IMR
27,2

200

Received June 2008
Revised March 2009
September 2009
Accepted October 2009

Relationship learning and performance enhancement via advanced information technology

The case of Taiwanese dragon electronics firms

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Abstract

Purpose – There has been growing interest on how emerging country firms can improve collaborative relationships with their international supply chain partners and improve performance outcomes. This paper aims to develop and test a model which emphasizes how advanced information technology and relationship learning can help Taiwanese electronics firms to improve their working relationship with international buyers.

Design/methodology/approach – Data were collected from 246 Taiwanese electronics firms which nurture relationships with international buyers. Structural equation modeling was employed to test the interrelationships between key concepts in the proposed conceptual model.

Findings – The findings suggest that applied technological innovation, a key IT resource, can enhance relationship learning for suppliers in their dealings with international buyers. This in turn contributes to higher supplier innovativeness and relationship performance. Moreover, applied technological innovation can improve supplier innovativeness directly. Interestingly however, applied technological innovation does not directly contribute to relationship performance.

Research limitations/implications – This paper provides empirical evidence on the contribution of applied technological innovation on enhancing relationship learning and innovation in interfirm relationships for Asia-Pacific dragon electronic firms.

Practical implications – Managers should focus on building relationship learning and adopting advanced IT to support joint learning activities in international channel relationships in order to improve relationship outcomes.

Originality/value – The paper develops hypotheses and tests a conceptual model which explains the contribution of applied technological innovation and relationship learning on supplier innovativeness and relationship performance.

Keywords Communication technologies, Innovation, Channel relationships, Taiwan, Emerging markets

Paper type Research paper

1. Introduction and motivation

Emerging market firms have been at the center of attention recently. Emerging market multinational enterprises (MNEs) are challenging Western firms in their core markets (The Economist, 2008) and top companies from developing countries in diverse industries such as electronics, automotive, and consumer durables are emerging. MNEs from the Asia-Pacific region are particularly visible, with firms such as Li and

Fang, Fan of HongKong, Haier of China, Samsung, and LG of Korea, Samling of Malaysia, and Acer of Taiwan headquartered in Singapore leading the list of MNEs (Chao *et al.*, 2003; Chao *et al.*, 2004). This phenomenon has recently resulted in an increasing number of academic contributions examining the international marketing strategy employed by Asian firms from emerging markets (Chao *et al.*, 2003; Dunning, 2006; Mathews, 2006). Several studies have mentioned that marketing strategies of Asia-Pacific emerging market firms are different from the marketing strategies from developed countries (e.g. Lee and Griffith, 2004; Mathews, 2006). Having served as OEM (original equipment manufacturer) suppliers for their Western customers, these firms have effectively leveraged interfirm learning mechanisms with their partners and proceeded to develop their own innovative capabilities further. Today, many firms from the Asia-Pacific region are now successfully deploying product design and innovation for their partners. Mathews (2006) refers to these new players in the twenty-first century as “dragon” multinationals. For example, HTC, a Taiwanese original design manufacturer (ODM) has developed a unique reputation for innovative research and design capability in providing high quality mobiles for Western telecom companies like Sony Ericsson and Vodafone. Furthermore, Asian firms are building their success on sophisticated information technology (IT) and e-commerce infrastructure and have integrated these advanced information technologies into their international marketing strategies including the management of their international supply chain relationships (Wood, 2004). Despite anecdotal evidence and conceptual discussions of how developing and newly industrialized country firms may succeed in the global marketspace, empirical evidence on this issue is still scant (Aulakh, 2007). Specifically, while relationship learning and advanced IT were identified as critical dimensions for Asia-Pacific firms to succeed in the management of international supply-chains (Chao *et al.*, 2003; Myers and Mee-Shew, 2008), little attention has been given to their innovation and performance outcomes.

This paper is set up to examine marketing strategies of MNEs from emerging markets. Particularly, it will focus on the role of advanced IT and relationship learning in the interaction of suppliers from the Asia-Pacific region and their international buyers. Asia-Pacific suppliers are facing significant pressures from their demanding international buyers, as, compared with developed country MNEs, MNEs from developing countries tend to be smaller and usually at a disadvantage compared to their partners (Cuervo-Cazurra and Genc, 2008). Relationship learning is arguably a pivotal dimension by which companies can learn from one another to increase their knowledge base and develop innovative capabilities for mutual benefits (Myers and Mee-Shew, 2008). However, relationship learning cannot be mandated by either organization; in the Asia-Pacific context the partners’ willingness to cooperate in learning activities (Selnes and Sallis, 2003) may take different forms from the traditional western context which has caught most of the attention in studies to date (Chen *et al.*, 2009).

This is where the role of advanced IT may come into play. An emerging stream of research seeks to link advanced technology with learning and organizational issues within the organization (Kane and Alavi, 2007; Real *et al.*, 2006; Tippins and Sohi, 2003; Yamin and Sinkovics, 2007). However, most of previous work focuses on intra-organizational learning. Few empirical studies have tried to extend the focus toward the impact of IT on inter-organizational learning (Malhotra *et al.*, 2005). This study looks into a specific aspect of inter-organizational learning, relational learning facilitated by advanced IT in the supplier-customer relationships in upstream international supply

chains. Particularly, we focus on supply chain communication systems (SCCS), a specific form of interorganizational information systems. According to Kim *et al.* (2006), we define SCCS as an information system shared by channel members in order to facilitate transactions, quality and cost calibration, and collaborative forecasting and planning. The communication and coordination nature of SCCS is expected to influence firm relationship learning activities in supplier-customer relationships.

This paper extends existing research on relationship learning in the supplier-customer context in the following ways: First, we contribute to the emergent interest on international marketing in the Asia-Pacific region (Chao *et al.*, 2004). Second, we follow up on Chao *et al.*'s (2003) call for research on the link between the internet, e-commerce and Asia-Pacific firms in terms of managing supplier-customer relationships. Third, we contribute to the limited research exploring the relationship between relationship learning and innovativeness (Chen *et al.*, 2009).

