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# Digital Integration: Understanding the Concept and its Environmental Predictors

Ricardo M. Checchi

# *DIGITAL INTEGRATION: UNDERSTANDING THE CONCEPT AND ITS ENVIRONMENTAL PREDICTORS*

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***July 28th, 2008***

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**DIGITAL INTEGRATION: UNDERSTANDING THE CONCEPT AND ITS ENVIRONMENTAL PREDICTORS**

by

**RICARDO MARTIN CHECCHI**

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree
of
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## ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor in Philosophy in Business Administration in the Robinson College of Business of Georgia State University.

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# Abstract


**DIGITAL INTEGRATION: UNDERSTANDING THE CONCEPT AND ITS ENVIRONMENTAL PREDICTORS**

By

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This study investigates the impact of environmental factors on the decision to electronically integrate operations with international customers and/or suppliers. The following research question motivates the study: *How does the environmental context affect the level of electronic integration of an organization with its international partners?* This study elaborates on the concept of electronic integration. Studies on integration in general and electronic integration in particular adopt a loose definition of integration: they all agree in that integration is the opposite of markets, but they define this opposite in different terms: relationship contracting, long-term contracting, coordination, etc. Finally, the study also responds to Wathne and Heide's (2004) call for a more comprehensive study of governance mechanisms in B2B, with emphasis on monitoring mechanisms.

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# Chapter 1 Motivation and Research Questions

The arrival of the Internet and the explosion of new information and communication technologies (ICTs) has altered the economic and social landscape and created new forms of business relationships. ICTs increase information flows, which in turn impact firm performance and competitiveness (Gnyawali and Madhavan 2001; Malone *et al.* 1987; UNCTAD 2003). Some of the benefits of the use of ICTs in business-to-business (B2B) include: reduction in transaction costs, better resource allocation, economies of scale, improved competitiveness, and increased availability of products and markets (UNCTAD 2003). In spite of the apparently evident benefits of the use of ICTs in B2B (henceforth called e-business or eB2B), there are differences in take-up both between and within countries (Teo *et al.* 2003).

E-business adoption has lagged in developing countries, due to "lack of awareness of what ICT could offer, insufficient telecommunications infrastructure and Internet connectivity, expensive Internet access, absence of adequate legal and regulatory frameworks, shortage of requisite human capacity, failure to use local language and content, and lack of entrepreneurship and a business culture open to change, transparency and democracy" (UNCTAD 2003 p. 2). Within country differences, on the other hand, are explained by factors such as coercive pressures from business partners, industry characteristics, and organizational size (Teo *et al.* 2003).

These eB2B differences in adoption between and within countries have been studied from various perspectives, including but not limited to economics [mainly

transaction cost economics (TCE) and agency theory (AT)]; operations management, in particular supply chain management (SCM); industrial marketing, especially relational marketing (RM); information systems, focusing on inter-organizational systems (IOS) and linkages; social-economics, primarily network processes; and in diverse other fields that look at the cultural consequences embedded in the adoption of innovations. The proposed study integrates these perspectives into a comprehensive framework and furthers past research by concentrating on the digital aspect of the eB2B relationship.

In particular, the proposed study investigates the impact of environmental factors on the decision to electronically integrate operations with international customers and/or suppliers. The following research question motivates the study:

*RQ1: How does the environmental context affect the level of electronic integration of an organization with its international partners?*

# Chapter 2 Theoretical Background and Theory Development

This dissertation has two main goals: (1) to further our understanding of electronic integration, and (2) to assess the environmental predictors of electronic integration. First, studies on electronic integration (EI) adopt a loose and narrow definition of EI: EI is generally defined *opposite of markets* (Malone *et al.* 1987) and as a one-dimensional construct that relates to the *proportion of business associated with a particular partner* (Zaheer and Venkatraman 1994). In this study we expand that definition. Secondly, the tradition of economic anthropology posits that the structure of organizational relationships is determined by the settings in which they exist. We focus on three dimensions of this setting: cognitive (uncertainty), cultural, and political (power) [adapted from Zukin and DiMaggio (1990)].

The current section is structured as follows: first, we introduce the existing literature on integration and quasi-integration; second, based on the theories of integration we define *digital integration*, the criterion variable; we then describe the framework of embeddedness as defined by Zukin and DiMaggio (1990); finally, we elaborate on each of the types of embeddedness considered in the present work.

## *2.1 Electronic Integration*

### 2.1.1 Integration and quasi-integration

The focus of the study is the integration of the operations of partnering organizations via electronic media. As such, we first examine the definition and structure of integration and then the digital (electronic) component. Integration is generally defined as "control over decisions" (Heide and John 1992 p. 33). In the literature, integration has been researched mainly from two perspectives: vertical integration and coordination/collaboration. Rather than being competing or complementary approaches, these perspectives focus on similar phenomena in different domains. These studies investigate issues related to the governance and control of the exchange. The domains vary from financial commitment to coordination.

*Vertical integration* relies on financial forms of governance, i.e., ownership, as ways to attain control over a resource or relationship. Coordination/collaboration, on the other hand, relies on entrepreneurial forms of governance, e.g., contracts, social norms, and trust, as ways to attain control over a resource or relationship. Traditionally, these perspectives have been studied separately and while they treat the extremes similarly (the market is regarded as having no ownership of supply lines, short-term contracts or transactions; hierarchy is defined as ownership of supply lines, long-term contracts or vertical integration), they take different roads when it comes to partial ownership versus non-ownership relational agreements. Some studies bridge these different intellectual stances by positing that *quasi-integration* (no ownership) can be a substitute for vertical integration (ownership) (Blois 1972; Blois 1980; Heide and John 1990; Zaheer and

Venkatraman 1994) whereas in the extreme, a quasi-firm (or quasi-hierarchy) would be formed instead of a hierarchy (Eccles 1981; Granovetter 1985). Figure 1 depicts the dichotomy between vertical integration and coordination/collaboration and the position of the different types of governance modes described in the literature. To fully understand the implications of this graphic, however, we need to further explore the concept of governance.

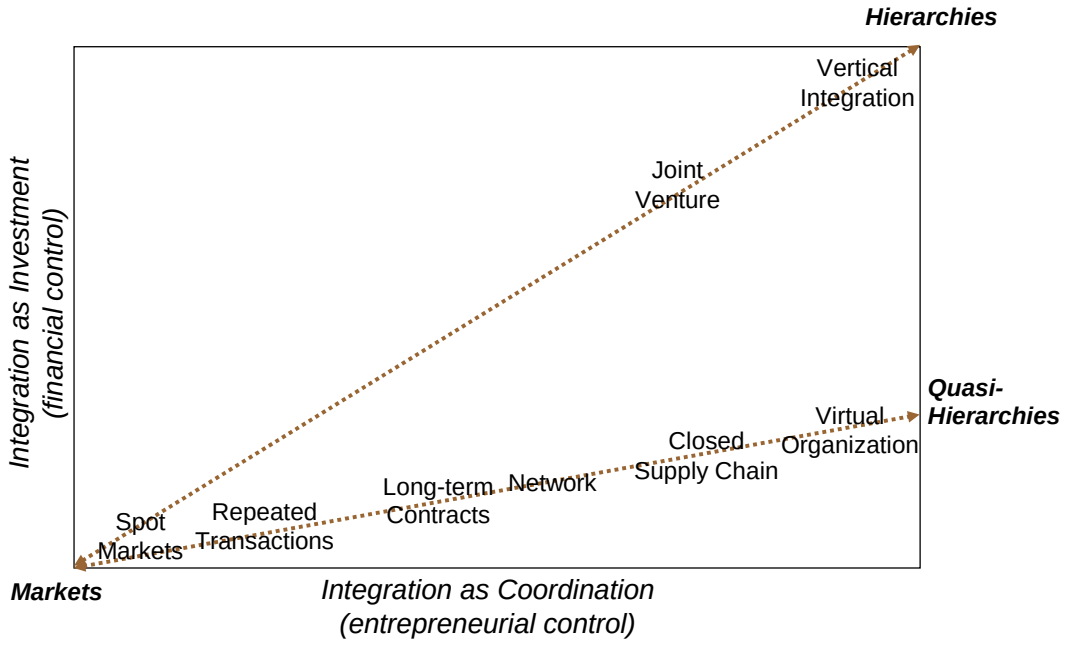


Figure 1. Two perspectives of integration
(adapted and expanded from Seppälä (2001; 2003) and Webster (1992))

