

Drivers of Virtual Interfirm Integration and Its Impact on Performance in International Customer–Supplier Relationships

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Received: 10 August 2016 / Revised: 9 January 2018 / Accepted: 5 February 2018 /

Published online: 28 February 2018

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Abstract Consensus exists suggesting that advances in information and communication technologies are a major driver in restructuring Multinational Enterprises (MNEs) and their cross-border supply chain activities. However, the role of virtual interfirm integration and its antecedents, contingency conditions and its association with performance in international exchange relationship is not clearly specified. This study proposes that virtual interfirm integration can serve as an alternative governance mechanism for suppliers. Thus, we examine its drivers, moderators, and performance outcomes in international exchange relationships in the context of suppliers and their MNE customers. The empirical context is a study of 240 Taiwanese-based electronics equipment manufacturers. We explore the effect of communication culture, internal, inter-organizational, and environmental dimensions on virtual interfirm integration, and supplier performance in international exchange. We conclude by sharing our findings on the pertinence of virtual interfirm integration in the supplier–MNE buyer relationships.

Keywords Information technology (IT) · Global supply chain · Virtual integration · Multinational enterprise (MNE) · Communication culture · Buyer–supplier relationship

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1 Introduction and Motivation

Changes in the landscape of international business, specifically key globalization dynamics such as outsourcing and advances in information technologies (IT), have facilitated shifts in the strategy and structure of multinational enterprises (MNEs). An increasing emphasis focuses on specialized “slivers” of activities, i.e. disintegrating and stretching value-adding activities of MNEs with global suppliers (Buckley and Ghauri 2004). For example, established multinational companies such as Dell, GM, and Wal-Mart have de-risked their operating model and ceded control of foreign manufacturing to contracting suppliers that continue to work closely with them to produce their brand products. The advance of IT and modern supply chain management systems (SCMs) has led to MNEs building virtual connectivity and improve coordination with their suppliers in dynamic markets (Subramani 2004).

In line with this trend, the issues concerning IT development in shaping global supply chains have increasingly captured scholarly attention. The extant literature contends that IT advances have been a major driver in restructuring MNEs and their operations of global supply chains (Birkinshaw et al. 2001; Nolan et al. 2002). This is due to its effect of enhanced efficient coordination and communication within and across organizational boundaries. Virtual interfirm integration (Zaheer and Venkatraman 1994)—a specific form of quasi-integration achieved through the deployment of specific information systems between supply chain partners—has assumed a key role in information systems (e.g. Wang et al. 2006) and operations management literature (e.g. Kim et al. 2006). Virtual interfirm integration differs significantly from vertical integration in traditional organizations in that supply chain partners are integrated via information flows rather than ownership. Our objective is to add to the existing stock of knowledge on virtual interfirm integration in global supply chains by investigating a number of issues that have not received sufficient attention in the literature. We elaborate on these issues next.

First, most studies on virtual interfirm integration have been conducted in a domestic market setting (Mukhopadhyay and Kekre 2002). Scant empirical research has investigated virtual interfirm integration in cross-border exchange relationships. Although increased globalization has resulted in profuse inter-firm relationships across national borders, which makes IT enabled coordination more salient in this setting, understanding of antecedents and outcomes of virtual interfirm integration in the international customer–supplier context remains limited. While several scholars addressed this issue from an MNE perspective (e.g. Rangan and Sengul 2009), few have investigated the virtual interfirm integration behavior of suppliers.

Second, most previous studies have examined either the relationship between virtual interfirm integration and its antecedents, or the relationship between virtual interfirm integration and associated performance outcomes (Mukhopadhyay and Kekre 2002; Zaheer and Venkatraman 1994). Very few studies have attempted to model the complete picture of virtual interfirm integration through simultaneously examining drivers and performance implications. Addressing this issue is thus appropriate, because without building a comprehensive model of virtual interfirm integration and its link to performance, it is not possible to gain a full understanding

of the condition under which virtual interfirm integration serves multinationals and their suppliers' coordination efforts in cross-border transactions.

Third, most prior studies have conceptualized virtual interfirm integration through adopting inter-organizational information systems (IOS) that focus more on the context of electronic data interchange (EDI) (Grover and Saeed 2007) to conduct operational tasks such as transactions, checking inventories, or output and process control between channel parties. However, technological innovation has resulted in contemporary IOS shifting from EDI toward more Internet-based, open standard IOS which incorporates functionalities such as collaborative forecasting, beyond the ones provided by traditional EDI (Zhu et al. 2006a). Hence, there is a need to conceptualize virtual interfirm integration as a multi-dimensional construct, which incorporates both electronic coordination and electronic collaboration.

Finally, the debate about the value of IT is still unresolved. Researchers have examined the value of IT applications in the inter-organizational context in general, and in supply chain relationships in particular (Sanders 2008, 2007). It is still not yet clear whether and how IT investments create value in international exchange relationships. In addition, while research argued environment may shape IT-performance relationships, IT value under environmental uncertainty is still an open issue (Melville et al. 2004; Wade and Hulland 2004). Thus, this research examines the contingency factors, including environmental volatility and communication culture in cross-border exchange relationships.

The specific context relates to cross-cultural exchange relationships between MNEs and their suppliers. Drawing on the literature of transaction cost economics (Williamson 1975), the resource based view (Barney 1991), and international business, we develop and test a model that explains the driving forces and performance consequences of virtual interfirm integration in the international customer-supplier arrangements. Specifically, we conceptualize virtual interfirm integration in terms of coordination and collaborative arrangements via electronic media between suppliers and their international customers. These relationships between Taiwanese original equipment manufacturing (OEM)/original design manufacturing (ODM) suppliers and their MNE customers in the electronics industry provide the context of this investigation. This context is ideal for our study, because customers of Taiwanese OEM/ODM suppliers pursue coordination and collaboration and strongly rely on electronic media. Further, contracting supplier relationships with Taiwanese firm frequently involves asymmetric bargaining power, where MNE buyers usually have the upper hand. This context is thus ideal to examine how virtual interfirm integration can serve as an alternative mechanism to govern asymmetry in international customer-supplier relationships.

Finally, we contend that internal, inter-organizational, environmental, and cultural factors influence the virtual interfirm integration of suppliers with MNE customers. We consider innovativeness as a key dimension, internal to the organization. Trust is an inter-organizational relationship dimension and in terms of environmental dimensions, we explicitly consider environmental volatility. In terms of cultural factors, we also consider the context of communication culture (Hall 1976). This is critically important to the context of virtual interfirm integration, since research has found communication culture to be an antecedent of virtual interfirm integration

in international supplier–customer relationships (Jean et al. 2010). We contend that trust, innovativeness, context of communication culture and environmental volatility are associated with virtual interfirm integration, and investigate the direct and moderating link between virtual interfirm integration and relationship performance.

The remainder of this article is organized as follows. A conceptual model is developed to delineate the relationships among key constructs. Predictions regarding the antecedents, moderators, and consequences of virtual interfirm integration are offered. These hypotheses are tested empirically, and the results are presented. The paper concludes with a discussion of findings and directions for future research.