The paper is organized as follows: We start by briefly reviewing the resource-based view (RBV), as related to IT and relationship learning in international supplier-customer relationships. Following, a conceptual framework that links IT advancement to relationship learning, innovativeness and relationship performance is proposed. This is then followed by a discussion of the survey methodology and empirical findings. We conclude by discussing the results, their theoretical and managerial implications, and draw up some limitations and suggestions for future research.

2. Theory and hypothesis development

The focus of this paper is to discuss how suppliers can leverage IT systems to create value through firm learning capability in exchange relationships. The extant literature on the link between IT systems and interfirm relationships is dominated by transaction cost economics (TCE) theory (Williamson, 1975). TCE argues that IT can enhance firm information processing capability and thus reduce firm internal and external coordination and communication costs, which in turn leads to the restructuring of governance issues in exchange relationships (Clemons *et al.*, 1993; Malone *et al.*, 1987). Yet, as TCE focuses on the impact of IT on cost and opportunism minimization instead of value creation TCE lacks explanatory power on how IT can create value for suppliers in international customer-supplier relationships. This is where an emerging view, rooted in the resource-based view (RBV), draws theoretical legitimacy. This RBV-based literature discusses how IT systems influence interfirm relationships and firm value creation (e.g. Wu *et al.*, 2006).

According to the RBV, firms can achieve sustained competitive advantage through accumulating different valuable, rare, imitable, and non-substitutable resources and capabilities (Barney, 1991). How to leverage resources and capabilities in creating and sustaining competitive advantage for the firm has become the central focus for marketing scholars. Prior studies have tried to link different resources and capabilities with various performance outcomes for the firm. Within the RBV theory framework not all resources are seen as source of firm competitiveness. Thus, it is critical to understand the conditions and circumstances under which firm resources and capabilities can reap benefits for the firm.

Recent studies on the impact of IT on interfirm relationships argue that IT can generate competitive value in an exchange relationship only when it is leveraged by combining it with complementary interorganizational resources and capabilities (Wu *et al.*, 2006). For example, specific channel capabilities such as information exchange,

coordination and responsiveness has been identified as key channel capabilities which mediate the link between IT and firm performance (Kim *et al.*, 2006; Wu *et al.*, 2006). The literature seems to provide support for the propositions that firms must combine IT resources with strategic intent to realize a favorable effect on firm performance in an exchange relationship (Davis and Golicic, 2009).

Recent studies further suggest that organizational learning plays a significant role in mediating the effects of IT resources on firm benefits (Tippins and Sohi, 2003). Organizational learning, an information-intensive capability, can leverage IT to process information in a superior manner. IT can enable a firm to develop and accumulate knowledge stores about its customers, suppliers and market demand which in turn influences firm resources (Tippins and Sohi, 2003). Following this stream of research, we examine a more specific form of organizational learning, namely relationship learning which allows converting IT resources into positive outcomes for suppliers.

Relationship learning is an important process which plays a crucial role in enhancing a firm's capability and competitive advantage in interorganizational relationships (Dyer and Singh, 1998; Selnes and Sallis, 2003). Selnes and Sallis (2003) define relationship learning as "a joint activity between a supplier and a customer in which the two parties share information, which is then jointly interpreted and integrated into a shared relationship-domain-specific memory that changes the range or likelihood of potential relationship-domain-specific behavior" (Selnes and Sallis, 2003, p. 80). Much of the recent literature on relational exchange dimensions builds on this conceptualization and reinforces the importance of relationship learning (Ling-yee, 2006) in creating firm value in interorganizational relationships. Chang and Gotcher (2007) highlight relationship learning as a tool to safeguard investments in asymmetric international subcontracting relationships, Myers and Mee-Shew (2008) provide insights from a dyadic study of the international supply chain and conclude that relationship learning[1] is highly beneficial, particularly for suppliers in the global supply-chain. Selnes and Sallis (2003) divide relationship learning into three sub-processes which include relationship learning by:

- (1) sharing information;
- (2) joint sense making; and
- (3) developing relationship – specific memories.

Our study adopts Selnes and Sallis' (2003) conceptualization of relationship learning.

In this study, we examine the implementation of advanced IT in SCCS (applied technological innovation). We propose that relationship learning is a key mediator of the effect of sophisticated and innovative IT on supplier relationships and innovation benefits in international supply chain relationships. We argue that through embedding advanced IT in a firm's international supply chain relationships, IT can facilitate the development of higher-order organizational capabilities, namely relationship learning, which can help firms achieve favorable performance outcomes in supply chain relationships (Davis and Golicic, 2009; Dong *et al.*, 2009). The focal performance construct in this study is relationship performance. We focus on relationship performance as an outcome variable because the emerging view of IT value research recognizes that IT investments change the nature of relationships and thus enhance relationship quality and relationship performance (Jean *et al.*, 2008; Sriram and Stump,

2004). Yet, despite this notion empirical evidence on this area is still limited and thus warrants further investigation (Ryssel *et al.*, 2004).

2.1 Conceptual framework

According to our previous discussions and drawing on the RBV, we propose a conceptual model that consists of applied technological innovation, relationship learning, supplier innovativeness and firm relationship performance, as shown in Figure 1. We propose that applied technological innovation as a resource, enhances higher organizational capabilities, specifically relationship learning, which in turn influences supplier innovativeness and relationship performance in international supplier-customer relationships. Furthermore, we expect that applied technological innovation also directly impacts on suppliers' innovativeness and relationship performance. Each construct and their interrelationships will be discussed subsequently.

