner Pressure" (PP) and "IOIS Assimilation" (IA) into the model and redid the analysis. The results showed statistical support for this relationship (coefficient = 0.21, t-value = 2.22) and confirmed Hypothesis 3b. In other words, partner pressure would directly influence the IOIS assimilation, or indirectly influence it through top management support. In addition, this study also incorporated the relationship between "Competition Intensity" (CT) and "IOIS Assimilation" (IA) into the analysis. The outcome was an insignificant relationship between the two (coefficient = 0.18, t-value = 1.74). Following the advice of Baron and Kenny (1986), the direct relationship described above was tested again after "top management support" was excluded from the model, and the result demonstrated support for the relationship between "Competition Intensity" (CI) and "IOIS Assimilation" (IA) (coefficient = 0.26, t-value = 2.80). This supports Hypothesis 3c with "Top Management Support" (TMS) as a full mediator.

In the second part, this study tested whether the IOIS assimilation would affect the performance of an organization through the two types of dynamic capability. Same as what was done in the previous section, the direct relationship between "IOIS Assimilation" (IA) and "Performance" (PF) was entered into the structural model for analysis, and the outcome revealed that the relationship was insignificant (coefficient = -0.03, t-value = 0.32). Again, based on the suggestions of Baron and Kenny (1986), this study redid the analysis after the variables "Supplier Responsiveness" (SR) and "Manufacturing Flexibility" (FL) were excluded from the model. The findings showed a statistically significant relationship between "IOIS Assimilation" (IA) and "Performance" (PF) (coefficient = 0.27, t-value = 2.93). This means Hypotheses 4a and 4b were supported and the two dynamic capability variables were both full mediators.

5. Discussion and Suggestions

As far as the direct effects are concerned, the results for Hypotheses 1 and 2 are shown in Figure 2 where Hypotheses 1b, 2a and 2b all received support from the data. Only Hypothesis 1a did not reach the significance level. It is worth noticing that technology readiness under the technological dimension did not have a significant effect on the IOIS assimilation, which is different from the findings in Zhu et al. (2006). A possible explanation is that, in the past few years, electronic infrastructure has become a necessity for competition (Bhatt & Grover, 2005) due to considerable decrease in the cost of information technology and to the high competition within the industry. This forces companies to have sufficient basic software and hardware equipment and information personnel. (The results of our data analysis also revealed that the average score for each of the three technology readiness questions were 4.65, 4.14 and 4.07, and their standard deviations were 0.67, 0.92 and 0.81.) This made it hard to demonstrate any significant influence on the level of IOIS assimilation. As for the variable technology integration under the technological dimension, the outcome was consistent with that of Zhu et al. (2006). In comparison, technology integra-

tion plays a more important role in IOIS assimilation.

The two factors under the organizational dimension are globalization level and top management support, which both had positive and significant influences on IOIS assimilation. That is to say those companies with higher level of globalization must rely on information technology to enhance the efficiency of their internal workflow and to strengthen their relationships with the supply chain partners in terms of information exchange and collaboration. Additionally, top management support for IOIS will bring more resources and attention to it, which is beneficial to IOIS assimilation.

In terms of the mediating effects, Hypotheses 3c, 4a and 4b were supported while Hypothesis 3b received partial support and Hypothesis 3a did not reach the significance level. This study investigated two important mediators, top management support and dynamic capabilities. The former mediated the relationship between the three factors of environmental dimension and IOIS assimilation while the latter mediated the relationship between performance and IOIS assimilation. Regarding the environmental dimension, government pressure neither directly nor indirectly, through top management support, influenced IOIS assimilation. Yet, partner pressure acted in a completely opposite way. It directly or indirectly affected IOIS assimilation through top management support, while competition intensity cast its influence only through top management support. Overall, top management support played the role of a partial or full mediator, which confirmed the viewpoint of Liang et al. (2007) that the top management is the first to experience the pressure from the environment and then initiated changes within the company.