2 Background and Conceptualization of Virtual Interfirm Integration

Virtual interfirm integration refers to a specific form of vertical-quasi integration achieved through implementing information systems (Wang et al. 2006). This research focuses on specific inter-organizational information systems: supply chain communication systems (SCCS). We define SCCS as an inter-organizational system shared by suppliers and international customers to carry out supply chain activities ranging from operational levels such as tracking orders, dealing with invoices and strategic levels such as collaborative demand planning and forecasting (Kim et al. 2006). TCE contends that vertical integration is preferred over market exchange when the sum of transaction and production cost of market exchange exceeds those of hierarchy (Williamson 1975). However, vertical integration incurs significant drawbacks such as inflexible structure and unable to deal with changing circumstances.

Thus, virtual interfirm integration is an alternative governance and coordination mechanism, providing such benefits as reduced coordination cost and transaction risk, which vertical integration does not always provide (Wang et al. 2006; Kim and Mahoney 2006). Scholars have argued that IT-enabled integration is an effective governance mechanism that does not involve common ownership for exchange parties (Zaheer and Venkatraman 1994). Virtual interfirm integration constitutes a mechanism which relational governance could provide, because of its requirement that both exchange parties to invest in relationship-specific investments and mutual commitment (Kim and Mahoney 2006). Thus, it has been argued that virtual interfirm integration facilitates joint decision-making and collaborations in exchange relationships to give firms better capability in managing their channel relationships (Kim et al. 2006).

Researchers have proposed varying approaches to operationalizing virtual interfirm integration (Wang et al. 2006; Zaheer and Venkatraman 1994). Earlier research only focuses on EDI use and integration as the proxy of virtual interfirm integration. Some recent studies have extended the conceptualization of virtual interfirm integration and operationalized it as a multidimensional construct. Subramani (2004) identified two patterns of IT use in virtual interfirm integration, including exploitation and exportation. Kim et al. (2005) referred to the specific domains of virtual interfirm integration for monitoring and for coordination. Integrating the work of both Subramani (2004) and Kim et al. (2005), this study adopts two dimensions in

conceptualizing virtual interfirm integration, coordination and collaboration, according to intentionality of use.

Virtual interfirm integration for coordination includes conducting coordination and control channel activities such as checking inventory and product quality information through SCCS (Kim et al. 2005; Wang et al. 2006). Virtual interfirm integration for specific IOS such as EDI has been conducted by channel partners to support common operation execution and control, to help firms reduce coordination cost (Yamin and Sinkovics 2007, 2010). Virtual interfirm integration for collaboration refers to conducting collaborative planning, forecasting, and product design for partners via SCCS (Subramani 2004) (Kim and Lee 2010). The internet-based open standard IOS such as Extensible Markup Language (XML) facilitates higher levels of virtual interfirm integration, which assists firms conduct more collaborative activities with their channel partners (Kim et al. 2006).

3 Conceptual Framework and Hypotheses

Prior research on inter-organizational information system (IOS) adoption has extensively drawn on organizational, interorganizational, and environmental variables to examine the determinants of IOS adoption (e.g. Zhu et al. 2006b; Grover and Saeed 2007). Merging this stream of research with international/cross-cultural business literature, we offer the proposed conceptualization in Fig. 1. This conceptualization identifies a set of important constructs in driving an supplier's virtual interfirm integration with MNE customers. Prior research has drawn extensively on TCE to examine the antecedents of virtual interfirm integration. According to TCE, virtual interfirm integration is an alternative coordination mechanism in governing exchange relationships, and argues that environmental uncertainty triggers firms to adopt hierarchical governance to reduce transactional hazards. Similarly, environmental volatility is a key driver for firms to implement virtual interfirm integration as an alternative form of hierarchical governance, which safeguards exchange relationships. In addition, TCE also treats trust as a crucial driver for governance decision of a firm. A trusting relationship creates an atmosphere that deters opportunism and helps develop long-term hierarchy like relationships. Thus, this study incorporated trust as a determinant of supplier virtual interfirm integration.

The resource-based view (Barney 1991) sees virtual interfirm integration as a key IT capability, which drives firm competitiveness (Wade and Hulland 2004). According to the RBV (Barney 1991), organizational capabilities are driven by firm internal strategic orientation (Zhou and Li 2010). Thus, we argue that innovativeness, a critical supplier orientation toward innovation (Hult et al. 2007), helps suppliers develop virtual interfirm integration in international exchange. Drawing from the theoretical development of international business and culture theories by Hall and Hall (1987), this study also included cultural factors unique to the international B2B context—the context of communication culture—into the conceptual framework. The context of communication culture highlights cultural communication, which could also affect the configuration of virtual interfirm integration for suppliers in relationships with MNE customers (Hall and Hall 1987).

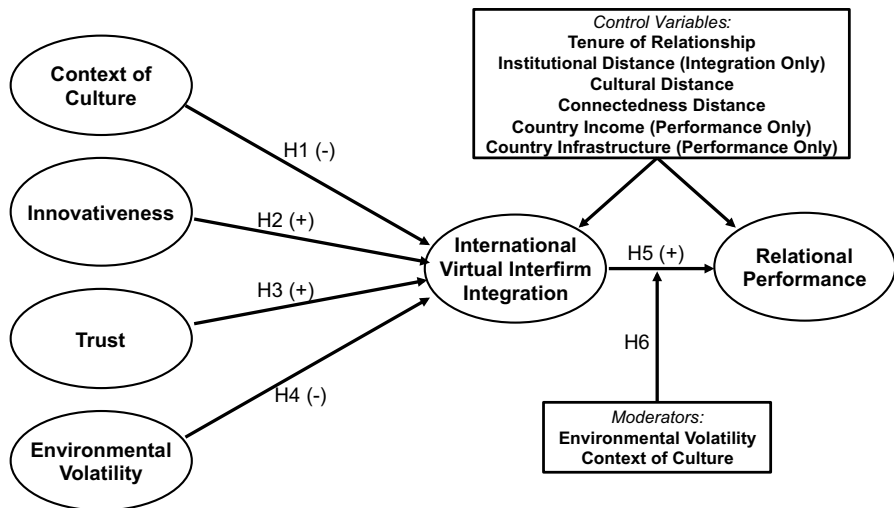


Fig. 1 Proposed conceptualization of virtual interfirm integration in international supplier–customer relationships

These antecedents might affect the degree to which a supplier would employ virtual interfirm integration with an MNE customer. Interviews with supplier executives support the relevance of these constructs and their ability to comprehensively represent cross-cultural exchange relationships. These constructs are important to understand virtual interfirm integration in the international customer–supplier exchange; however, researchers have not adequately articulated a coherent explanation accounting for suppliers’ virtual interfirm integration and associated performance outcomes. The RBV argues that virtual interfirm integration is a critical IT capability, which leverages advanced technologies in conducting key activities in the value chain to enhance firm competitive advantage. Thus, drawing on the RBV perspective, the proposed framework posits a direct link between virtual interfirm integration and performance in the international customer–supplier exchanges. The framework aims to determine the condition for the best virtual interfirm integration configuration, as a source of competitive advantage for the suppliers in international exchange relationships. Thus, following the arguments that environment may shape IT value (Dong et al. 2009), the current study investigates the moderating effects of environmental volatility and context of culture in the virtual interfirm integration–relationship performance link. The hypothesized linkages among these constructs are presented in Fig. 1.