One definition of governance is that it is the set of "formal and informal rules of exchange between partners" (Griffith and Myers 2005 p. 255). Several theoretical bases have been applied to the study of governance in inter-organizational relationships (see Table 1). The most relevant of these are: agency theory (AT), resource dependency theory (RDT), transaction cost economics (TCE), relational view (RV), relational exchange theory (RET), and the information processing view (InfoView) of the firm.

This section describes interorganizational relationships from the perspectives mentioned, and then conceptualizes electronic integration based on these perspectives.

#### 2.1.1.1 Agency Theory: Alignment and Control

Given that buyer-supplier relationships are cooperative relationships, i.e., agency relationships, they are subject to agency costs, even though there are no clear-cut principal-agent roles (Jensen and Meckling 1976). An agency relationship is a contract under which a person or organization (the principal) uses the services of another person or organization (the agent) "to perform some service on their behalf which involves delegating some decision making authority to the agent" (Jensen and Meckling 1976 p. 5). Agency theory proposes that governance mechanisms are designed and put in place in order to mitigate the agency conflicts existing in the relationship (Jensen and Meckling 1976 p. 7).

The most salient mechanisms in the structure of the relationship are behavioral and outcome monitoring and risk sharing through incentives –rewards and/or punishments–(Eisenhardt 1985; Jensen and Meckling 1976). The agency conflicts are usually related to management of resources. Agency theory, however, is not the only theory that looks at management or control over resources.

**Table 1. Theories applied to the study of inter-organizational relationships**

| Theory | Assumptions | Thesis | Integration Terms Used | Theoretical Components | Effect on IORs | Source |
|---|---|---|---|---|---|---|
| Agency Theory (AT) | Agent and principal have different goals and behave selfishly | Governance mechanisms are enacted to mitigate the agency conflicts existing in the relationship | Relational contract | • Risk sharing<br>• Monitoring | Self-interests<br>Observability → Control mechanisms | Jensen and Meckling (1976)<br>Eisenhardt (1985) |
| Resource Depend-ency Theory (RDT) | Power dependence bases are influenced by the allocation of resources | Firms integrate (or quasi-integrate) vertically to acquire control over valued resources | Hierarchy<br>Relational contract | • Ownership<br>• Long-term contract | Mutual dependence<br>Power imbalance → Vertical integration | Pfeffer and Salancik (1978)<br>Pfeffer (1987) |
| Transaction Cost Economics (TCE) | There are certain transaction costs that are lost in spot-like relationships | Efficiencies result from establishing transaction-specific structures | Hierarchy<br>Quasi-hierarchy | • Ownership<br>• Long-term contract<br>Transaction Specific Assets | Opportunism<br>Uncertainty → Vertical (quasi-) integration | Williamson (1975; 1979) |
| Relational View (RV) | Firms might obtain competitive advantages from the relationships they have with other firms. | Firms establish relation-specific structures to leverage those advantages | Interfirm resources and routines | • Relation-specific assets<br>• Knowledge sharing routines<br>• Complementary resources and capabilities<br>• Governance mechanisms | Interfirm resources and routines → Relational rents | Dyer and Singh (1988) |

**Table 1. Theories applied to the study of inter-organizational relationships**

| Theory | Assumptions | Thesis | Integration Terms Used | Theoretical Components | Effect on IORs | Source |
|---|---|---|---|---|---|---|
| Relational Exchange Theory (RET) | Social norms must be respected to have successful long-term relationships | Social norms within a relationship are a complement to contracting | Social contracting (Relational norms) | • Solidarity<br>• Mutuality<br>• Flexibility<br>• Role integrity<br>• Information sharing | Relational norms → Relationship performance | Macneil (1980); Heide and John (1992) |
| Information Processing View (InfoView) | Firms have information processing needs that derive from uncertainty | Firms create information processing mechanisms to cope with uncertainty | Coordina-tion mechanisms | • Slack resources<br>• Self-contained tasks<br>• Vertical integration systems<br>• Lateral relationships | Uncertainty → Coordination mechanisms | Galbraith (1973) |

#### 2.1.1.2 Resource Dependency Theory: Control over Resources

Resource dependency theory (Pfeffer 1972) is also concerned with control over resources, although it focuses on the effect of power on contracts, rather than on self-interests and contracting costs. RDT posits that power/dependence bases are influenced by the allocation of resources, which determines the structure of relationships (Emerson 1962; Hatch 1997; Pfeffer 1972; Pfeffer 1987; Pfeffer and Leong 1977; Pfeffer and Salancik 1978). According to resource dependency theory, firms seek control over those resources on which they are highly dependent (Casciaro and Piskorski 2005; Pfeffer and Salancik 1978). Organizations can acquire control over resources completely via vertical integration (Pfeffer 1972; Pfeffer 1987) or partially via long-term contracts, i.e., quasi-integration (Pfeffer and Leong 1977). RDT, therefore, studies the emergence of resource control as a way to control resources and reduce external dependency.

#### 2.1.1.3 Transaction Cost Economics: From Markets to Hierarchies

Other theories also study the control over external resources via vertical integration or quasi-integration, but focus on idiosyncratic investments and coordination of activities (Williamson 1979; Williamson 1981). TCE is one of these theories. According to TCE, the flow of materials or services in the value chain is coordinated via two basic mechanisms: markets or hierarchies (Malone *et al.* 1987). Markets use market forces such as supply and demand and price to coordinate flow of materials or services (Malone *et al.* 1987). Alternatively, hierarchies use command chains to coordinate the flow of materials or services; managerial decisions determine the product or service characteristics, the price and the delivery conditions (Malone *et al.* 1987). TCE uses the

characteristics of transactions (uncertainty, frequency and required asset specificity) as predictors of the chosen form of governance, that is, market mechanisms or firm hierarchical controls (Williamson 1998). Further theoretical advances extended the theoretical principles to the study of interfirm relationships to include long-term relational contracts, joint ventures, quasi-firms, and quasi-integration (Zaheer and Venkatraman 1994), which Williamson had introduced as hybrid forms of integration (Williamson 1985). These studies characterize interfirm relationships as taking place on the opposite poles of *market versus quasi-integration*.

Rather than defining interfirm relationships in terms of these polar extremes, we follow the more modern approach of integration as a continuum of relationalism, which ranges between markets and hierarchies (Ganesan 1994; Macneil 1980). While the market end is usually referred to as market, the hierarchy end had been termed either firm (Coase 1937), hierarchy (Williamson 1979; Williamson 1981), or relational exchange (Dwyer *et al.* 1987; Ganesan 1994; Macneil 1980). Relationalism is measured by the level of investment in transaction-specific assets and the existence of market safeguards. Transaction specific assets are assets specialized to the particular needs of the relationship (Malone *et al.* 1987). Safeguards are added supports into the contract, such as incentives and penalties or information disclosure (Williamson 1998). Together, these two elements denote a closer relationship between the partnering organizations, which might involve mutual adaptation of assets and processes.