2.2 Hypothesis

2.2.1 *Applied technological innovation and relationship learning.* Applied technological innovation is defined as the extent to which a firm adopts or uses the most advanced technology (Kim *et al.*, 2006). In our model, applied technological innovation mainly refers to the deployment of the most advanced IT for the suppliers to improve their supply chain communication systems (SCCS) in international supply chain relationships (Kim *et al.*, 2006). According to Kim *et al.* (2006), we define SCCS as an information system shared by channel members in order to facilitate transactions, quality and cost calibration, and collaborative forecasting and planning.

Applied technological innovation in SCCS is expected to facilitate three sub-processes of relationship learning including information exchange, joint sense making and relational-specific memory in international supply chain relationships. This is consistent with the RBV which argues the complementarities of firm resources in value creation (Powell and Dent-Micallef, 1997). Complementarity is said to exist when the value of one resource is enhanced by the presence of another resource (Tippins and Sohi, 2003).

Figure 1.
Proposed conceptual
model

Accordingly, the value of advanced IT can be enhanced by complementing with relationship learning, an information-intensive interorganizational process,

First of all, unlike traditional Electronic Data Interchange (EDI), new formats of Internet-based interorganizational information systems such as extended markup language (XML) allow firms to link with a large number of supply chain partners and exchange rich information which goes beyond day-to-day transaction-related information. Therefore, it is expected that the advancement of technological innovation in supply chains such as the Internet facilitates the breath and quality of information exchange between suppliers and their international customers.

Joint sense making of relationship learning refers to the customer and the supplier in the exchange relationship jointly interpreting information in order to resolve problems and discussing strategy (Selnes and Sallis, 2003). Advanced IT in SCCS such as collaborative planning, forecasting, and replenishment (CPFR) or advanced warehouse systems can help uncover patterns in data and help process large quantities of raw data. Such systems can help to interpret information in a more timely and accurate way for supply chain partners (Malhotra *et al.*, 2005). Moreover, advanced IT in SCCS such as IT-enabled interpretation systems enables information obtained from supply chain partners to be organized, rearranged, and processed to create new knowledge (Malhotra *et al.*, 2005). Due to IT-enabled connectivity, firm members in supply chain relationships can more easily share individual interpretations of the information making consensus development more efficient (Tippins and Sohi, 2003).

In line with the concept of organizational memory (Walsh and Ungson, 1991), relationship-specific memory refers to an ongoing joint activity between the customer and supplier directed at integrating acquired information into a shared relationship-domain-specific memory that has the potential to influence behavior (Selnes and Sallis, 2003). Relationship memory can be evident and manifest in the form of physical artifacts such as contractual documents, computer databases, and programming (Ling-ye, 2006; Lukas *et al.*, 1996). It has been argued that technological innovation in SCCS like CPFR can serve as a relational contract which enhances mutual commitment between channel partners and thus refreshes relationship memory (Kim and Mahoney, 2006). Moreover, advanced IT-supported organizational memory systems enable members in the supply chain to access the knowledge that is stored in memory bins more easily (Tippins and Sohi, 2003). Such systems allow firms to bring previously stored information to bear on information received from external sources in order to create new knowledge (Malhotra *et al.*, 2005). Memory systems can manifest themselves as database that store and enable retrieval of the history of events related to the formation interactions or informal exchange with exchange channel partner. For example, Enterprise Resource Planning (ERP) system includes advanced database systems which allow firms to tap into information received from external sources in order to create new knowledge in supply chain relationships (Malhotra *et al.*, 2005).

Given the potential impact that applied technological innovation has on the various relationship learning processes including information sharing, joint sense making, and relationship memory, the following hypothesis is stated:

H1. Applied technological innovation affects relationship learning positively.

2.2.2 Relationship learning and supplier innovativeness. Innovativeness has been regarded as crucial capability for the firm in order to create competitive advantage in a dynamic and turbulent environment. Following Hurley and Hult (1998), we define

supplier innovativeness from a collective perspective, that is, openness to new ideas as an aspect of a firm's culture. The innovation process involves the acquisition, dissemination, and use of new knowledge. Therefore, innovation is closely related to organizational learning (Calantone *et al.*, 2002).

In the business to business (B2B) supply chain context previous studies have recognized the importance of interorganizational collaboration on firm innovation capability (Goes and Park, 1997; Powell *et al.*, 1996). Nowadays, it is difficult for a company to build up innovation capability on its own due to the increasing cost and risk of the innovation. Interorganizational relationships between suppliers and customers provide a platform for companies to acquire and assimilate knowledge and thus create their knowledge bases (Malhotra *et al.*, 2005). In addition, according to the RBV, firms specializing on knowledge sharing within the relationship can increase socio-technical interactions, which in turn, can generate new ideas and lead to innovation (Dyer and Singh, 1998). Despite the importance of relationship learning on innovation, there is only limited evidence exploring the relationship between relationship learning and innovation (Chen *et al.*, 2009).

Information sharing between the customer and the supplier in the exchange relationship enables both parties to coordinate and plan operational and strategic issues. Firms are making an effort to go beyond the exchange of day-to-day operation information with partners by sharing long-term information such as market trends, changes in customer preferences, new product introductions and future product plans. The quality and breath of information sharing in a supply chain relationship enables firms to increase their knowledge base and in turn create new knowledge for innovation (Malhotra *et al.*, 2005).

Joint sense making between the customer and the supplier is also expected to enable a firms' innovative capability. Both parties jointly interpret information to make sense through joint teams and frequent meetings can enable consensus development more efficiently and avoid confusion and conflict in the exchange relationships. Information overload is a concern when both exchange parties share too much information. Only by joint sense making firms can filter information from exchange partners and transform the information into the firm's way of doing business and enable innovation. Moreover, frequent joint sense making is expected to establish knowledge sharing routines and thus facilitate interaction between buyer and seller and thus enhance innovativeness in the relationship (Roy *et al.*, 2004; Wang *et al.*, 2008).