3.1 Influence of Communication Cultures on Virtual Interfirm Integration

We draw from the work of Hall (1976) who articulated the characteristics of communication and classified culture into high vs. low context culture. Hall (1976) argued that persons in a high-context culture (e.g. Japan, China) rely on the communication context more than in a low-context culture (e.g. US, Germany). Much of the

supplier virtual interfirm communication is about exchanging order-sizes, forecasts, production outputs and stocks. While arguably the information will frequently be transmitted in some written form, we argue that depending on the cultural context, the dominant form of information transmission will change. That is, persons from a high-context culture obtain information mainly from their personal information network, while those from a low-context culture seek information from a research base or use information sources such as databases and the Internet. In this research we look at the emic-etic continuum of examining cultural phenomena primarily through an etic lens (Morris et al. 1999).¹ The context of communication culture framework by Hall (1976) offers a unique way to classify various cultures according to the degree of embeddedness of communication context across countries. Given that the main power of virtual interfirm integration in the current study is to facilitate communication between exchange partners, the context of communication culture as a way to classify various communication cultures may be a critical determinant of virtual interfirm integration in international buyer–supplier relationships. However, only limited research has applied the Hall classification to investigate B2B innovation adoption, such as virtual interfirm integration in international buyer–supplier relationships.

Based on Hall's framework, this study argues that businesses in a high-context culture are likely to prefer in-person contacts to carry out every day B2B activities and such preference will reduce the need for IT-supported coordination. For example, during our field interviews with a key account managers in charge of Japanese customers, he indicated "Japanese customers are less likely to communicate and transfer business information via Internet and IT systems with us, they prefer to contact and communicate supply chain information via personal contacts". In contrast, businesses in a low-context culture may prefer to use codified information sources, obtained from electronic coordination and collaboration in international channel relationships. Consequently, this work follows Hall's classification of communication culture and hypothesizes the following effect of communication culture on virtual interfirm integration:

H1: With customers from low-context cultures, the extent to which the supplier is virtually integrated with its MNE customer will be greater.

3.2 Innovativeness and Virtual Interfirm Integration

Prior studies have attempted to link organizational factors as determinants of IOS adoption (Zhu et al. 2006b). According to a recent review by Grover and Saeed (2007), organizational factors such as top management support, organizational slack, organizational readiness to accept new technology, and IT capability are considered

¹ We pursue the etic perspective in this work, as our research design is quantitative, survey-based and thus draws on scales which are concerned with the identification and assessment of universal attitudinal and behavioral concepts (Sinkovics and Holzmüller 2001). One reviewer highlights that future work could seek to uncover emic aspects.

import determinants of EDI use. An organization with enhanced innovative orientation is more likely to accept new technology. Consequently, this research focuses on innovativeness as a key determinant of a supplier's virtual interfirm integration with an MNE customer. Hult et al. (2004) conceptualize innovativeness as the capability of a firm to innovate by introducing new processes, products, or ideas into the organization. Innovativeness is among the most important organizational capabilities linked to firm success.

Innovativeness constitutes the key impetus for a supplier's virtual interfirm integration for the following reasons: First, innovative suppliers are more likely to develop better products and services for their customers in exchange relationships. Innovative suppliers perceive greater benefits provided by IT-enabled coordination and collaborations in international buyer–supplier relationships (Zhu et al. 2006a). For example, in the context of a global electronics supply chain, branded MNEs such as Dell and HP collaborate with Original Design Manufacturing (ODM) suppliers using B2B IT applications to develop products. Innovative suppliers are prone to advanced technology solutions to enhance their business process. Therefore, innovative firms are more likely to possess greater IT capability. Based on these arguments, we hypothesize,

H2: The greater a supplier's innovativeness is, the greater the level of virtual interfirm integration with the MNE customer.

3.3 Impact of Trust on Virtual Interfirm Integration

This study defined trust as the confidence exchange parties have for the reliability and integrity of the other (Zhang et al. 2003). The relational exchange theory views trust as a relational governance mechanism, helping deter opportunistic behavior because it lessens perceived vulnerability between partners (Cavusgil et al. 2004). Prior studies have identified trust as one of the most important inter-organizational factors for adopting IOS such as EDI (e.g. Zaheer and Venkatraman 1994; Hart and Saunders 1997; Lee and Lim 2005). Virtual interfirm integration involves sharing confidential information for coordination and collaboration between exchange parties. Therefore, it has potential risk to be misused as proprietary information by partners. Andraski and Haedicke (2003) note that the main concern of many suppliers with different buyers is the case where they share too much information. Then, when there is an unexpected high demand, those with greater bargaining power and information demand preferential treatment at the expense of others. Virtual interfirm integration may create a lock-in effect for the transaction party and an investing party may lose flexibility in exchange relationships. Given that international exchange relationships are more culturally diverse than domestic ones, exchange parties may be more skeptical and unwilling to use virtual interfirm integration as a coordination and collaboration mechanism to share confidential information. A significant imbalance in bargaining power may exist for suppliers with MNE customers. Thus, trust is particularly important for suppliers to electronically integrate with their MNE customers. A significant level of trust may help deter the risk of opportunistic behaviors

by partners in international exchange relationships and thus facilitate virtual interfirm integration. Accordingly, we hypothesize,

H3: The higher trust a supplier has in the supplier–MNE customer relationship, the greater the level of virtual interfirm integration with the MNE customer.

3.4 Effect of Environmental Volatility on Virtual Interfirm Integration

Environmental volatility refers to the extent to which an environment changes quickly (Skarmetas et al. 2002; Klein et al. 1990). In a competitive environment such as the global electronics industry, rapid fluctuations in demand and supply conditions aggregate a level of uncertainty because of difficulties associated with making accurate market forecast. The TCE literature suggests that one way to deal with environmental uncertainty is vertical integration with channel partners to reduce transaction cost (Klein et al. 1990). However, vertical integration incurs coordination cost and compromises firm flexibility in channel structures.

At the same time, virtual interfirm integration provides an alternative form of vertical integration without ownership. IT-enabled coordination and collaboration enhances information processing capabilities of the transaction parties and is a more efficient vertical coordination mechanism in coping with environmental uncertainty (Wang et al. 2006). Thus, researchers have argued that firms are more willing to electronically integrate with their partners to reduce transaction cost under environmental uncertainty (Wang et al. 2006).