Unlike what was suggested in the research of Hsu et al. (2006), government pressure had neither direct nor indirect influence on IOIS assimilation. This perhaps reflected the insufficient effort made by the Taiwanese government to promote or demand companies to invest in and apply IOIS, thus, the top management did not sense the urgency or pressure. The government failed to have direct influence on increasing the level of IOIS adoption. As for partner pressure, other than the fact that it dictated IOIS assimilation through top management support, it also had a direct influence on the assimilation. This may imply the existence of other mediators, for instance, the employees might have played the role of an alternative mediator. That is, partners from the supply chain may not limit their contact only to the top management. It is likely that they engage in various kinds of transactions and tasks directly with the employees, so other than the top management, other employees can also feel the pressure from the supply chain partners and are inclined to integrate the IOIS into everyday tasks, which, in turn, achieve in a higher level of assimilation of the system. The analysis also revealed that competition intensity could only influence IOIS assimilation through top management support, which is consistent with our hypothesis.

In terms of the mediating effect of dynamic capability, the results suggested that an increase in the level of IOIS assimilation would have a positive influence on the company's performance, but it worked through dynamic capability rather than a direct effect, a result that was also found in the study of Wang et al. (2007). This finding showed that not only the assimilated IOIS can change a company and improve on two of the dynamic capacities, namely, supplier responsiveness and manufacturing flexibility. But it can also enhance a company's performance through the improvement of these two dynamic capabilities. Furthermore, the results also demonstrated that information technology could not provide a company with better performance directly. Just like what the resource-based view calls attention to, only by creating special abilities through information technology that are hard to be imitated can a company generate competitive advantage.

5.1 Implications

Theoretically, this study is another work that is based upon the perspective of TOE. But what sets it apart from previous research is the idea of top management playing a mediating role. There are similarities between our results and that of Liang et al. (2007), which showed that the top management was indeed under the influence of external environment and played the leading role in an organization when it came to facing the pressure from the environment. This pushed it to initiate changes within the company. It is worth noting that among earlier research that employed the framework of TOE, they mostly believed that the top management could directly affect the implementation or assimilation of information technology, but this study advocated a relationship among the three dimensions of technology, organization and environment, where they influenced one another. This study found that although government pressure had neither a direct nor an indirect effect on IOIS assimilation, the top management partially or fully mediated the influence of supply chain partners and competition intensity.

In addition, this study explored the influence of assimilated information technology. Most of the prior research only discussed issues related to the implementation of information technology (e.g., Hsu et al., 2006). Yet when an information technology reached the implementation phase, it could not have major influence on the company. So this study focused on the assimilation of information technology (Zhu et al., 2006). Regarding the effect of assimilated information system, this discussion centered on the performance it generated, and the results confirmed that IOIS could actually promote performance but it must go through the development of dynamic capabilities in order to have any effect. This is to say that whether or not a company can create unique abilities through information technology will be the key to whether or not an information technology can produce competitive advantage for a company. This study also suggests that due to the difficulty in truly reflecting the change in a company brought by information technology during the phases of implementation or application, future research should expand into the phase of assimilation when exploring the influence of information technology on a company, or to discuss the three phases of implementation, usage and assimilation simultaneously (Lee et al. 2009).

Finally, this study confirmed that dynamic capability played the role of a mediator that connected information technology and performance (Banker et al., 2006). At the same time, the development of dynamic capability effectively improved a company's performance. Future research can also build on this concept when examining the relationship between information technology and performance.

In terms of practical implications, technology integration had relatively more direct influence on the assimilation of information technology when compared with technology readiness. Most of the companies were already high in technology readiness, reflecting the fact that investment in the infrastructure of information technology had already become a necessary factor for all companies to compete for their survival. Thus, it was harder for technology readiness to show any significant influence on the companies in this study. As a result, readiness in the infrastructure of software and hardware equipments is only the basic, what is more important to a company is the level of integration of the internal and external information systems. This integration can effectively help a company to reach a higher level of assimilation during the application of IOIS.