Relationship-specific memory is external to the organization and takes the form of a repository of specialized memories (Ling-yee, 2006; Selnes and Sallis, 2003). It has been argued that relationship memory can be evident as firm-to-firm ties and network positions that are regarded as social capital (Ling-yee, 2006). Social network studies argue that informal interfirm relationships allow firms to develop better innovative capability because close interfirm ties enable firms to transfer idiosyncratic and privileged information which leads to more creative outcomes (Rindfleisch and Moorman, 2001; Uzzi and Lancaster, 2003). For example, through close collaboration with their international customers, suppliers can keep adjusting the understanding of the end-user needs, preferences and behavior, which can help suppliers develop better products and services.

Based on the positive impact of relationship learning processes including information sharing, joint-sense making and relationship-specific memory on supplier innovativeness, we propose:

H2. Relationship learning has a positive influence on supplier's innovativeness

2.2.3 Relationship learning and relationship performance. A well-performing relationship exists if both the exchange parties in the relationship are satisfied with the relationship's effectiveness and efficiency. Accordingly, in our study, relationship performance refers to the extent to which the supplier is satisfied with the effectiveness and efficiency of the interorganizational relationship. Efficiency of the collaborative relationship takes the form of suppliers become more efficient with inventory levels and cost control that results in lower costs and lower prices (Ling-yee, 2006; Selnes and Sallis, 2003). Effectiveness of the collaborative relationship is defined as the extent to which the partners consider their relationship worthwhile, productive and satisfying (Ling-yee, 2006; Selnes and Sallis, 2003).

Some studies have acknowledged the importance of relationship learning to relationship performance (Selnes and Sallis, 2003). When two organizations engaging in learning, they are more likely to better understand each other's needs and wants and to respond accordingly. Information sharing about product, technology and market structure between exchange partners helps firms to reduce uncertainty about unforeseen changes in the supply chains and thus enables them to reduce costs and achieve operational efficiency. Moreover, information sharing about end user preference helps suppliers to improve current processes and develop better product quality for their international customers in the international supply chain relationship (Myers and Mee-Shew, 2008).

Joint sense making can also enable firms to achieve better relationship performance. It is difficult for firms in exchange relationships to interpret and make sense of shared information. Relationship learning through joint sense making in international supply chain relationships can reduce confusion and thus develop consensus of shared information. Thus, joint sense making has been argued to enhance cross-functional coordination and facilitate collaboration between exchange parties (Selnes and Sallis, 2003). In turn, joint sense making can increase the quality of shared information and help the supplier better understand the needs of their international customer.

Relationship memory, manifested as social capital and interfirm ties, is expected to be related to relationship performance. Prior studies show that social capital and the strength of interfirm ties are positively related to new product development and firm performance (Rindfleisch and Moorman, 2001). Supplier firms engaging in relationship learning activities can keep updating and adjusting the relationship with their customers in order to refresh relationship memory. This in turn can help suppliers in the development of better relationships with their customers in terms of providing better quality of products and meeting customer needs. This is particularly important for supply chain partners operating in global and dynamic markets, as the complexity of cultural distance and shorter product life cycles make the way of governing exchange relationship more difficult (Jean *et al.*, 2008; Wu *et al.*, 2007).

Against the background of various relationship learning processes including information sharing, joint-sense making and relationship-specific memory on relationship performance, we propose:

H3. Relationship learning has a positive influence on relationship performance

2.2.4 Supplier's innovativeness and relationship performance. Various empirical studies have confirmed that innovation capability is the most important determinant to firm

performance (Calantone *et al.*, 2002). In an interorganizational relationship, supplier's innovation capability is a crucial determinant to relationship performance. An innovative supplier could provide more customized and better quality products and services to its customer and increase the customer's satisfaction in the collaborative relationship (Teece, 2007). Moreover, a supplier's innovation capability could allow it to make some unforeseen adjustments such as reducing inventory cost and increasing delivery timeliness and thus enhance the relationship effectiveness in the interfirm relationship.

Moreover, with the trend of outsourcing innovation growing, a supplier's innovative capability is a signal for the customer to select qualified suppliers to outsource certain projects (Quinn, 2000). The emerging notion of open innovation also triggers firms to search innovative partners to work with around the world (Yoo *et al.*, 2009). An innovative supplier can provide high quality and customized products which can satisfy the customer's needs and drive better relationship performance. For example, in the high-technology industry, products become easily obsolete due to short product life cycles. Electronics component suppliers need to keep updating their innovative capability in order to adapt to environmental dynamism and meet the demanding customers' needs (Teece, 2007). Innovativeness has been regarded as a dynamic capability which helps firms to address rapidly changing environments (Teece, 2007). Suppliers' innovativeness allows them to create an isolation mechanism which makes it difficult for competitors to imitate and thus can create better customer satisfaction and customer value. Therefore, we conclude:

H4. Supplier's innovativeness positively influences relationship performance.

2.2.5 Applied technological innovation and relationship performance. Even though there is some published work in the extant literature focusing on the relationship between IT and firm relationship performance, the research findings are rather mixed. For example, in a supply chain context, Sriram and Stump (2004) find that IT alignment has a significant and positive direct influence on firm relationship quality. On the contrary, Ryssel *et al.* (2004) and Wu *et al.* (2006) demonstrate that internal and external IT systems do not have a positive and significant impact on firm relationship value in the supply chain. Similarly, in the context of customer relationship management (CRM) technology, Jayachandran *et al.* (2005) do not find a direct link between CRM technology use and customer relationship performance.

Recent studies have tried to explain the "IT productivity paradox" (Brynjolfsson, 1993) debate from different theoretical perspectives. Drawing from RBV, the emerging stream of research argued that IT does not have a direct influence on specific firm performance. Only when IT resources leverage higher order organizational processes and capability the benefits of IT investment could be fully realized (Wade and Hulland, 2004). This idea has been elaborated and empirically tested in some recent studies. For example, Tippins and Sohi (2003) demonstrate that IT capability enhance firm performance only through the mediated effect of organizational learning. Following this stream of research and drawn on RBV, we argue that the impact of IT on relationship performance is indirect and mediated by relationship learning and innovativeness in the exchange relationship:

H5a. Applied technological innovation does not have a positive and significant impact on relationship performance.