However, a volatile physical and economic environment may present a barrier to the supplier to rely on electronic coordination and collaboration with the international customer. This is because of the difficulty associated with obtaining necessary and accurate information for effective electronic coordination, and in monitoring activities of the other partner. Under a volatile environment, product and market information changes quickly, thus making it more difficult to exchange timely information. An uncertain environment is likely to undermine the intention of a firm to conduct information-based collaboration such as CPFR due to the concerns of inaccurate forecast and planning. As a result, greater environmental volatility is associated with weaker electronic organization, such as electronic brokerage, to permit ongoing adaptations to changing market conditions (Grover and Saeed 2007). In an international exchange relationship where environmental uncertainty is exacerbated due to geographical and cultural distance between exchange partners (Skarmetas et al. 2002), electronically integrated may incur lock-in effect which reduce suppliers' adaptability. Hence, the supplier may not be willing to electronically integrate with the international customer to maintain its adaptability to have more international customers under a volatile environment.

Further, electronic integration requires transaction specific investments, for instance, suppliers need to invest in proprietary information systems and equipment. According to the TCE (Subramani and Venkatraman 2003), high transactional specific investment may incur concerns for appropriation and opportunism from the other exchange party, particularly in the asymmetric relationship in the

supplier–MNE customer relationships. Accordingly, suppliers may be less willing to be electronically integrated with MNE customer under high environmentally volatility to avoid further exploitation or appropriation. Thus, we predict:

H4: The greater the environmental volatility a supplier faces, the less the supplier will virtually integrate with the MNE customer.

3.5 Effect of Virtual Interfirm Integration on Relationship Performance

Relationship performance is defined as the extent to which a supplier's relationship with MNE customers is productive and rewarding (Skarmeas et al. 2002). Viewed as an effective form of governance, virtual interfirm integration provides better information processing capabilities to help suppliers with their operations and coordination processes with MNE customers. Therefore, it is expected that virtual interfirm integration enhances supplier performance by reducing transactions cost. Higher levels of virtual interfirm integration in IT-enabled collaborative activities such as CPFR, can serve the role of a relational contract, helping suppliers minimize transactional cost and creating governance value through self-enforcing agreements (Kim and Mahoney 2010). Kim and Mahoney (2006) further argue that virtual interfirm integration as a relationship specific investment enhances mutual commitment to the exchange relationship. Obviously, effective governance and relationship specific investment are valuable resources of firm competitive advantage in inter-organizational relationships (Dyer and Singh 1998). In the case of OEM supplier–MNE customer relationships, supplier use of virtual interfirm integration can enhance firm reputations and IT capabilities, and thus help solidify existing arrangements while attracting more international business opportunities (Kang et al. 2009). Therefore, virtual interfirm integration can enhance the relationship performance of a firm in the international market.

The RBV literature investigated various attributes of IT resources and their contributions to firm performance (e.g., Wade and Hulland 2004). The view further contends that firms create value by combining heterogeneous resources that is economically valuable, difficult to imitate, or imperfectly mobile across firms (Barney 1991). In line with RBV, virtual interfirm integration is a more valuable outside-in IT resource to generate higher firm performance (Jean et al. 2008). Kim et al. (2006) empirically showed the positive relation of virtual interfirm integration to market performance in supply chain relationships. Thus, this study expects that virtual interfirm integration helps reap benefits for suppliers in relationships with their MNE customers.

H5: The greater a supplier is virtually integrated with an MNE customer, the greater the supplier relationship performance is.

3.6 The Moderating Roles of Environmental Volatility and Communication Culture

In our model, the effect of virtual interfirm integration on relationship performance in supplier–MNE customer relationships is expected to be influenced by environment variables in this study. Specifically, we examine two environment variables, environmental volatility and context of culture as potential moderators. In the strategy literature, the dynamic capabilities perspective argues that the value of a firm's resource and capabilities can be shaped by environmental dynamism and uncertainties (Teece et al. 1997). The dynamic capabilities perspective suggests that firms need to reconfigure resources and capabilities in order to respond to environmental changes and to sustain competitiveness.

In a volatile environment where prices and markets change rapidly, a supplier cannot be certain about the ability of each buyer in meeting their demand and price expectations. Thus, firms are likely to increase their adaptability through working with multiple customers in order to deal with unexpected market changes. Virtual interfirm integration under such conditions could restrict the suppliers' ability to coordinate within a specific dyad and forfeit their chances to locate multiple buyers and gather diverse market intelligence on prices (Grover and Saeed 2007). Hence, volatile environments may impede suppliers' capacity to benefit from virtual interfirm integration and in effect reduce relationship performance. Further, in volatile environments, customers may be motivated to further exploit supplier lock-in, specifically under conditions of asymmetric bargaining power relationships. Hence, it will reduce the chances that virtual interfirm integration serves as a safeguard mechanism of relationship performance enhancement. Accordingly, we argue that:

H6a: Virtual interfirm integration will have a stronger effect on relationship performance under low environmental volatility.

Communication culture (Hall 1976) shapes up the information sharing environment and may influence the effect of virtual interfirm integration on relationship performance. When the MNE customer is from high context culture, communication and the flow of information rely more on personal contacts and interactions (Hall 1976). In that case, information sharing is based mainly on physical contacts or is internalized in the personal domain (Kim et al. 1998). In contrast, when the MNE customer is from a low context culture, the mass of information is vested in the explicit code. Low-context messages tend to be more context-free, relying more on explicit communications. According to the strategic fit perspective (Venkatraman 1989), a firm can increase its performance by achieving a fit between its strategies and environmental context. In line with this logic, when the MNE customer is from a low context culture may provide suppliers an information-sharing environment focusing more on explicit and electronic coordination. Thus, the effect of virtual interfirm integration on relationship performance is expected to be stronger when the MNE customer is from a low context culture.

H6b: Virtual interfirm integration will have a stronger effect on relationship performance when customers from low-context cultures.

3.7 Control Variables

Prior studies have found many variables that affect virtual interfirm integration and relationship performance. In particular, Berry et al. (2010) highlight the potential role of distance in international buyer–seller relationship. That is, any gap expressed as a distance in various socio-economic conditions between the countries where business partners are from, may cause some misunderstanding and incorrect assessment of impacts of various firm strategies (Berry et al. 2010). Implying the unfamiliarity of the business environments in a foreign market by multinational firms, such cross-national differences that managers either perceive or recognize, play an important role in their operations in foreign markets (Berry et al. 2010). Recognizing this, we selected cultural distance, institutional distance, and global connectedness distance as factors that influence the nature of the supplier–MNE customer relationships. We also incorporated two country level control variables² including country income and communication infrastructure into the model as factors that influence a firm's relational performance in addition to the selected cross-national difference variables as shown in Fig. 1. We believe these country level social-economic variables are critical to control for in the study given this study explores interfirm communication between international buyer–sellers that shapes up relational performance. Furthermore, this study adopts relationship tenure as additional control variable as the length of relationship may imply the quality of relationship and, thus, relationship performance (Jap 2001). These factors have been examined in the literature in the context of international exchange relationships and virtual interfirm integration (Zhang et al. 2003; Subramani 2004). So, they are included in our study as control variables.

4 Methodology

4.1 Research Context and Sample

The unit of analysis in this study is the specific subcontracting relationship between Taiwanese suppliers and their international MNE customers in the electronics industry. The Taiwanese electronics industry contributes to the global industry structure and world economy significantly through the development of information technology (Dedrick and Kraemer 2007). To this end, an examination of the Taiwanese electronics industry captures industry leaders from the supplier perspective as well as contributing dominating MNE partners such as Intel, IBM, HP, and Dell. Most branded electronic companies outsource their product development and manufacturing to so-called original design manufacturers or ODMs, thus disintegrating their supply chain.