Meanwhile, one should not ignore the influence of top management on a company. Past research has proved that the top management contributed to the implementation of information systems within a company. This study discovered that the top management also played the role of a mediator between external environment and changes

within an organization. Inside a company, many thriving projects or smooth implementation of information technologies were often initiated by the leader and relied on the integration of resources within the organization. Gaining top management support can help guarantee the success of a project. The top management is also the one that interacts with trading partners. Application of the same information system by members of the supply chain in completing transactions will be the strongest driving force to assimilate information technology. In addition, this study found that it was possible for partner pressure to affect employees and lead to IOIS assimilation. From the company's point of view, having the top management and employees who share the same understanding of the dynamics of the supply chain can encourage the top management to invest more resources in IOIS or increase the likelihood of employees handling everyday tasks through IOIS. These allow information technology to bring greater benefit. Other than these, the top management also plays a key role in direct contact with competitive pressure. When the top management feels the fierce competition intensity within the industry, it will strengthen its confidence and action to promote IOIS assimilation that leads information technology to bring value to the cooperative interactions between the company and its supply chain partners.

Perhaps unique to our Taiwanese sample, this study, did not find support for the direct and indirect influences of government pressure over IOIS assimilation unlike previous research. Although the Taiwanese government promoted several exemplary subsidiaries for information in recent years and assisted hundreds of companies with their development of systems related to supply chain integration, the results of this study showed that the government's influence over companies was still limited. Thus, the government should be more aggressive and supply related resources. It should motivate the companies to adopt IOIS through the formulation of regulations, lowering tax or the implementation of other incentives.

Moreover, this study again verified that information system was a positive asset for a company. In other words, companies should not hold back their investment in information technology but they must pay attention to careful evaluation and strict execution so that the information system and business workflow can be closely integrated. Also, when a company implements an information system, it should place special emphasis on how the system is actually being used. This is because the effect of an information system is not immediate. The system needs to be combined with daily tasks and business processes in order to transform the capabilities of a company and then create better performance. Without integrating IOIS into the processes that the trading partners interact with, a company cannot increase the collaboration efficiency of its suppliers or the flexibility of its production. In this case, the implementation is only a waste of resources and cannot produce much benefit for the company.

5.2 Limitations

Constrained by factors such as manpower, resources and time, one of the biggest limitations of this research was the small sample size. Thus, future research should make an effort in increasing the sample size so as to ensure robust statistical results. Because each questionnaire was filled out by one single respondent, it is possible that the questionnaire did not reflect the actual condition of the company. The authors suggest that future studies should have one questionnaire filled out by a group of respondents, survey more people within one company, or even conduct data collection through case studies. These approaches can better examine the true condition of IOIS assimilation. The measure of technology readiness in this research failed to capture the variance across different companies, probably due to the fact that most companies were all quite developed

in their software and hardware infrastructure. Future research can device other methods to measure this variable. Lastly, this study only sampled the manufacturing industry in Taiwan, thus, the results cannot be generalized to other industries or countries. However, its model can serve as a foundation for future research on different industries (e.g., the service sector) or on international comparison to understand how information technology changes the capabilities of other industries, how does it influence company's performance, etc.

References

Bajwa, D. S., Lewis, L. F., Pervan, G., Lai, V. S., Munkvold, B. E., & Schwabe, G. (2008). Factors in the global assimilation of collaborative information technologies: An exploratory investigation in five regions. *Journal of Management Information Systems*, *25*(1), 131-165.

Bakos, J. Y., & Treacy, M. E. (1986). Information technology and corporate strategy: A research perspective. *MIS Quarterly*, *10*(2), 107-119.