H5b. The relationship between applied technological innovation and relationship performance is mediated by relationship learning.

H5c. The relationship between applied technological innovation and relationship performance is mediated by supplier innovativeness.

2.2.6 Applied technological innovation and supplier innovativeness. According to RBV, IT as a firm resource plays a key role in the process of converting capabilities into certain competences (Real *et al.*, 2006). Sambamurthy and Robert (2000) point out that IT competences will contribute to innovation capability and augment relational structures, thus contributing to specific improvements for the firm. However, empirical evidence on the direct impact of IT on innovation capabilities is scant in the extant literature. Previous researchers mostly focus on the impact of IT on efficiency outcomes instead of its role to promote innovation (Dewett and Jones, 2001). Some anecdotal evidence and conceptual studies suggest that IT can determine the way information is stored, transmitted, communicated and processed and thus facilitate the generation of new ideas and creativity (Dewett and Jones, 2001). Based on a conceptual analysis Roy *et al.* (2004), for example, argue that the adoption of advanced systems for supply chain management can facilitate the generation of innovation in supply chain relationships because the redundant knowledge between buyers and sellers can be captured through advanced IT systems that electronically link routine buyer-seller information such as production forecasting and planning.

A potential problem for adoption of applied technological innovation in supply chain relationships may be that if a buyer-supplier relationship is based on a rigid IT format instead of more personal interaction, the loss of flexibility and broad-based interaction may be detrimental to innovation generation in the supply chain context (Roy *et al.*, 2004).

In the case of Asian pacific firms, many firms have taken on innovative tasks for their international customers in the form of international outsourcing arrangements. Many of these companies have integrated advanced IT to support innovation processes and collaboration with their international customers. For example, HTC, a Taiwanese mobile phones producer, has served as contract manufacturer in designing next generation mobiles for worldwide telecom companies. HTC has adopted advanced IT systems like product design management (PDM) systems in its innovation process. The application of innovative technology has enabled organizations to reduce communication and coordination costs, and radically decentralize management of innovations across the supply chain (Yoo *et al.*, 2009).

While empirical research does not provide a unidirectional relationship with regard to the impact of applied technological innovation on suppliers' innovativeness, based on the more positive reasoning provided above, we suggest an exploratory hypothesis:

H6. Applied technological innovation has a positive effect on supplier's innovativeness.

3. Methodology

3.1 Research context

The empirical context for this study is provided by Taiwanese electronics suppliers. The choice of Taiwan was made on the grounds of three specific reasons. First, Taiwan is ranked No. 4 in the 2008 market potential index for emerging markets (GlobalEDGE, 2008). Taiwanese dragon electronics firms have taken over major parts of value-added

activities in the global electronics market on the basis of Original Equipment Manufacturing (OEM) or Original Design Manufacturing (ODM) contractual arrangements. This role highlights the importance of appropriate levels of relational exchange between physically dispersed international supply-chain partners (Chang and Gotcher, 2007; Myers and Mee-Shew, 2008) and suggests that the findings can be generalized to supply-chain relationships in other emerging markets.

Second, Taiwanese dragon electronics firms have emerged against the background of the megatrend of international outsourcing (Doh, 2005; Mol *et al.*, 2005). A key dimension facilitating this international outsourcing development is the creation of interorganizational learning routines (Ling-yee, 2006; Selnes and Sallis, 2003). Recently, there has been a growing recognition that Taiwanese firms are successful in learning and creating knowledge through these different contractual relationships with their MNE customers (Chang and Gotcher, 2007).

Third, members in the electronics industry are pioneering the development of information technology and have already made significant investments to manage their supply chains with their international customers through interorganizational information technology (Chen, 2003). For example, Dell has deliberately chosen to use a particular form of interorganizational IT to coordinate and collaborate with its OEM/ODM suppliers in Taiwan. It has been argued that suppliers which adopt advanced IT to link up with their supply chain partners, reap certain performance benefits (Sanders, 2008; Subramani, 2004). Thus, Taiwanese dragon electronics firms provide a good case for the examination of the contribution of applied technological innovation to the relationship learning with their OEM/ODM buyers.

3.2 Data and sample

The data used to test the hypothesis are drawn from a survey of senior executives from Taiwanese electronics industry. The sampling frame for the survey comprises all electronic companies from the year 2007 directory of the Top 5,000 Largest Firms in Taiwan, published by China Credit Information Service Ltd (a total of 1,069 companies). The sample frame covered a range of electronics companies including communication products, semiconductors, computer components and peripherals. All firms were contacted via phone to assess their eligibility and locate appropriate informants for the study.

Data was obtained through a key informant technique, which is consistent with prior studies on interorganizational issues (Kumar *et al.*, 1993). Key informants for this study were defined as senior account managers and/or marketing managers who are in charge of maintaining relationship with international customers and had knowledge about IT investment in their supply chain relationships. We also assessed their familiarity with the questions through the data collection instrument.

The survey was conducted in two waves. Four weeks after the first mailing of questionnaires and introductory letter, reminder letters and questionnaires were sent out to non-respondents. Our efforts resulted in 246 useable questionnaires, accounting for an effective response rate of 23 percent.

Following the procedure suggested by Armstrong and Overton (1977), we conducted two tests to check the potential of non-response bias. First, we compared selected respondents' characteristics (e.g., number of employees, annual sales revenue, and age of the company) to those of the original population sample, which was available from the electronics manufacturer directory. In chi-square tests, we did not

find any significant differences with respect to these criteria. Second, we compared early with late responses. The first 25 percent of the returned questionnaires were defined as early responses and the last 25 percent were regarded as late responses. We found no significant differences from comparing the means of the all constructs in our conceptual model in two groups. Neither did we find any significant differences with respect to the descriptive variables mentioned above. Therefore, we concluded that non-response bias was not a significant problem in this research. Some descriptive results of the respondents are shown in Table I.