This study uses survey methodology. Key informants in this study are senior OEM/ODM account managers who are directly involved in international

² We thank one of our reviewers for this suggestion.

Table 1 Demographic characteristics of respondent firms (n = 240)

	Percentage		Percentage
Product distribution		Sales revenue	
Communication products	12.1	NT100M–NT500M (US \$3M)	19.6
Systems	6.3	NT501–NT1B	15.8
Computer peripherals	14.2	NT1B–NT5B	39.2
Optoelectronics	14.6	NT5B–NT10B	7.5
Semiconductors	15.8	More than NT10B (US \$300M)	17.9
Computer components	37.1		
Employee numbers			
Less than 100	20.0		
100–199	21.7		
200–499	26.7		
500–999	13.3		
1000–4999	14.6		
5000–9999	1.7		
10,000 and above	2.1		

subcontracting relationships with branded firms and possess IT knowledge. The sampling frame comprises all electronic companies from the 2007 directory of the *Top 5000 Largest Firms in Taiwan*, published by the China Credit Information Service Ltd. All firms in the database were contacted to assess their eligibility and locate appropriate informants for the study.

The data collection followed a two-step approach. Qualitative interviews were initially conducted with 15 senior OEM/DOM account managers or directors to frame the context of the study and obtain conceptual input necessary to solidify construct development and contextualization of the survey instrument. Extra care was taken to counter-balance perspectives provided by MNE partners. Hence, two interviews were recorded with branded electronics MNE buyers. The second step undertook a large-scale survey. To maximize response from Taiwanese-based electronics companies, we followed the suggestion by Yu and Cooper (1983) to combine telephone and personal contact surveys. For a total of 1056 potential participants who agreed to participate in the study in the initial telephone and e-mail surveys, a questionnaire was faxed or e-mailed. A total of 240 useable questionnaires were returned, resulting in an effective response rate of 22.72% (240/1056). Table 1 presents respondent characteristics.

Non-response bias was assessed by classifying responses into two groups, early responses and late responses (Armstrong and Overton 1977). Independent *t* tests on demographic variables such as revenue and employee number were performed. No significant difference was identified. This study also ran additional *t* tests on key study variables such as electronic integration in the proposed conceptual model between these two groups. Again, no significant difference emerged. Hence, we conclude that non-response bias does not present a problem in this study (Armstrong and Overton 1977).

4.2 Measurement

Multi-item scales and seven-point response formats were used to measure all variables. First, virtual interfirm integration of a supplier with the MNE customer was viewed as a higher-order construct and operationalized with electronic interfirm coordination and collaboration on the basis of the work by Kim et al. (2005, 2006). Virtual interfirm coordination was assessed by employing a four-item scale, which captures the coordination and control aspects of virtual interfirm integration. Virtual interfirm collaboration was measured using three items focusing on the degree to which collaborative channel activities were conducted through information systems. This study adapted the scale for innovativeness of the supplier from Hurley and Hult (1998), addressing supplier abilities to introduce new technology to the industry and to the company, and the uniqueness and innovativeness of service. A four-item scale was adapted from Doney and Cannon (1997) to measure trust. These items measure supplier perception of the credibility and benevolence of MNE customers. For relationship performance, this study developed a scale consisting of five items based on the previous work of Selnes and Sallis (2003) and Kim et al. (2006) and adapted to current study. Specifically, we ask the suppliers to identify their different aspects of performance resulting from relationship with their major international customer including sales growth, market share, product quality, current processes or creation of new processes, learning about customers and markets for our products.

Cultural distance in this study is operationalized as a composite score based on the commonly used procedure in the international business literature developed by Kogut and Singh (1988). The procedure calculates distance score for each MNE customer's country based on a variance-weighted average of the four dimensions of Hofstede, including individualism, uncertainty avoidance, masculinity, and power distance (Hofstede 1984). In terms of context of culture, Hall (1976) classifies countries into high or low-context cultures based on the way messages are communicated within a society. High- and low-context culture groups of the MNE customers were coded based on the Hall's classification. For environmental volatility, a four-item scale was adapted from Skarmeas et al. (2002), capturing the changeability of market shares, difficulty in monitoring trends, stability of industry volume, and accuracy of sales forecasts. Institutional distance is operationalized by calculating the distance between the supplier country and buyer country on all six dimensions including voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption (Cuervo-Cazurra and Genc 2008) published by WorldBank. Global connectedness distance was calculated using the number Internet users per 1000 across country published by World Development Indicators (Berry et al. 2010).

Finally, tenure of relationship in this study refers to the length of a supplier's relationship with the international buyer. We asked the respondents to indicate the time span of the supplier–buyer relationship in years and then the variable was log-transformed to alleviate univariate non-normalities and account for potential nonlinear effects (Wooldridge 2000).

Table 2 Assessment of common method bias

Model	χ^2	df	p	CFI	NNFI	SRMR
M1: Null model	3841.14	231	0.000	n/a	n/a	n/a
M2: Trait only model	390.05	194	0.000	0.935	0.946	0.049
M3: Method only model	2352.41	209	0.000	0.344	0.406	0.169
M4: Trait and method model	257.14	172	0.000	0.968	0.976	0.036
Model Comparison	$\Delta\chi^2$	Δdf		p	Conclusion	
Testing for the presence of trait factors						
M1–M2	3451.09	37		< 0.01	M1 > M2	
M3–M4	2095.27	37		< 0.01	M3 > M4	
Testing for the presence of a method factor						
M1–M3	1488.73	22		< 0.01	M1 > M3	
M2–M4	132.91	22		> 0.01	M2 > M4	

5 Analysis and Results

5.1 Common Method Bias

Since all measures in this study were collected via a single questionnaire, common method bias is a potential threat to the study (Podsakoff and Organ 1986; Wu et al. 2006). We used a two-step approach to elucidate this issue. Firstly, the Harman one-factor test was used (Podsakoff and Organ 1986; Wu et al. 2006). A principal component analysis of all the items included in this study was performed. No dominant factor emerged (the first factor explains only 13% of the total variance), which provided no evidence for the presence of common method bias in this study. Secondly, we pursued a more rigorous approach to assess the extent to which common method bias affects the data analysis by conducting a test for potential common method bias using a hierarchical nested covariance structure model offered in the literature (e.g., Cote and Buckley 1987). The literature suggests that we estimate three models: trait only model (M2), method only model (M3), and trait and method model (M4). Table 2 reports the results of our estimations along with the results of testing for the presence of trait factors and for the presence of a method factor (Lee et al. 2004). According to the results, variances from construct items (or traits) are significant. However, variances from the method present at 1% construct items are considered as in M2 and M4. This suggests that only an insignificant portion of the covariance originates from the method used in data collection. To further assess the extent to which such method variances are present in our data, we calculated the mean percentages of variance explained by the construct items and by the common method factor. The results show that the mean percentage of variance explained by the construct items is 67.1%, while that of the common method factor is only 3.5%, indicating that common method bias is minor (Lee et al. 2004). Therefore, we conclude that common method bias does not pose a major threat to this study.