Banker, R. D., Bardhan, I. R., Chang, H., & Lin S. (2006). Plant information systems, manufacturing capabilities, and plant performance. *MIS Quarterly*, *30*(2), 315-337.

Baron, R., & Kenny, D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173-1182.

Barua, A. P., Konana, A. B., & Whinston, F. Y. (2004). Assessing Internet enabled business value: An exploratory investigation. *MIS Quarterly*, *28*(4). 585-620.

Carr, A. S., & Smeltzer, L. R. (2000). An empirical study of the relationships among purchasing skills and strategic purchasing, financial performance, and supplier responsiveness. *Journal of Supply Chain Management*, *36*(3), 40-54.

Carr, N. G. (2003). IT doesn't matter. *Harvard Business Review*, *81*(5), 41-49.

Chen, R. S., Sun, C. M., Helms, M. M., & Jih, W. J. (2008). Aligning information technology and business strategy with a dynamic capabilities perspective: A longitudinal study of a Taiwanese Semiconductor Company. *International Journal of Information Management*, *28*(5), 366-378.

Chi, L., Holsapple, C. W., & Srinivasan, C. (2007). Competitive dynamics in electronic networks: A model and the case of interorganizational systems. *International Journal of Electronic Commerce*, *11*(3), 7-49.

Correa, H. L., & Slack, N. (1996). Framework to analyze flexibility and unplanned change in manufacturing systems. *Computer Integrated Manufacturing Systems*, *9*(1), 57-64.

Garicano, L., & Kaplan. N. (2001). The effects of business-to-business e-commerce on transaction costs. *Journal of Industrial Economics*, *49*(4), 1-23.

Ghalayini, A. M., Noble, J. S., & Crowe, T. J. (1997). An integrated dynamic performance measurement system for improving manufacturing competitiveness. *International Journal of Production Economics*, *48*(3), 207-225.

Grover, V., & Saeed, K. (2007). The impact of product, market, and relationship characteristics on inter-organizational system integration in manufacturer-supplier dyads. *Journal of Management Information Systems*, *23*(4), 185-216.

Gular, I., Guillen, M. F., & MacPherson, J. M. (2002). Global competition, institutions, and the diffusion of organizational practices: The international spread of ISO 9000 quality certificates. *Administrative Science Quarterly*, *47*(2), 207-232.

Hartono, E., Li, X., Na, K., & Simpson, J. T. (2010). The role of the quality of shared information in interorganizational systems use. *International Journal of Information Management*, *30*(5), 399-407.

Hsu, P., Kraemer, K. L., & Dunkle, D. (2006). Determinants of e-business use in U.S. firms. *International Journal of Electronic Commerce*, *10*(4), 9-45.

Jasperson, J., Carter, P. E., & Zmud, R. W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work Systems. *MIS Quarterly*, *29*(3), 525-557.

Johnston, H. R., & Vitale, M. R. (1998). Creating competitive advantage with interorganizational systems. *MIS Quarterly*, *12*(2), 153-165.

Kraemer, K. L., Dedrick, J., Melville, N., & Zhu, K. (2006). *Global e-commerce: Impacts of national environments and policy*. Cambridge, UK: Cambridge University Press.

Lee, O., Wang, M., Lim, K. H., & Peng, Z. (2009). Knowledge management systems diffusion in Chinese enterprises: A multistage approach using the technology-organization-environment framework. *Journal of Global Information Management*, *17*(1), 70-84.

Lian, J. W., Yen, D. C., & Wang, Y. T. (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. *International Journal of Information Management*, *34*(1), 28-36.

Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. *MIS Quarterly*, *31*(1), 59-87.

Mu, E., Kirsch, L. J., & Butler, B. S. (2015). The assimilation of enterprise information system: An interpretation systems perspective. *Information & Management*, *52*(3), 359-370.

Mata, F., Fuerst, W., & Barney. J. (1995). Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quarterly*, *19*(4), 487-505.