All of the measures used in this research were collected via the same questionnaire, which introduced the possibility of common method bias (Doty and Glick, 1998). Harman's one-factor test was used to address the issue (Podsakoff *et al.*, 2003). We performed unrotated principal components analysis on all measurement items involved, extracting seven factors (including the sub-dimensions of relationship learning) with eigenvalues greater than 1.0, which accounted for 75 percent of the total variance. Since factor one did not account for the majority of the variance (only 36 percent), this indicated that common method variance is not a problem in this study. Moreover, we also were able to collect objective performance data on sales revenue and profitability from 26 Taiwanese suppliers in the sample. Correlations between the objective sales revenue and profitability indicators and the items of our relationship performance dimension were at 0.67 ($p < 0.01$) and 0.72 ($p < 0.01$). Again, this established trust that common method variance may not be a source of concern in our dataset (see Table II).

	%
<i>Product distribution</i>	
Communication products	12.2
Systems	6.5
Computer peripherals	14.2
Optoelectronics	14.6
Semiconductors	15.9
Computer components	36.6
Total	100
<i>Employee numbers</i>	
Less than 100	20.3
100-199	21.1
200-499	26.4
500-999	13
1,000-4,999	14.6
5,000-9,999	1.6
10,000 and above	2.8
Total	100
<i>Sales revenue (NT)</i>	
100M-500M (US\$3M)	19.1
501-1B	15.9
1B-5B	39.0
5B-10B	7.3
More than 10B (US\$300M)	18.7
Total	100

Table I.
Sector and size
characteristics of
responding firms

IMR		
27,2		%
	<i>Length of international relationship</i>	
	Less than 1 year	4.5
	1-2 years	8.9
	3-5 years	39
	6-10 years	35
	11 years and above	12
212		
Table II.	<i>Country of origin of international partners</i>	
International relationship	America	43.5
characteristics of	Asia	34.6
responding firms	Europe	22.9

3.3 Questionnaire development and measures

Because IT aspects are relatively new to the domain of international business and marketing research, theory is still being developed (Samiee, 2008). Therefore, to create the survey items, 15 in-depth interviews were conducted with 15 senior OEM/DOM account managers or directors. In order to balance the dyadic point of view in international subcontracting, we also conducted two interviews with branded electronics MNE buyers. These interviews, along with an extensive review of the literature, were used to develop the questionnaire.

Overall, all constructs in the model were measured with multiple-item scales. As much as possible, well-validated measures reported in previous top marketing journal were used. These scales were all transferred into the Taiwanese context. Two native Chinese were involved in translating the questionnaire into Chinese, both professional English translators. Two further professional translators helped in the process of “back-translation” of items into English. The process was facilitated by a marketing researcher with the help of a postgraduate student, specializing in cross-cultural scale-development. Functional equivalence and conceptual equivalence of the borrowed scales was checked in a pre-test of the questionnaire with ten industry experts, who filled in the questionnaire in a mock-exercise and provided qualitative feedback on the items and the process. We also followed Churchill’s (1979) multiple-steps and multivalication methods to modify and develop the items for key construct in the conceptual framework. For all scales, each item was measured using a seven-point Likert scale (where 7 = strongly agree, and 1 = strongly disagree).

In the framework, relationship learning is a second order construct. Its first-order indicators are information sharing, joint-sense-making and relationship-specific memory (Selnes and Sallis, 2003). We used nine items adapted from Selnes and Sallis (2003) to measure this construct. A four-item scale was used to measure applied technological innovation. It was taken from Kim *et al.* (Kim *et al.*, 2006). Supplier’s innovativeness was measured by three items adapted from Hurley and Hult (1998). A five items scale was used to measure relationship performance including relationship effectiveness and efficiency. It was drawn from Selnes and Sallis’s (2003) study.

3.4 Reliability and validity

A second order confirmatory factor analysis was carried out to investigate the convergent and discriminant validity of the constructs proposed in the conceptual

model (Bentler, 2005). The measurement model including all constructs was fitted by the estimated procedure of the EQS program (Bentler, 2005). The results of the analysis are shown in Table III. The model provides a good fit given the complex nature of the second-order confirmatory factor analysis (Chi-square = 357.8162 with degree of freedom (df) = 180; CFI = 0.952; NFI = 0.908; NNFI = 0.944; RMSEA = 0.06). Moreover, all items loaded on their respective constructs and are statistically significant. Further, the composite reliability for all constructs was above the 0.7 level (shown in Table III) suggested by Nunnally (1978) and Hair et al. (2006), indicating adequate reliability for each construct.

Moreover, all factors loadings were statistically significant at the 5 percent level, and all of the factor loadings exceed the arbitrary 0.5 standard (Fornell and Larcker, 1981), as shown in Table III. Thus, these measures demonstrate adequate convergent validity. In terms of discriminant validity, this study assessed the discriminant validity of each construct in two ways (Wu *et al.*, 2007). First, a procedure recommended by Bagozzi, Yi and Phillips (1991) was adopted. We examined pairs of related constructs in a two-factor CFA, once constraining the correlations between two constructs to unity and once freeing this parameter. Then a chi-square difference test was conducted. The results indicated that the chi-square values were significantly lower for the unstrained models at the 5 percent level, which suggests that the constructs exhibit discriminant validity. We further employed discriminant validity tests as suggested by Fornell and Larcker (1981). As shown in Table IV, the square root of the average variance extracted is greater than all corresponding correlations, which indicates adequate discriminant validity.