5.2 Measurement Model and Construct Validity

Confirmatory factor analysis (CFA) was conducted using EQS for Windows 6.1 to evaluate the measurement model. The CFA model includes all five study constructs. To purify the measures, items with a loading less than 0.5 were eliminated to increase convergent validity. Item scales linked to more than one construct were also removed to improve discriminant validity. The purification process yielded at least three items for each construct. As Table 3 shows, the CFA model revealed an excellent fit with covariances provided by the dataset with $\chi^2 = 390.05$ on 194 df, NNFI = 0.935, CFI = 0.946, and RMSEA = 0.064 (Bentler and Chou 1987).

Subsequently, the unidimensionality of constructs was evaluated by assessing convergent validity, discriminant validity, and construct reliability. According to the results, all items are significantly loaded on their corresponding factor ($p < 0.01$) and their loadings are greater than 0.5 as shown in Table 3, suggesting that all study constructs have an adequate level of convergent validity (Nunnally and Bernstein 1994). For discriminant validity, the average variance extracted (AVE) from each construct should be greater than its shared variances (Fornell and Larcker 1981). As reported in Table 4, the average variance extracted (AVE) for each construct ranged from 0.55 to 0.71 while the shared variances among constructs ranged from 0.02 to 0.66, as reported in the upper triangle of Table 4. However, no shared variances were greater than the AVE of the respective construct. These results demonstrate a good level of discriminant validity between the study constructs (Fornell and Larcker 1981). Finally, the composite reliability of each construct and standardized parameters of measurement items are reported in Table 3. All composite reliabilities are greater than 0.86, far above the acceptable level of 0.7 suggested in the literature (Nunnally and Bernstein 1994).

5.3 Virtual Interfirm Integration as a Second Order Construct

Before estimating the structural model with virtual interfirm integration as a second order construct, we estimated another CFA with virtual interfirm integration specified as a second-order construct to assess its validity as a second-order construct. All other constructs remained the same as in the previous CFA. The results were $\chi^2 = 390.62$ with 196 df, NNFI = 0.936, CFI = 0.946, and RMSEA = 0.064. While NNFI shows a minor fit improvement, most other fit indexes remained nearly the same. The Chi square difference confirms the two CFA models are not statistically different. To assess the model fit improvement between these non-nested models, we examined the reported CAIC index. To improve a non-nested model fit, the CAIC index should be decreased. According to the results, there was a fit improvement from the first order model (CAIC = - 871.987) to the second order model (CAIC = - 884.429).

Subsequently, the validity of the second-order construct was assessed by first examining the loadings of the two dimensions of virtual interfirm integration for convergent validity. As shown in Table 5, the loadings were 0.70 for electronic coordination and 0.90 for electronic collaboration, indicating a good level of convergent

Table 3 Measures and composite reliabilities

Constructs and measures	λ	Composite reliability
<i>Innovativeness</i>		0.87
Our firm's management actively seeks innovative ideas	0.87	
Innovation is readily accepted in program/project management	0.91	
Technical innovation is readily accepted in our firm	0.69	
<i>Trust</i>		0.88
We believe the information that our international customer provides us	0.78	
Our international customer is genuinely concerned that our business succeeds	0.89	
When making important decisions, our international customer considers our welfare as well as his own	0.74	
Our international customer is trustworthy	0.80	
<i>Environmental volatility</i>		0.92
Sale forecasts in your business are quite inaccurate	0.91	
It is very difficult to monitor the trends in our industry	0.99	
Sales volume in our industry is very volatile	0.75	
<i>Virtual interfirm integration-coordination</i>		0.89
Our international customer monitors our quality of product electronically	0.70	
We exchange product price and market information with our international customer electronically	0.73	
We and our international customer coordinate production plans with each other electronically	0.91	
We and our international customer coordinate inventory levels with each other electronically	0.93	
<i>Virtual interfirm integration-collaboration</i>		0.88
Relying on our information system we collaborate on forecasting and planning with our international customer	0.93	
Collaboration in demand forecasting and planning with our international customer is always possible through our information system	0.89	
We collaborate with our international customer on new product design and development through our information system	0.69	

Table 3 (continued)

Constructs and measures	λ	Composite reliability
<i>Relationship performance</i>		0.86
Increased sales growth	0.73	
Increased market share	0.66	
Enhance product quality	0.75	
Improvements to current processes or creation of new processes	0.72	
Learning about customers and markets for our products	0.84	
<i>CFA Model Goodness of Fit Indexes</i>		
Chi square: 390.05 on 194 df, NNFI: 0.935, CFI: 0.946, and RMSEA: 0.064		

All items were measured using a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree

Table 4 Intercorrelations and shared variances of measures (n = 246)

	F1	F2	F3	F4	F5	F6
Innovativeness (F1)	<i>0.69</i>	0.13	0.02	0.09	0.16	0.25
Trust (F2)	0.36	<i>0.65</i>	0.07	0.07	0.12	0.44
Environmental turbulence (F3)	− 0.14	− 0.26	<i>0.79</i>	0.04	0.06	0.05
Virtual interfirm integration-Co (F4)	0.30	0.26	− 0.20	<i>0.68</i>	0.66	0.11
Virtual interfirm integration-Coll (F5)	0.40	0.34	− 0.25	0.81	<i>0.71</i>	0.15
Relationship performance (F6)	0.50	0.66	− 0.22	0.33	0.39	<i>0.55</i>

The correlations are in the lower triangle of the matrix. Shared variances are in the upper triangle of the matrix. The average variance extracted is in the diagonals (in italic)

Table 5 Virtual interfirm integration—second order construct

First-order construct	Loadings
Virtual coordination	0.70
Virtual collaboration	0.90

Average variance extracted = 0.65; composite reliability = 0.79

validity. For discriminant validity, we examined the AVEs and shared variances. The shared variances ranged from 0.02 to 0.30, which is much less than the AVE of 0.65 for virtual interfirm integration, showing a good level of discriminant validity for virtual interfirm integration as a second order construct. The composite reliability of virtual interfirm integration, the second order construct, was 0.79, which is greater than 0.70, suggested in the literature (Nunnally and Bernstein 1994). These results suggest good construct validity for virtual interfirm integration as a second-order construct.

5.4 Structural Model

To test the hypotheses, the proposed model with all measurement items from the CFA model with virtual interfirm integration as a second order construct and two control variables (i.e., tenure of relationship and cultural distance for virtual interfirm integration and tenure of relationship for relational performance), was estimated using EQS for Windows 6.1. The results reveal an excellent model fit with the empirical covariances provided by the data with $\chi^2 = 588.391$ on 338 df, NNFI = 0.943, CFI = 0.953, RMSEA = 0.055. Based on the good fit of the structural model, the proposed hypotheses were tested.