#### 2.1.1.4 Relational View: Synergy

Similarly to TCE, RV proposes that "a firm's critical resources may span firm boundaries and may be embedded in interfirm routines and processes." (Dyer and Singh 1988 p. 661) As such, partner organizations may generate competitive advantages "through the synergistic combination of assets, knowledge or capabilities." (Dyer and Singh 1988 p. 661) Organizations may accrue these advantages if they move their alliance away from a market-type relationship (Dyer and Singh 1988). The distance to the market may be defined in terms of four attributes: (1) relation-specific assets, (2) knowledge sharing routines, (3) complementary resources and capabilities, and (4) governance mechanisms (Dyer and Singh 1988). While Dyer and Singh don not specify such continuum from markets to quasi-hierarchies, their conceptualization of *moving away from markets* (Dyer and Singh 1988) may be interpreted as such.

#### 2.1.1.5 Relational Exchange Theory: Relational Norms

RET is based in a similar market-hierarchy continuum. The strength of relational norms positions the relationship along a *discrete transaction - relational exchange* continuum (Dwyer *et al.* 1987). Norms can serve as a governance mechanism by proscribing deviant behavior (Heide and John 1992). In general, norms are defined as "a belief shared to some extent by members of a social unit as to what conduct ought to be in particular situations or circumstances." (Gibbs 1981 p. 7) A number of relational norms have been identified in the literature, including: solidarity, mutuality, role integrity (Kaufmann and Stern 1988; Macneil 1980), flexibility, and information sharing (Heide and John 1992). Therefore, RET argues that the economic exchange can be defined

along a continuum defined by norms, as opposed to ownership and contracts in TCE or synergies in RV.

TCE, RV and RET conceptualize the governance mechanisms that regulate the relationship in terms of how the relationship is different from a market. These mechanisms, they argue, emerge in response to uncertainty, opportunism risks, and the idiosyncratic savings and synergies that may accrue from the relationship. The final theory we discuss, the information processing view, takes a different line of attack, particularly with regard to uncertainty.

#### 2.1.1.6 Information Processing View: Coordination through Communication

The information processing view of the firm posits that intra- and inter-firm structures emerge in response to the information processing needs of the organization(s) (Galbraith 1973). Greater task uncertainty requires that greater amounts of information be processed (Galbraith 1973). Firms utilize four different mechanisms to deal with uncertainties: (1) creation of slack resources, (2) creation of self-contained tasks, (3) investment in vertical integration systems, and (4) creation of lateral relationships. Of these, creation of slack resources and self-contained tasks are substitutes for intra- or inter-organizational integration. Investment in vertical information systems and creation of lateral resources, on the other hand, integrate organizations by increasing information sharing and communications. In summary, firms create information processing mechanisms to increase interfirm coordination.

#### 2.1.1.7 Summary and synthesis of the components of electronic integration

The literature identifies two main general goals for integration, namely control and coordination, as exemplified in the following quote:

> "But in lieu of cost considerations or legal contracts, effective control and coordination were achieved, and opportunism avoided, through the regulatory presence of moral obligations, trust, and concern for preserving reputations." (Larson 1992 p. 84)

This distinction is pervasive in research on interfirm relationships. While some studies focus on both goals (implicitly or explicitly), most focus on either of them. Agency theory, resource dependency theory and transaction cost economics based research focuses mostly on the control aspects of the relationship. These theories suggest that *relationship elements* are "primarily aimed at curbing opportunistic behavior and establishing control over partner organizations" (Vlaar et al. 2007 p. 411). Information processing view of the firm based research, on the other hand, posits that coordination costs form the basis for the design of *relationship elements* (Gulati and Singh 1998). Relational based view and relational exchange theory are used to study both control and coordination needs as predictors to the structure of relationships. As a result, interfirm relationships are characterized by elements designed to increase coordination and increase control.

As indicated earlier, integration relates to the existence of elements of the relationship that distinguish it from a market, and we classify these elements as coordination-oriented and control-oriented. Two categories have been identified in the literature for coordination-oriented elements: investments in relational assets and process integration (i.e., capital vs. process integration). Control-oriented elements are classified

into two groups as well: formal and relational contracts (i.e., formal vs. informal). Each of these dimensions is presented below.

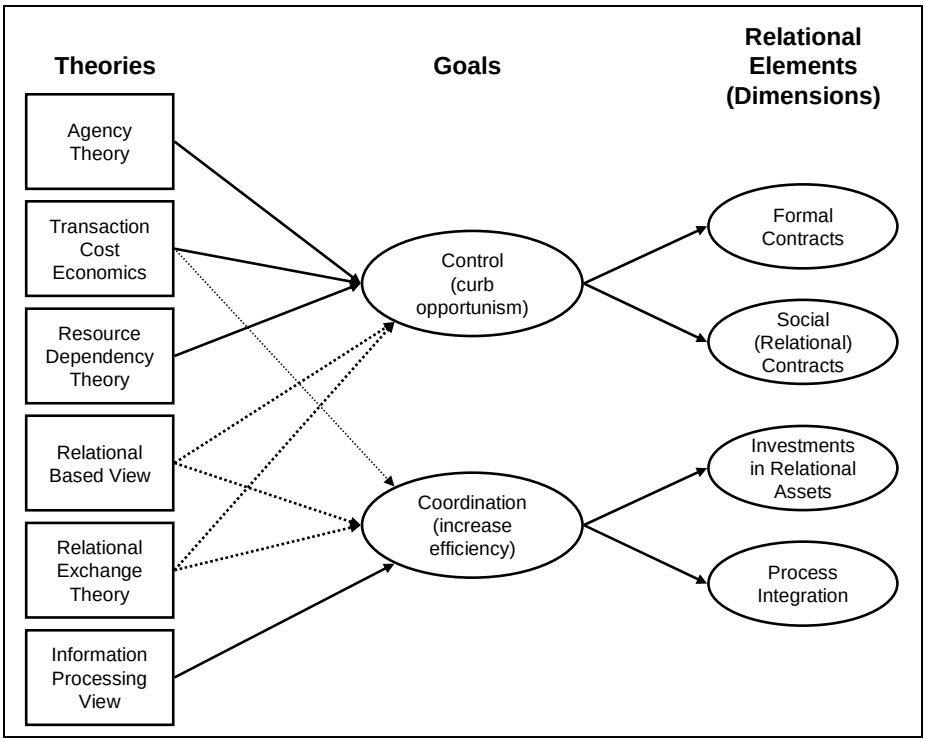


Figure 2. Process of Synthesis: from Theories to Dimensions

### 2.1.2 Relational Dimensions

#### 2.1.2.1 Relation-specific assets

Relation-specific assets are idiosyncratic investments in the relationship that are not easily re-deployable or have no salvage value if the firm were to end the relationship (Ganesan 1994; Williamson 1981). Williamson identifies six different types of asset specificity: (1) site specificity, (2) physical asset specificity, (3) human asset specificity, (4) brand names, (5) dedicated assets, and (6) temporal specificity (Williamson 1979; Williamson 1981; Williamson 1998). Later research in IT in supply chains that applies TCE posits that intangible asset specificity forms the basis for contracting (Dyer and

Singh 1988; Subramani and Venkatraman 2003). Some of that research conceptualizes intangible asset specificity as human (or human-capital) asset specificity, while newer conceptualizations focus on process and expertise (or domain knowledge) specificity (Subramani 2004; Subramani 1999; Subramani and Venkatraman 2003).