3.5 Structural model test results

Figure 2 presents test results of the overall model fit in the structural model. The overall fit statistics indicate a very good fit for the full model (Chi-square: 327.04, df = 178, NNFI:0.952, NFI:0.916, CFI:0.960, RMSEA:0.058). Regarding the hypothesized relationships, the coefficient on the path from applied technological innovation to relationship learning is 0.328 ($t = 10.491$, $p < 0.01$). Thus the positive relationship suggests that *H1* is supported. The path coefficient from relationship learning to supplier innovativeness is 0.587 ($t = 13.933$; $p < 0.01$), which supports *H2*. The path coefficient from relationship learning to relationship performance is 0.477 ($t = 3.69$, $p < 0.01$). Thus, *H3* is supported. The path coefficient from supplier innovativeness to relationship performance is 0.203 ($t = 2.027$, $p < 0.05$), which supports *H4*. The direct impact from applied technological innovation to relationship performance is non significant (coefficient = -0.066), and therefore in accordance with what is expressed in *H5a*. Moreover, we also find that the impact of applied technological innovation on relationship performance is mediated by relationship learning and innovativeness, which support *H5b* and *H5c*. Finally, the path coefficient from applied technology innovation to supplier innovativeness is 0.167 ($t = 2.547$, $p < 0.01$), which supports *H6*. A summary of the hypothesized relationships and test results is shown in Table V.

4. Discussion and implications

In this study, drawing from RBV, a theoretical framework for applied technology innovation by suppliers, relationship learning, supplier innovativeness, and relationship performance was developed and empirically tested. For testing, data collected from Taiwanese electronics suppliers in relationship with MNE customers

Construct and measures	Std. factor loadings	Composite reliability (α)	Average variance extraction
Applied technological innovation		0.944	0.809
Our company uses the most advanced IT for supply chain management	0.834		
Relative to our competitors, our IT for supply chain management is more advanced	0.917		
My company is always first to use new IT for supply chain management in our industry	0.934		
In our industry my company is regarded as an IT leader for supply chain management	0.910		
Relationship learning – information sharing		0.888	0.727
It is expected that both our company and our international customer share information that might help the other company	0.82		
Our company is supposed to exchange information with out international customer frequently; even it is not part of the contract	0.919		
It is expected that both our company and international customer keep each informed about events or change that may affect the other company	0.814		
Joint-sense-making		0.941	0.841
It is common to establish joint teams to solve operational problems in the relationship	0.955		
The atmosphere in the relationship stimulates productive discussion encompassing a variety of opinions	0.895		
We have a lot of face-to-face communication in this relationship.	0.900		
-relationship-specific memory		0.834	0.627
In the relationship, we frequently adjust our common understanding of trends in technology related to our business	0.829		
We frequently meet face to face in order to refresh the personal network in this relationship	0.827		
We frequently evaluate and, if needed, update information about the relationship stored in our electronic databases	0.713		
Supplier innovativeness		0.866	0.686
Our firm's management actively seeks innovative ideas	0.870		
Innovation is readily accepted in program/project management	0.912		
Technical innovation is readily accepted in our firm.	0.686		
Relationship performance		0.883	0.602
The relationship with our international customer has resulted in creation of new products, product enhancements	0.669		
The relationship with our international customer has resulted in better product quality	0.730		
The relationship with our international customer has resulted in reduced production cost, increased cost efficiencies	0.806		

Table III.
Results of second
order CFA

(continued)

Construct and measures	Std. factor loadings	Composite reliability (α)	Average variance extraction
The relationship with our international customer has resulted in improvements to current processes or creation of new processes	0.860		
The relationship with our international customer has resulted in learning about customers and markets for our products	0.801		
Second order relationship learning factor		0.751	0.520
Information sharing	0.968		
Joint-sense-making	0.541		
Relationship-specific memory	0.575		

Notes: CFA Model goodness of fit indexes: Chi-square = 357.8162 and with degree of freedom (df) = 180; Comparative fit index (CFI) = 0.952; Bollen fit index = 0.952; Bentler-Bonett NFI = 0.908; Bentler-Bonett non-normed fit index (BBNFI) = 0.944; root mean square of approximation (RMSEA) = 0.063; 90 percent confidence of RMSEA (0.054; 0.073)

Table III.

	Mean	SD	1	2	3	4
1. Applied technology innovation	4.023	1.324	<i>0.899</i>			
2. Relationship learning	5.127	0.031	0.280**	<i>0.721</i>		
3. innovativeness	5.359	1.103	0.332**	0.512**	<i>0.828</i>	
4. Relationship performance	5.317	0.937	0.155**	0.459**	0.428**	<i>0.776</i>

Notes: Numbers in italic denote the square root of the average variance extracted (AVE); ** $p < 0.01$; $n = 246$

Table IV.
Mean, SD, inter-construct correlations and average variance extracted

Notes: Structural model fit parameters – Chi-square: 327.04; df = 178, NNFI: 0.952; NFI: 0.916; CFI: 0.960; RMSEA: 0.058; * $p < 0.05$; ** $p < 0.01$. Dashed line indicates insignificant paths

Figure 2.
The structural model

Table V.
Summary of hypothesis
test results

Hypotheses	Results
<i>H1.</i> Applied technological innovation for affects relationship learning positively	Supported
<i>H2.</i> Relationship learning has a positive influence on supplier's innovativeness	Supported
<i>H3.</i> Relationship learning has a positive influence on relationship performance	Supported
<i>H4.</i> Supplier's innovativeness positively influences relationship performance	Supported
<i>H5a.</i> Applied technological innovation does not have a positive and significant impact on relationship performance	Supported
<i>H5b.</i> The relationship between applied technological innovation and relationship performance is mediated by relationship learning	Supported
<i>H5c.</i> The relationship between applied technological innovation and relationship performance is mediated by suppliers' innovativeness	Supported
<i>H6.</i> Applied technological innovation has a positive effect on supplier's innovativeness	Supported

was used. Empirical findings support all our hypothesized relationships and reveal that applied technology innovation, an IT resource, is crucial for developing relationship learning. Relationship learning is an important organizational capability, which ultimately enhances supplier innovation capacity and relationship performance between small dragon SMEs from Taiwan and their multinational partners. Based on the empirical evidence, a number of guidelines can be offered to both scholars and practitioners regarding the theoretical and managerial implications.