Min, H., & Galle, W. P. (2003). E-purchasing: profiles of adopters and nonadopters. *Industrial Marketing Management*, *32*(3), 227-233.

Neirotti, P., & Paolucci, E. (2011). Assessing the importance of industry in the adoption and assimilation of IT: Evidence from Italian enterprises. *Information & Management*, *48*(7), 249-259.

Rai, A., & Bajwa, D. S. (1997). An empirical investigation into factors relating to the adoption of executive information systems: An analysis of EIS for collaboration and decision support. *Decision Science*, *28*(4), 939-974.

Riggins, F., Kriebel, C., & Mukhopadhyay, T. (1994). The growth of interorganizational systems in the presence of network externalities. *Management Science*, *40*(8), 984-998.

Ringle, C. M., Wende, S. & Will, S. (2005). SmartPLS 2.0 (M3) beta, Hamburg, http://www.smartpls.de.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly*, *27*(2), 237-263.

Shah, M. H., & Siddiqui, F. A. (2006). Organisational critical success factors in adoption of e-banking at the Woolwich bank. *International Journal of Information Management*, *26*(6), 442-456.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533.

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological inno-*

vation. Lexington, MA: Lexington Books.

Uchenna C. E. (2008). E-business deployment in Nigerian financial firms: An empirical analysis of key factors. *International Journal of E-Business Research*, *4*(2), 29-46.

Wang, E. T. G., Klein, G., & Jiang, J. J. (2007). IT support in manufacturing firms for a knowledge management dynamic capability link to performance. *International Journal of Production Research*, *45*(11), 2419-2434.

White, D., & Fortune, J. (2002). Current practice in project management-An empirical study. *International Journal of Project Management*, *20*(1), 1-11.

Wu, L. Y. (2006). Resources, dynamic capabilities and performance in a dynamic environment: Perceptions in Taiwanese IT enterprises. *Information & Management*, *43*(4), 447-454.

Xu, S., Zhu, K. & Gibbs, J. (2004). Global technology, local adoption: A crosscountry investigation of Internet adoption by companies in the United States and China. *Electronic Markets*, *14*(1), 13-24.

Zaheer, A., & Zaheer, S. (1997). Catching the wave: Alertness, responsiveness, and market influence in global electronic networks. *Management Science*, *43*(11), 1493-1509.

Zhang, C., Xue, L., & Dhaliwal, J. (2016). Alignments between the depth and breadth of inter-organizational systems deployment and their impact on firm performance. *Information & Management*, *53*(1), 79-90.

Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research*, *16*(1), 61-84.

Zhu, K., Kraemer, K. L., Xu, S., & Dedrick. J. (2004). Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of Management Information Systems*, *21*(1), 17-54.

Zhu, K., Kraemer, K., & Xu, S. X. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science*, *52*(10), 1557-1576.

Zhu, Y., Li, Y., Wang, W., & Chen, J. (2010). What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry. *International Journal of Information Management*, *30*(3), 265-276.

About Authors

Shu-Chen Yang is an associate professor in Department of Information Management, National University of Kaohsiung, Taiwan. Professor Yang received his Ph.D. and M.S. in Information Management from the National Central University, Taiwan. He is also a visiting professor in Rangsit University, Thailand. He has published in several referred journals (e.g., Psychology and Marketing, International Journal of Information Management, Journal of Management, Journal of Business Ethics, Asia Pacific Management Review, Journal of Information Management, Journal of e-Business, Management Review, Managing Service Quality, Internet Research, and others) and conference papers. His current research interests are in Internet marketing, supply chain management, and e-business.

Chia-Chun Kang is a doctoral student in College of Finance and Banking, National Kaohsiung First University of Science and Technology, Taiwan. Her current research interests are in Business Governance and Financial Derivatives.

Zhong-Yu Chao is a graduate student in Department of Information Management, National University of Kaohsiung, Taiwan. His current research interests are in supply chain management and e-business