These are relevant because the firm "invests resources (time and money) to exploit the system functionality to derive *specific* business competencies from IOS through lower cost of information-exchange, faster response to inquiries and improved service.[1]" (Zaheer and Venkatraman 1994 p. 553) This is consistent with Anderson and Weitz's (1992) and Ganesan's (1994) conceptualization of asset specificity. Overall, asset specificity relates to investments in links to the partnering organization. From the above mentioned components for process specificity, software and applications is left as assets, while procedures are considered a separate component: interfirm coordination processes.

#### 2.1.2.2 Inter-firm coordination processes

Robicheaux and Coleman (1994) conceptualize (operational) integration in terms of the operational actions of the parties. In their study of marketing channels, they use four inter-firm processes as indicants of the level of integration: joint actions, assistances, monitoring, and information exchange. Alternatively, Bello *et al.* (2002) define operational integration through ICTs (a more generic approach) in terms of three process characteristics: (1) formalization, (2) task and resource centralization, and (3) standardization. In the study of IT in supply chains, operational integration has included

[1] Italics in original

administrative and operational procedures (Subramani 2004; Subramani 1999; Subramani and Venkatraman 2003) or information, physical and financial flow integration (Rai *et al.* 2006). We use the latter in the conceptualization of process integration.

Physical flow integration refers to "the degree to which a focal firm uses global optimization with its supply chain partners to manage the stocking and flow of materials and finished goods" (Rai *et al.* 2006 p. 229). Information flow integration refers to "the extent of operational, tactical, and strategic information sharing that occurs between a focal firm and its supply chain partners" (Rai *et al.* 2006 p. 229). Finally, financial flow integration refers to "the degree to which financial flows between a focal firm and its supply chain partners is driven by workflow events" (Rai *et al.* 2006 p. 229). Interfirm process integration as defined above is relevant because it comprises the different process components involved in the relationship. Operational integration, via asset and process specificity, is complemented with formal and informal governance mechanisms that regulate the behaviors.

#### 2.1.2.3 Relational Norms

Relational norms are informal governance mechanisms; monitoring, incentives and rewards are formal governance mechanisms. These governance mechanisms are, purposely or not, aimed at establishing, developing, and maintaining successful relational exchanges (Heide and John 1992; Morgan and Hunt 1994). Social (relational) norms specify permissible limits on behavior, and thus serve as a protective governance mechanism that safeguard against opportunistic use of decision rights (Heide and John

1992). Heide and John (1992) identify three relevant "dimensions" of relational norms: flexibility, information exchange, and solidarity.

Flexibility represents the expectation that both parties will adapt in good-faith to changing circumstances (Heide and John 1992). Information exchange represents the expectation that both parties will proactively share information useful to the other partner (Heide and John 1992). Finally, solidarity represents the expectation that both parties value highly the relationship and will make efforts to maintain it (Heide and John 1992). These relational norms, i.e., informal mechanisms, are complemented by risk-sharing and monitoring, i.e., formal mechanisms.

#### 2.1.2.4 Agency Mechanisms.

Risk sharing via incentives and rewards is an intrinsic element of agency theory. When organizations are interested in building and maintaining long-term relationships, they are willing to absorb or share part of the risks (Camuffo *et al.* 2005). Camuffo *et al.* (2005) identify two main sources of risk in supply chain activities: "the risk arising from unpredictable fluctuations of demand and the risk arising from variations in prices/costs." (Camuffo *et al.* 2005 p. 6) Incentives are enacted in order to minimize and/or share risks. Incentives come in two forms: pecuniary incentives are incentives or penalties in monetary form (such as increase sale price), and non-pecuniary incentives are incentives or penalties in non-monetary form (such as promises or blocks on future contracts) (Moldoveanu and Martin 2001).

Monitoring mechanisms complement incentives by both providing performance measures to which the incentives are tied and an enforcement function more typical of hierarchies (Aulakh *et al.* 1996). The literature identifies two basic types of monitoring mechanisms: output and process controls (Anderson and Oliver 1987; Aulakh *et al.* 1996; Eisenhardt 1985; Oliver and Anderson 1994). Output and process controls are different in that they are generally associated, respectively, with different economic and behavioral outcomes (Anderson and Oliver 1987; Aulakh *et al.* 1996). Output controls focus on assessments of the actual traded goods or services. Process controls, on the other hand, focus on monitoring of the ongoing activities of the partners. In summary, electronic integration is characterized by four main formative attributes: relation specific assets, interfirm coordination processes, relational norms, and agency control mechanisms; the following section describes the concept of embeddedness and its predictive effect on electronic integration.

**Table 2. Synthesis of theories and dimensions of electronic integration**

| Theory | Relation-Specific Assets | Interfirm Coordination Processes | Relational Norms | Agency Mechanisms |
|---|---|---|---|---|
| Agency Theory (AT) | | | | Incentives<br>Monitoring |
| Resource Dependency Theory (RDT) | Ownership and/or Control | | | |
| Transaction Cost Economics (TCE) | Asset specificity | Process specificity | | Monitoring |
| Relational Based View (RV) | Relation-specific assets<br>Complementary resources and capabilities | Knowledge sharing routines | | Governance mechanisms |
| Relational Exchange Theory (RET) | | | Solidarity<br>Mutuality<br>Flexibility<br>Role integrity<br>Information exchange | |
| Information Processing View (InfoView) | Vertical integration systems<br>Slack resources (R) | Vertical integration systems (information sharing)<br>Lateral relationships<br>Self-contained tasks (R) | Lateral relationships (informal relationships) | |
| **Digital-related components** | ***IOS and knowledge specific assets*** | ***Information flow integration*** | ***Information sharing norms*** | ***Monitoring*** |

(R) Reverse: the more of these mechanisms are present, the more market-like is the relationship.

## *2.2 Embeddedness*

Similar to the structure of a building being adapted to its surroundings, e.g., the composition and strength of the soil, the weather, the accessibility to water and sewage, the existing electric and communication networks, the local edification code, etc., the structure of inter-organizational relationships is also adapted to their own setting, e.g., the composition and strength of its suppliers and customers, the uncertainty of the market and technology, the existing networks of relationships, cultural environments, etc. Originally introduced by Polanyi (1957), the concept of embeddedness argues that the economy is immersed in and subject to its societal context.

Contrary to contemporary conventional economic wisdom, Polanyi argues that the society determines economic behavior[2] and that material gain is not the only incentive to participate in economic activity (Dalton 1965; Polanyi 1957; Wilk 1996). Dalton posits that "the institutions [organizations] through which goods were produced and distributed in repetitive, structured fashion, were 'embedded' in – a subordinate part of – social institutions" and that those social institutions control economic activity (Dalton 1965 p. 3). He further states that economic exchanges and allocation of rights to natural resources are structured in response to the need for communities to assure the provision of items necessary for community life (Dalton 1965). More contemporary studies

[2] Some of the theories utilized in this proposal point out factors that influence economic behavior and institutions in general. The economic behavior being considered is *digital integration*, the institutions being influenced are the firms involved in an economic exchange and the relationship between them. These terms, economic behavior, economic exchange and electronic integration, are used interchangeably throughout this document and refer to the latter.

address embeddedness as a complement to economic rationalities and posit that individual motivations are not the only stimulus for economic activity.