Hypothesis 1 claimed that the difference in communication cultures (e.g., high vs. low context of cultures) would positively affect virtual interfirm integration. That is, if the MNE buyer is from a high context culture, virtual interfirm integration will be lower. The result supports hypothesis 1 ($b = -0.117$, $p < 0.05$). Hypothesis 2 claimed that supplier innovativeness will positively affect virtual interfirm integration, which is supported by the result ($b = 0.322$, $p < 0.01$). Hypothesis 3 states that supplier trust in the international buyer will result in a high level of virtual interfirm

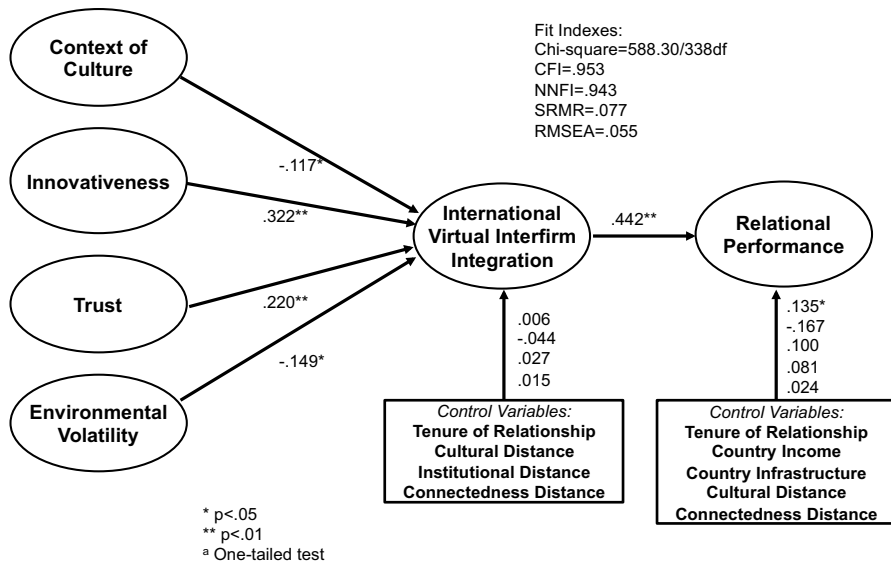


Fig. 2 Role of virtual interfirm integration in the supplier–MNE buyer relationships

integration. The results also support this hypothesis ($b = 0.220$, $p < 0.01$). The results further lend support for Hypothesis 4, for a negative effect of environmental turbulence on virtual interfirm integration ($b = -0.149$, $p < 0.05$).

Regarding the effect of virtual interfirm integration on relationship performance, Hypothesis 5 states that virtual interfirm integration will positively influence relationship performance. The results provide support for this hypothesis ($b = 0.442$, $p < 0.01$).

In terms of the control variables, we found the impact of tenure of relationship ($b = 0.006$, $p > 0.05$), cultural distance ($b = -0.044$, $p > 0.05$), institutional distance ($b = 0.027$, $p > 0.05$), and global connectedness distance ($b = 0.015$, $p > 0.05$) on virtual interfirm integration not significant. However, the effect of tenure of relationship ($b = 0.135$, $p < 0.05$) on relational performance was significant while that of country income ($b = -0.167$, $p > 0.05$), country infrastructure ($b = 0.100$, $p > 0.05$), cultural distance ($b = 0.081$, $p > 0.05$), and connectedness distance ($b = 0.024$, $p > 0.05$) on relational performance was not. Figure 2 summarizes these results.

For the moderating effects of environmental volatility and context of culture on the relationship between virtual interfirm integration and relational performance, we carried out ordinary least squares (OLS) regression analyses with relational performance as dependent variable and virtual interfirm integration as independent variable. Before adding the interaction terms to the regression model, the independent variable and two moderating variables are mean-centered to minimize the potential issue from multicollinearities between the independent variable and moderating variables (Aiken and West 1991). As reported in Table 6, the results support that environmental volatility moderates the effects of virtual interfirm integration on

Table 6 Moderating effect tests on relationship performance

	Model 1	Model 2	Model 3
Virtual interfirm integration (VII)	0.33**	0.13*	0.14*
Innovativeness		0.31**	0.30**
Trust		0.24**	0.23**
Environmental volatility (EV)		− 0.11	− 0.07
Tenure of relationship		0.12 ^a	0.12 ^a
Context of culture (CC)		− 0.18 ^a	− 0.19 ^a
Country income		− 0.01	− 0.02
Communication infrastructure		− 0.20	− 0.21
Connectedness distance		0.19	0.20
Cultural distance		0.06	0.05
VII × EV			− 0.11 ^a
VII × CC			0.04
R-square	0.111	0.332	0.344
Adjusted R-square		0.303	0.309

* $p < 0.05$ ** $p < 0.01$ ^aOne-tailed test

relational performance negatively ($p < 0.05$), which supports H6a. However, context of culture does not moderate the effects of virtual interfirm integration on relational performance significantly ($p > 0.05$). Thus, H6b is not supported.

6 Discussion and Managerial Implications

The growth of international outsourcing activities has made managing inter-organizational relationships critically important. Virtual interfirm integration via advanced IT has been increasingly adopted as an effective coordination mechanism in the supplier–MNE buyer relationships. Especially so in international exchange, because cross-border coordination is challenging due to the cultural and geographic separation between the MNE buyers and suppliers. Despite its managerial relevance, there is limited understanding of the role that virtual interfirm integration plays in international exchange relationships between suppliers and MNE buyers. This study adds to the contemporary knowledge-base on virtual interfirm integration by exploring how it develops in cross-cultural relationships and establishes a direct link between virtual interfirm integration and firm performance. Drawing from TCE and RBV, we investigate environmental volatility, innovativeness, and trust as key drivers of virtual interfirm integration. Based on the conceptualization of Hall (1976) regarding the context of culture, we examine the effect of communication culture on the degree of virtual interfirm integration in international exchange relationships and the performance outcome. In addition, this study examined the contingency conditions of virtual interfirm integration under environmental volatility and context of culture.

The results of this study offer valuable implications for both theoretical development and managerial practice.

First, as a second order construct including electronic coordination and electronic collaboration, virtual interfirm integration in the supplier–MNE customer relationships has a positive effect on relationship performance for the supplier. The results demonstrate that virtual interfirm integration through technology-based coordination and collaboration channel activities can play a crucial role as an effective alternative governance mechanism. Supplying firms with a greater extent of virtual interfirm integration with their MNE customers can enhance information processing capabilities and reduce cross-border coordination costs, which ultimately improve performance outcome. This is consistent with TCE, which argues that an effective governance mechanism can enhance firm value in exchange relationships. This is also consistent with the RBV perspective of IT-business value, which argues that IT alone is not sufficient for enhancing firm performance (Devaraj et al. 2007; Cao and Dowlatshahi 2005). This view contends that only by integrating in specific firm activities such as coordination and collaboration in international exchange relationships can IT be a source of firm competitive advantage. Virtual interfirm integration in international exchange relationships can thus be an effective governance mechanism and serve as firm capability to create value for suppliers in international exchange relationships. Virtual interfirm integration reduces transaction costs and helps suppliers reap tangible rewards in sales growth, market share, and profitability, and even contributes to new products and learning about customers and markets for products. This result shed light on better understanding of how suppliers can effectively manage their asymmetry relationship with MNE buyers.