First of all, this study demonstrates that relationship learning plays a pivotal role in mediating the impact of applied technological innovation on innovativeness and relationship performance for suppliers in international supply chain relationships. The relationship between small suppliers and MNE buyers is characterized by asymmetry, thus, learning capability including information exchange, joint-sense making and relationship-specific memory helps suppliers to create better innovative capabilities and improve their relationship performance. This article provides empirical evidence for the role of knowledge and learning in interfirm relationships (Dyer and Singh, 1998; Johnson *et al.*, 2004), especially for smaller suppliers such as Taiwanese dragon SMEs who lack the resources and capability in relationships with dominant MNE customers.

Second, this study highlights that applied technological innovation, a specific IT resource for suppliers, helps in enhancing the value creation process of relationship learning and innovation in interfirm relationships. In global supply chain relationships like outsourcing arrangements in the electronics industry, MNEs play a central role in pushing suppliers to implement certain advanced IT in supply chain management. However, little is known whether suppliers could actually yield payoffs from these costly transactional specific investments (Sanders, 2008; Subramani, 2004). This study shows that applied technological innovation in SCCS for suppliers can both facilitate relationship learning and suppliers innovativeness. This process enhances relationship performance. However, the direct effect of applied technological innovation on relationship performance is not significant. This is an important realization, which demonstrates that the value of IT in supply chain relationships can only be realized through enhancing some organizational processes including learning and innovation.

The finding supports the emerging view of RBV on IT value (Tippins and Sohi, 2003; Wade and Hulland, 2004).

Furthermore, this study verifies innovativeness as the determinant of relationship performance for suppliers in international supply chain relationships. Innovativeness mediates the influence of relationship learning on relationship performance. This is consistent with the notion that innovation capability is one of the most important organizational capabilities for small suppliers to successfully challenge incumbents and compete in international market (Knight and Cavusgil, 2004). Moreover, the result in this study also demonstrates that innovativeness is an IT-driven capability. It is expected that supplier firms can enhance their innovative capability through adopting advanced IT for SCCS.

Finally, recent theory and research advances in international marketing and international business have called for more empirical studies to uncover the actual bundles of capabilities that characterize the competitive advantages of emerging country MNEs (Knight and Cavusgil, 2004; Mathews, 2006). Building on the RBV, this study links bundles of resources and capabilities including advanced IT, relationship learning, and innovativeness to superior relationship performance for Taiwanese electronics suppliers. Thus, empirical evidence is offered on how small countries' firms from East Asia, usually in lack of tangible resources, can achieve great success in the global electronics market.

5. Limitations and future research

Several limitations of this study should be acknowledged. First, this study only adopts the supplier's perspective in international supply chain relationships, which raises a potential bias. Future research may also examine our proposed model from MNE buyers' perspectives. Second, this study is based on cross-sectional data, while we acknowledge that the nature of innovativeness and learning is a dynamic and continuous. Thus, although this will add layers of complexity, longitudinal data may help in future research to provide insights into the dynamic nature of the enhancement of innovativeness and relationship learning of IT in international channel relationships. Further, the context of this study is limited to the perspective of Taiwanese electronics suppliers, which limits the generalizability of our findings to suppliers to other countries. Future research that examines our model in other cultural contexts may improve generalizability of our findings. Moreover, against rapidly changing environments, learning has been regarded as a dynamic capability which can help firms to address competition. Scholars have argued that dynamic capabilities are IT-driven. Thus, future studies can extend RBV and integrate dynamic capabilities view (Teece *et al.*, 1997) into this stream of research to examine how environmental changes shape the impact of IT on relationships learning. A possible research approach could be to take the moderating effect of environmental changes into account. This can contribute to the contingency view of IT on firm performance research (Davis-Sramek *et al.*, 2009).

In addition, the original Selnes and Sallis (2003) construct of relationship learning was introduced as a formative measure. Recent literature highlights critical philosophical and practical differences in dealing with reflective versus formative measures (Diamantopoulos, 2008; Diamantopoulos *et al.*, 2008; Diamantopoulos and Winklhofer, 2001; Henseler *et al.*, 2009). Nevertheless, a number of scholarly work has adopted the relationship learning construct as a reflective measure (Chang and Gotcher, 2007; Chen *et al.*, 2009; Ling-yee, 2006). While we have followed this trend and

also adopted the reflective measurement approach, work is encouraged which explicitly examines the reflective or formative nature of the focal construct.

Finally, our study also was limited to examining only one dimension, applied technological innovation as a key IT resource, while further IT resources such as IT alignment (Wu *et al.*, 2006) or electronic integration (Jean, 2007) and their linkages with innovativeness and relationship learning in interfirm relationships are open for future examinations.

6. Conclusion

Emerging countries and their firms are becoming a critical research topic in international marketing and international business. Despite the emergence of this topic, empirical work which helps to understand how emerging market firms from a small country context can successfully compete *vis-à-vis* their large multinational counterparts is only drawing a rudimentary picture. Based on 246 electronics firms from Taiwan, this study develops and tests a model which delineates the relationship between suppliers' applied technological innovation, relationship learning, innovativeness and firm relationship performance. The results of this study help to advance our understanding of how supplying firms in Asia-Pacific countries can apply technological innovation, a key IT resource, to enhance relationship learning when dealing with international buyers. This contributes to higher supplier innovativeness and relationship performance.

Note

1. While employing the original Selnes and Sallis (2003) measure of relationship learning, Myers and Mee-Shew (2008) actually label this dimension "knowledge sharing".

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