Drawing on the tradition of economic anthropology, Zukin and DiMaggio (1990) posit that the social structure in which the economy is embedded may be defined in terms of four inter-related dimensions: cognitive, cultural, structural and political. Figure 3 conceptualizes the relationship between the organization and these four dimensions of the environment. Each of these embeddedness patterns is hypothesized to affect the intentions and actions of organizations to digitally integrate with other organizations. Various researchers have worked on the concept of embeddedness (e.g., Gnyawali and Madhavan (2001), Granovetter (1985)).

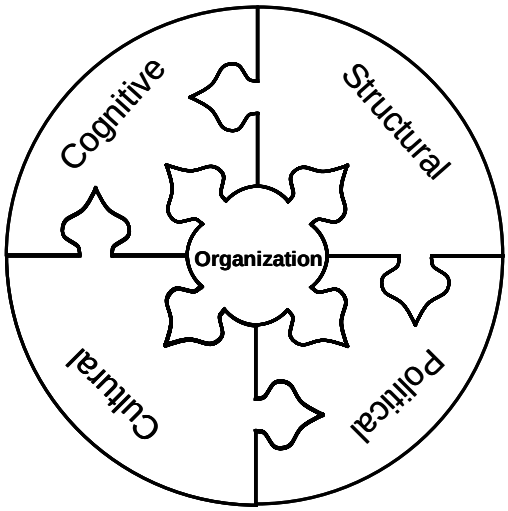


Figure 3. The concept of embeddedness

Due to the nature of each of these constructs, the present study only focuses on cognitive, cultural and political. The study of structural embeddedness focuses on social structures and patterns of relationships. This requires the study of social networks, which

is not consistent with the present study. In this section, we describe the three types of embeddedness considered and their relation to integration.

### 2.2.1 Cognitive Embeddedness

> *"The ways in which the structured regularities of mental processes limit [or enable] the exercise of economic reasoning" (Zukin and DiMaggio 1990 p. 15)*

A cognitive turn in economics and sociology has put uncertainty in the spotlight in recent decades following the work of Simon, March and colleagues at Carnegie-Mellon University (Dequech 2003). This new school of thought posits that firms are limited in what they can predict about the future and that they adapt to cope with this limitation (Galbraith 1973; Simon 1957; Simon 1987; Simon 1991; Zukin and DiMaggio 1990). These cognitive limitations are said to be caused by uncertainty (Galbraith 1973; Simon 1957; Simon 1987). Extant research on organizational and interorganizational structures and governance mechanisms identify uncertainty as a driving force for hierarchical control (Galbraith 1973; Gulati and Singh 1998; Williamson 1975; Williamson 1979; Williamson 1981; Williamson 1985).

In the tradition of the information processing view of the firm, uncertainty is defined as "the difference between information possessed and information required to complete a task" (Tushman and Nader 1978 p. 615). Alternatively, in the tradition of TCE, uncertainty is defined as an inability to predict the future due to lack of information (Milliken 1987).

The perception of uncertainty is not the only element influencing decision making process and the willingness to collaborate electronically across borders.

### 2.2.2 Cultural Embeddedness

> *"Culture, in the form of beliefs and ideologies, taken for granted assumptions, or formal rule systems, also prescribes strategies of self-interested action and defines the actors who may legitimately engage in them" (Zukin and DiMaggio 1990 p. 15)*

Extant research suggests that culture, too, influences information technology adoption and transfer (Hermeking 2005; Hill *et al.* 1998; Klein *et al.* 2003; La Ferle *et al.* 2002; Straub *et al.* 1997; Straub *et al.* 2001) and international economic exchanges (Dyer *et al.* 1998; Griffith and Myers 2005). Some researchers point to national culture as a subtle, less tangible and complex factor (Ford *et al.* 2003). Although there are many definitions of culture, most agree in that culture is a set of social characteristics shared by a group of people and that these characteristics act as mental programs, predisposing people's behaviors in certain circumstances (Hofstede 1980). There are different ways to approach the study of culture, ranging from the qualitative information-rich and time-intensive ethnographies, to the quantitative, leaner positivist methodologies.

Among the quantitative methodologies, Hofstede's framework of cultural dimensions (Hofstede 1980) is probably the most widely recognized. A wealth of studies use Hofstede's framework (either completely or in part) as a predictor of organizational behavior. Ford states that between 1980 (the original publication date) and 1999, Hofstede's work " had been cited nearly 1700 times in the Social Science Citation Index (SSCI)." (Ford *et al.* 2003 p. 9). Hofstede proposed that the culture of employees in different countries varies along four dimensions: power distance, uncertainty avoidance, masculinity/femininity, and individualism/collectivism (Hofstede 1980). In a subsequent study, Bond (1987) identified a fifth dimension: Confucianism or future orientation,

which Hofstede (1988) then added to his framework. The five dimensions included in Hofstede's final framework are:

- *Uncertainty avoidance (UAI)*: relates to the level of comfort that individuals feel in the face of uncertain or unknown situations.
- *Power distance (PDI)*: relates to relationship of the individuals to their superiors and subordinates and provides an indication of the degree to which people accepts vertical forms of power and participation in the decision making process.
- *Individualism vs. Collectivism (I/C)*: relates to the relationship of individuals to their fellows (be it family, work or other collective) and provides an indication of the degree to which individuals in a group act in the best interests of the group or their own.
- *Masculinity vs. Femeninity (M/F)*: relates to the degree of competitiveness and assertiveness of the people and their concerns for others and quality of life.
- *Confucian Dynamism or long-term orientation (LTO)*: relates to future- versus past- and present-oriented values and compares how people regard perseverance and thrift (high LTO), versus respect for tradition and fulfilling social obligations (low LTO) (Ford *et al.* 2003).

While this framework is probably the best known and most widely used, it is by no means the only framework, nor does it lack in controversy. Hofstede's framework "has been criticized for: reducing culture to an overly simplistic four or five dimension conceptualization; limiting the sample to a single multinational corporation; failing to capture the malleability of culture over time; and ignoring within-country cultural heterogeneity" (Kirkman (2006 p. 286) citing Sivakumar and Nakata (2001)) . Even though these criticisms have merit, the framework is still valid on an ecological level when applied to the national and regional level (Ford *et al.* 2003).

#### 2.2.2.1 Alternative frameworks

At the same time, other frameworks exist that assess the cultural traits of populations in quantitative form. The GLOBE Project, for example, defines culture in terms of nine different dimensions: (1)performance orientation, (2)uncertainty avoidance, (3)humane orientation, (4)institutional collectivism, (5)in-group collectivism, (6)assertiveness, (7)gender egalitarianism, (8)future orientation, (9)power distance (House *et al.* 2004). This study elaborates on Hofstede's work. It includes all five of Hofstede's dimensions and expands on his work in two ways: by adding more dimensions (some of which are derived from Hofstede's) and by conceptualizing each dimension in two different ways: practices and values (House *et al.* 2004).

We chose to utilize Hofstede's dimensions for two reasons: some of GLOBE's dimensions are difficult to interpret and it has not been as widely validated as Hofstede (Wennekers *et al.* 2007). Also, of Hofstede's dimensions, we use only Uncertainty Avoidance. This dimension is the most relevant of the four to the study of information exchange given the effect of information on reducing uncertainty.

### 2.2.3 <u>Political Embeddedness</u>

> *"The manner in which economic institutions and decisions are shaped by a struggle for power that involves economic actors and nonmarket institutions" (Zukin and DiMaggio 1990 p. 20)*

Power has been recognized as a significant influence in economic activity. Organizational action is influenced by external organizations (DiMaggio and Powell 1983). This is true of interorganizational relationships and the adoption of interorganizational systems and technologies (Chwelos *et al.* 2001; Teo *et al.* 2003). The

degree of influence, i.e., *e*nacted power (Chwelos *et al.* 2001), on the decision to integrate electronically, will depend on a: (1) the relative power of the parties, and (2) the stimuli to integrate.