It is particularly worth noting that, building on dynamic capabilities perspective and strategic fit, this study tested the moderating effects of environmental volatility and context of culture on the link between virtual interfirm integration and relationship performance. This study contributes to the strategic IT literature by addressing the role of environment uncertainty in IT value creation, which to date remains an open issue (Dong et al. 2009). We found differential relationships of virtual interfirm integration to performance improvement contingent on environmental volatility. The result shows the effect of virtual interfirm integration on relationship performance is weaker under high environmental volatility. The theoretical explanation is that digitally enabled coordination may not be a good configuration in a high volatile environment. Virtual interfirm integration may incur certain inflexibility that may restrict suppliers' capabilities to adapt to changing and unpredictable environment.

However, the results of the antecedents of virtual interfirm integration in the suppliers–MNE buyer relationships show that communication culture has a significant effect on the degree of virtual interfirm integration. There has been limited empirical attention in the literature paid to the effect of communication culture on the degree of virtual interfirm integration in international exchange relationships. According to our results, a supplier from a high context culture will tend to be more reluctant to use inter-organizational information systems for coordination and collaboration activities with its MNE buyers from a high context culture. This finding verifies that communication culture between exchange parties in international exchange relationships, used in this study as an etic view, plays a crucial role in determining the

degree of virtual interfirm integration. The context of culture framework by Hall (1976) as a type of etic approaches offers an important tool to understand and react to various communication cultures across countries.

This study did not find an effect of cultural distance on virtual interfirm integration. This is interesting and consistent with recent view in the literature on the potential misleading role of cultural distance in international business (Lew et al. 2016; Stahl and Tung 2015). For example, driven by globalization and a significant cross-pollination effect of culture (Ralston et al. 2008), global managers possess an increasing global mindset and similar culture value. Therefore, using a composite score of cultural distance in examining cross-border activities has become more challenging for international business studies (Tung 2008). Instead, this study finds that the use of communication culture as a measure of cultural difference between international transaction partners more appropriate in exploring virtual interfirm integration in international exchange relationships. The findings should not be surprising as Hall's (1976) framework more specifically addresses the differences in communication styles found across countries even though both Hofstede's cultural distance and Hall's (1976) framework offer another approach to the etic view from the communication culture point of view. That is, our finding suggests that global business managers should rely on a more activity-specific, yet culture-general, etic view based on the communication culture to the extent it is available to gain a direct benefit from their understanding of those etic views.

The results also demonstrate that a supplier's innovativeness can facilitate the development of virtual interfirm integration in international exchange relationships. We find evidence that innovativeness plays a crucial role in developing the IT-based interfirm interactions, which is conducive to higher firm performance. Innovativeness seems to have a signaling function to show the ability and strategic orientation of the supplier to engage in cross-border virtual business activities. This is consistent with prior literature, which proposes the crucial role of an innovative organizational culture in diffusing innovation (Hurley and Hult 1998). The results highlight a supplier's innovativeness helps not only stay ahead of competition as an organization internally but also develop more productive international exchange relationships with MNE customers externally.

The effect of trust on virtual interfirm integration is consistent with our expectation and thus reinforces the importance of developing healthy, trust-based relationships as key antecedents of virtual interfirm integration with MNE buyers. Trust serves as a key foundation for successful virtual interfirm integration between exchange partners, and is an inter-organizational tool to facilitate effective virtual coordination and collaboration between exchange partners.

In terms of environmental uncertainty, our results also show that environmental volatility presents a barrier to virtual interfirm integration between a supplier and its MNE customers. The cross-cultural context, which exacerbates the geographical and cultural distance of exchange partners, obviously implicates a reduced willingness to integrate business activities closely via electronic means. While it could potentially enhance exchange partners' responsiveness and flexibility in the cross-cultural relationship, environmental volatility seems to reduce the possibility of carrying out virtual interfirm activities.

From a managerial perspective, the findings suggest that managers of suppliers need to be aware of and take advantage of the potential benefits of investing in virtual interfirm integration, i.e. coordination and collaboration processes with their customers. The results show that suppliers can reap the benefits from the successful relationships with MNE customers through virtual interfirm integration. Virtual interfirm integration offers a good route for channeling internal mechanisms such as innovativeness, and inter-organizational mechanism like trust. Innovativeness and trust emerge as powerful antecedents of virtual interfirm integration and thus relationship performance eventually, and are prerequisites for implementing virtual connectedness. The effects of trust and innovativeness on relationship performance through the indirect linkage via virtual interfirm integration suggest a potent role of these antecedents.

The negative association of environmental volatility with virtual interfirm integration suggests that unpredictable industry trends and competition remain a threat for suppliers, reducing their likelihood of engaging in virtual interfirm integration. As our results show, virtual interfirm integration features positive effects on performance. The context of communication culture incorporated in this study shows a significant negative effect on virtual interfirm integration, and highlights that communication culture plays an important role in the relationship exchange via electronic means. Thus, managers need to pay more attention to cultural context when implementing virtual interfirm integration in the international exchange.

7 Limitations and Directions for Future Research

Study findings need to be considered against a set of limitations. First, when examining virtual interfirm integration and its associated antecedents and performance outcomes, this study considered the supplier's perspective. While there is a paucity of studies taking the supplier perspective and thus this viewpoint is an important contribution, it may be valuable to compare whether the findings are equally applicable from the perspective of the international customer. Dyadic perspectives in this context pose the specific challenge of asking respondents about the identity and contact details of their counterpart. We have been unsuccessful in eliciting appropriate response from our respondents, but future avenues are wide open for this area of research. Further, while our results support the direct relation ship between environmental volatility and virtual integration, the interaction effect is not supported. The relationship between environmental volatility and virtual integration may be more complex than we propose. We acknowledge the limitation of this arguments and suggest further study to investigate some boundary conditions on the relationship between environmental volatility and virtual integration. Also, the specific context was a supplier sample in Taiwan, suggesting that an extension of the study to other countries is desirable. Furthermore, future studies may investigate various forms of electronic exchange such as the electronic market, and discuss its antecedents and performance implications in the international market. Another limitation of the present study relates to the difficulty in establishing casual relationships due to the cross-sectional nature of the data employed in testing the hypotheses. Although

this study adopted several study variables from secondary data sources to overcome potential issues a study relying on a cross-sectional survey may have, there would still be a potential feedback loop from the dependent variable to some of the antecedents such as trust and/or virtual integration that the dataset this study used does not recognize. Future research may use longitudinal data and/or cross-lagged analysis to confirm our findings in this study. We hope this study will inspire further research to address issues pertaining to the critical role virtual interfirm integration plays in international buyer–seller relationships.

Acknowledgements We gratefully acknowledge insightful comments received from Mo Yamin, Noemi Sinkovics and Ram Mudambi during seminars at The University of Manchester, Alliance Manchester Business School, UK and Fox School of Business, Temple University, Philadelphia, USA.

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