Some researchers point out that power is a complex concept, difficult to grasp, messy and elusive (Jasperson *et al.* 2002). Hall (1999) defines power as having "to do with relationships between two or more actors in which the behavior of one is affected by the behavior of the other" (Hall 1999 p. 100). As such, power is commonly conceptualized as *ability to influence*. In this sense, the term reflects a broad spectrum of power bases, e.g., information, expertise, and control over resources. Yet, the use of power will be a function not only of the amount of power yielded by the partners, but also of the stimuli to use it.

The interest or stimuli of a firm on engaging in electronic integration stems from the recognition of an internal need within the organizations (Chwelos *et al.* 2001; Premkumar 1995). Recognizing the potential benefits of electronic integration is a first step towards the intent to integrate. Interestingly, no studies to date investigated the interaction between power and interest; existing studies evaluate their effects additively, rather than interactively. As such, in the present study, potential influence, as a measure of power, is regarded as a combination of interest and power.

In summary, political embeddedness will comprise the interaction between power and interest. In the next section we describe the research model and formalize the relationship between embeddedness and electronic integration.

# Chapter 3 Research Model

Next we present a model that offers a deeper understanding of electronic integration by dissecting it into four dimensions and examining the effects of uncertainty, culture and power on digital integration. First, we derive the *digital dimensions* of electronic integration (Figure 4). We do this by investigating which informational components are present in each of the dimensions presented above. Second, we theorize the effects of each of the environmental dimensions considered (i.e., uncertainty, culture and power) on the degree of digital integration. Some of these predictors are theorized to have a direct effect on digital integration, while others are theorized to have moderated effects (Figure 5 and Table 3).

## *3.1 Digital Integration*

Overall, the aforementioned perspectives (AT, RDT, TCE, RET, RV, and InfoView) define integration in terms of the governance and coordination structures of the exchange. As noted in the prior discussion, integration in the literature has been conceptualized in narrow terms that are specific to each theory or in a broad sense as ownership or proportion of business related to a particular partner. Considering the increasingly important role of ICTs in economic activity, Malone *et al.* (1987) extend the framework of integration to a continuum of electronic markets – electronic hierarchies. Venkatraman *et al.* give the name of *electronic integration* to this continuum (Bensaou and Venkatraman 1995; Venkatraman 1991; Zaheer and Venkatraman 1994).

Zaheer and Venkatraman define electronic integration as "a specific form of vertical quasi-integration achieved through the deployment of dedicated information systems between relevant actors in adjacent stages of the value-chain" (Zaheer and Venkatraman 1994 p. 551). As such, the above conceptualizations of integration and quasi-integration apply to electronic integration. In this work, we distinguish between electronic integration and *digital integration (DI)*. While electronic integration refers to quasi-integration enabled by information technologies, we define digital integration as the **degree or presence in a vertical relationship of hierarchy-like mechanisms that are informational in nature**.

In that sense, the dimensions considered above are limited to the processes and systems that pertain to the exchange of information (Figure 4):

- *Asset specificity:* information related assets include dedicated inter-organizational systems (IOS) as well as knowledge unique to the

relationship. IOS are conceptualized in terms of software and applications (e.g., billing, inventory management) and administrative and operational procedures (e.g., vendor selection, bar-coding) unique to the relationship (Subramani 2004; Subramani 1999; Subramani and Venkatraman 2003). Knowledge specificity is conceptualized as knowledge and understanding of processes that is unique to the relationship.

- *Inter-firm processes:* we consider only information flow integration. As stated before, information flow integration refers to "the extent of operational, tactical, and strategic information sharing that occurs between a focal firm and its supply chain partners" (Rai *et al.* 2006 p. 229).
- *Social/relational norms*: of the various norms that have been studied, information exchange is the most relevant to our study. Information exchange norms refer to the expectation that both parties will proactively share information useful to the other partner (Heide and John 1992).
- *Agency mechanisms:* while incentives are an important agency mechanism, they are not in itself an informational element. Monitoring, on the other hand, is an informational element consistent with our conceptualization of digital integration.

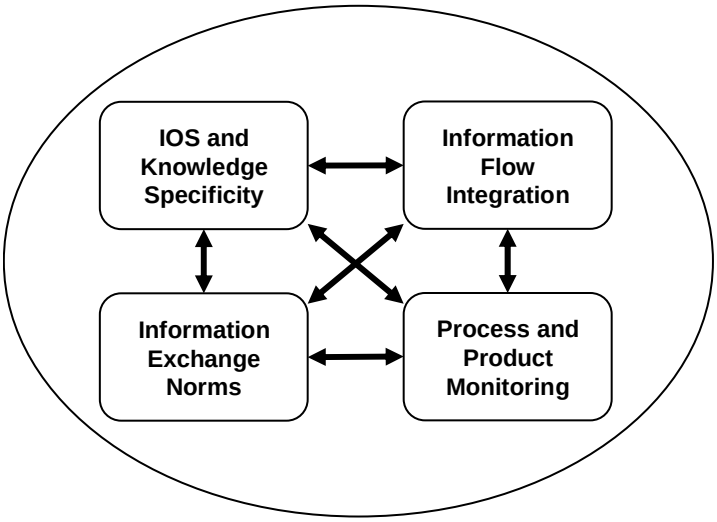


Figure 4. Components/dimensions of digital integration

In addition to deepening our understanding of digital integration, we investigate its predictors.

## *3.2 Predictors of Digital Integration*

There is ample evidence that uncertainty affects the structure of organizations and relationships (e.g., Heide and John (1992), Ganesan, (1994) and Choudhury (1997)). Interestingly, the research is not always consistent. We explain the inconsistencies by adding a moderating variable (coordination benefits vs. opportunism risks). Research that investigates the effect of culture on digital integration also presents conflicting results. In this case we adopt the propositions presented by studies from the international business field, since the settings in which they are conducted are better aligned with ours. Finally, power has been predicted to influence integration. We further extend this research by dissecting enacted power into power and stimuli. Figure 5 summarizes the model and Table 3 presents an advance on the hypotheses.

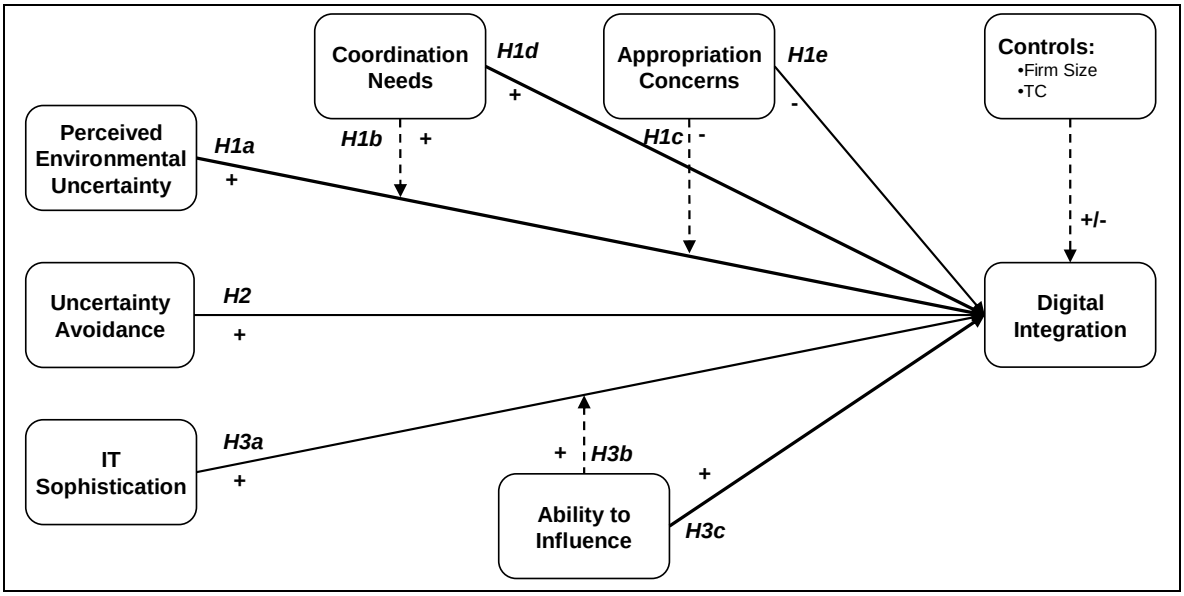


Figure 5. Research model

**Table 3. Hypotheses**

| Determinants | Effect | | Hypothesis | Selected References |
|---|---|---|---|---|
| Uncertainty | Direct | H1a: | Perceived environmental uncertainty is positively related to digital integration | Heide and John (1992), Choudhury (1997) |
| ⊗ Coordination needs | Moderator | H1b: | The relationship between perceived environmental uncertainty and digital integration is moderated by the intensity of coordination needs. | Dekker (2004) |
| ⊗ Opportunism | Moderator | H1c: | The relationship between perceived environmental uncertainty and digital integration is moderated by the intensity of opportunism risks. | Dekker (2004) |
| Coordination needs | Direct | H1d: | Coordination needs is positively related to digital integration. | Dekker (2004) |
| Opportunism | Direct | H1e: | Opportunism is negatively related to digital integration. | Dekker (2004) |
| Culture (UAI) | Direct | H2: | Higher levels of national uncertainty avoidance are related to higher levels of digital integration | Dyer *et al.*, (1998,) |
| IT sophistication | Direct | H3a: | Higher levels of IT sophistication are related to higher levels of digital integration. | Chwelos *et al.* (2001) |
| ⊗ Ability to Influence | Moderator | H3b: | The impact of IT sophistication on digital integration is moderated by the ability to influence of the focus partner. | Mohr *et al.*, (1996) Chatterjee (2002) |
| Ability to Influence | Direct | H3c: | Ability to influence is related to digital integration. | Mohr *et al.*, (1996) Chatterjee (2002) |

## *3.3 Uncertainty*

While some studies agree in that organizations choose tighter, i.e., more integrated, forms of governance in conditions of high uncertainty, others find opposite effects. Some previous research suggests that uncertainty increases the level of joint action (Heide and John 1990) and the adoption of inter-organizational information systems (Choudhury 1997). Alternatively, Ganesan (1994) finds a negative relationship between environmental diversity, a proxy for uncertainty, and long-term orientation, a proxy for integration. Bello and Gilliland (1997) also posit that, in international contexts where uncertainty opens the door to opportunistic behavior, increased uncertainty would warrant lower levels of commitment. Dekker (2004) identifies a trade-off between two control problems that might explain these contradicting results: the coordination of tasks and the management of appropriation concerns (or opportunism risks).

### 3.3.1 Moderated Effects

Overall, studies find that when organizations perceive the need to increase coordination, they feel motivated to collaborate (i.e., share information), and when they perceive opportunism risks that would derive from sharing information, organizations feel motivated to either vertically integrate or maintain arms-length relationships, but not to engage in collaborative relationships (Atallah 2003; Baiman and Rajan 2002; Kumar and van Diesel 1996; Williamson 1985). Coordination needs arise as a result of interdependencies (Galbraith 1973; Galbraith 1977; Gulati and Singh 1998; Kumar and van Diesel 1996). Opportunism risks, on the other hand, are related to opportunistic use of decision rights by the partners. These control issues are hypothesized to moderate the effect of uncertainty on integration and thus, hopefully, resolve the seeming contradiction

between the points of view in this literature. We also examine their direct effects as reported in previous research.

The following hypotheses will thus be examined:

*H1a: Perceived environmental uncertainty is positively related to digital integration*

*H1b: The relationship between perceived environmental uncertainty and digital integration is moderated by the intensity of coordination needs.*

*H1c: The relationship between perceived environmental uncertainty and digital integration is moderated by the intensity of opportunism risks.*

*H1d: Coordination needs is positively related to digital integration.*

*H1e: Opportunism is negatively related to digital integration.*

Integration affects coordination needs and opportunism risks because information, sometimes strategic, is shared between the partners. The value and role of information, however, is culturally sensitive, and therefore will also be influenced by cultural characteristics (Griffith and Myers 2005). The next section addresses the impact of culture on the relationship.

### *3.4 Culture (Uncertainty Avoidance)*

Two areas of application of culture are relevant to the proposed study: (1) international relational exchanges, and (2) innovation in general and adoption of ICTs in particular. The literature on international relational exchanges suggests that culture might explain differences in supplier relationships (Dyer *et al.* 1998; Griffith and Myers 2005; Shore 2001). Cultures high in individualism, low in power distance, low in uncertainty avoidance and with a short-term orientation would prefer an arms-length-type of contracting, while cultures with the opposite characteristics would prefer a partnership-type of relationship (Dyer *et al.* 1998; Shore 2001). Arms-length relationships are characterized as short term contracts, with frequent re-bidding, low levels of information sharing, low levels of relation-specific investments, and low levels of trust (Dyer *et al.* 1998; Shore 2001). Partnership-type exchanges, on the other hand, are defined as long-term contracts, less frequent re-bidding, high levels of information sharing, high levels of relation-specific investments, and high levels of trust (Dyer *et al.* 1998; Shore 2001). This classification of exchanges is consistent with the market-hierarchy continuum shown earlier. These studies, however, are particular to the area of integration and leadership, and ignore the adoption of technologies, which are involved in electronic integration.

Studies on innovation in general and adoption of ICTs in particular found different effects of Hofstede's dimensions on innovation and adoption of ICTs. Many of these studies focused on uncertainty avoidance (UA), which was negatively correlated with innovativeness in general (Steenkamp *et al.* 1999) and with the adoption of the Internet (Mooij 1998; Mooij 2000; Mooij 2004) or ICT products (Yeniyurt and Townsend 2003). This effect was moderated (weakened) by literacy and international

trade. LaFerle *et al.* (2002) extended the analysis to all four dimensions and found that three of the four original dimensions were significantly correlated to internet adoption while the masculine/feminine dimension presented inconclusive results. In the same study, LaFerle *et al.* (2002) found that the effect of M/F in Internet adoption is significant after controlling for I/C. Although significant, the adoption of these technologies did not seem to conflict with cultural norms and values such as information exchange and the value of information in the studies mentioned.

In the present context, cultural norms that relate to information sharing between organizations, power structures, and cooperation do conflict with the adoption of technologies that mediate the relationship. Therefore, we propose that the impact of relation-oriented cultural norms is stronger than cultural acceptance of technology. Due to the constraints of the study, only uncertainty avoidance is included in the present study.

The following hypothesis will be tested:

*H2: Higher levels of national uncertainty avoidance are related to higher levels of digital integration*

The selection of a cultural dimension was split between uncertainty avoidance and power distance. These are the two dimensions that present the most conflict with regards to sharing information. Uncertainty avoidance interacts highly with the need to share information to reduce uncertainty. Power distance, at the same time, relates to issues of equality and the perception of information as power. While they both seem relevant, UAI

seemed more appropriate in the present context. However, power itself is relevant to the study and was included separately.

### *3.5 Power and Stimuli*

Power is commonly conceptualized as ability to influence. The degree of influence, i.e., enacted power (Chwelos *et al.* 2001), on the decision to integrate digitally, will depend on: (1) the relative power of the parties (ability to influence), and (2) the stimuli to integrate. The relative power of the parties is represented by the dependence on the partner and the degree of influence (a direct measure of power) (Chatterjee 2002; Mohr *et al.* 1996). Decisions to integrate or not would be influenced by the power to integrate as well as the willingness to do so. The degree of IT sophistication is a driver of willingness and ability to engage in digital integration (Chwelos *et al.* 2001; Iacovou 1995; Pare and Raymond 1991; Raymond and Pare 1992). They contend that "sophisticated firms usually are less likely to feel intimidated by the technology, possess a superior corporate view of data as an integral part of overall information management, and have access to the required technological resources" (Iacovou 1995 p. 469). Based on this line of thought, the following hypotheses emerge:

*H3a: Higher levels of IT sophistication are related to higher levels of digital integration.*

*H3b: The impact of IT sophistication on digital integration is moderated by the power of the focus partner.*

*H3b: The impact of IT sophistication on digital integration is moderated by the power of the focus partner.*

*H3c: Ability to influence is related to digital integration.*

## *3.6 Control constructs*

For the proposed study, we also consider constructs typically included in research in international business, B2B marketing, supply chain, and inter-organizational information systems research. These constructs are listed in Table 4.

**Table 4. Control constructs used in inter-organizational research**

| **Construct** | **Hypothesized effect** | |
|---|---|---|
| Firm Size | Positive | It is expected that larger firms have increased levels of digital integration. |
| Customer Firm Size | Positive | It is expected that larger firms have increased levels of digital integration. |
| Technological Culturation | Positive | It is expected that higher levels of technological culturation leads to more comfort with information technologies and digital integration. |

One construct regularly included in B2B research and not included in the present research is trust. The reason for this is the interactions that we may expect between trust and opportunism, power and culture. The following section presents the research design and data collection.

# Chapter 4 Research Design

We chose to use a field study methodology using an online questionnaire and archival data. The survey asks subjects to choose a significant foreign partner and respond to all questions to the best of their ability. Secondary data was gathered to assess macro-level measures (culture). A pilot test was performed on the instrument to evaluate and refine the measures. This section describes the process and outcome of the research design.

## *4.1 Research Context*

This research is about B2B in an international context. As such, the model requires that the study be conducted among organizations with international customers or suppliers. For reasons laid out below, we chose to utilize a panel with participants in the U.S., the U.K. and Germany.

### 4.1.1 Unit of analysis

The unit of analysis is the relationship. A relationship is a business link between two organizations (Figure 6). We chose one participant per relationship and asked her questions intrinsic to a B2B relationship. We do this by asking the respondent to select their most critical foreign customer and answer questions using this party as a reference point. Therefore, only participants involved in sales to international customers were selected for this study. The rationale to utilize salespeople is twofold: on one hand, methodological, on the other hand, practical.

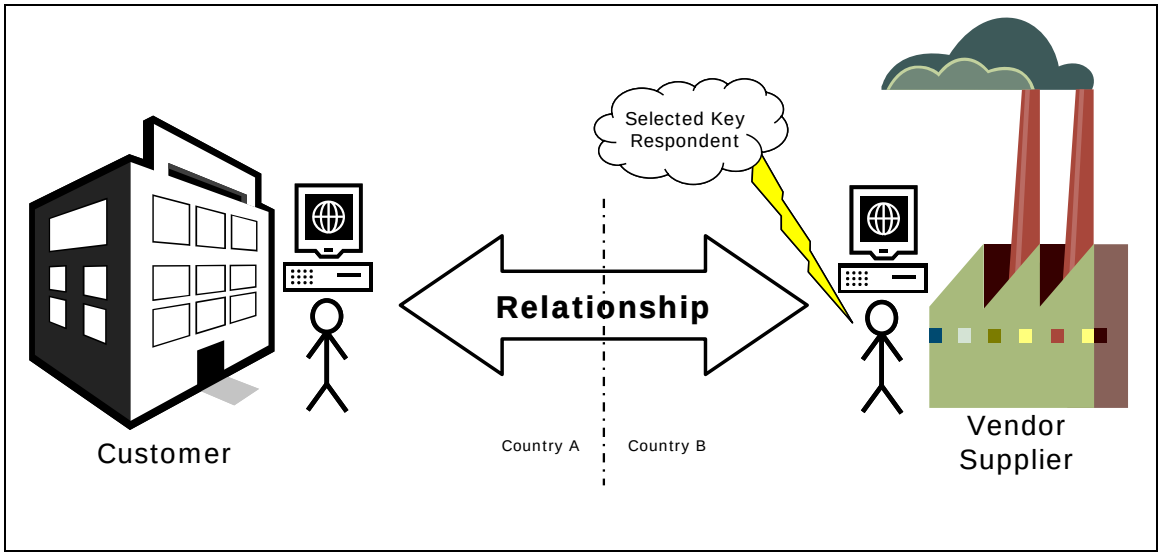


Figure 6. Rich-picture of international B2B relationships

### 4.1.2 Customers or Suppliers

Methodologically, there is no reason why the vendor/supplier side is better than the customer side for gathering data. Both sales and procurement people have equal understanding of the relationship; they just sit on opposite sides of the table. At the same time, selecting both (from different relationships) would add an extra level of analysis that exceeds the scope of the present study. Finally, an optimal option would have been to obtain dyadic data, that is, from both sides of the same relationship, but this option presented practical constraints.

The practical reasons for the selection relate to the configuration of the panel. While some participants in the panel were involved in procurement, the numbers were borderline enough to achieve the required sample size and presented significant risks (Table 5). As evident from Table 5, we would need a response rate of 25% to reach a sample size of 55 procurement people in Germany. Thus, a sufficient number of dyads was not available from the panel.

**Table 5. Available subjects in panel**

| Country / Function | U.S.* | U.K. | Germany |
|---|---|---|---|
| Procurement | N/A | 1,275 | 220 |
| Sales / Business Development | N/A | 8,578 | 990 |

* Data not available for U.S. This is not a problem because there are considerably more members in the U.S. than U.K. or Germany

### 4.1.3 Selection of Countries

The second decision was the selection of countries. As noted above, we chose to utilize a panel with participants in the U.S., the U.K. and Germany. Again, the rationale for the selection of countries is both methodological and practical. Methodologically, we look for countries that differ on the dimension of choice (UAI) but are similar in all other dimensions. As such, we chose three western countries with greater variance on UAI. Choosing western countries help achieve similarity within non-UAI dimensions. Then we need to select countries that differ in UAI. Ideally, those countries would have been the Netherlands or Denmark (low UAI), Portugal or Greece (high UAI), and the U.S. (average UAI); although this selection would present high variability on other dimensions as well, which is not desirable (Table 6).

**Table 6. Selected countries and cultural values (www.geert-hofstede.com)**

| Country | PDI | IDV | MAS | UAI | LTO |
|---|---|---|---|---|---|
| Denmark | 18 | 74 | 16 | **23** | n/a |
| Netherlands | 38 | 80 | 14 | **53** | 44 |
| United States | 40 | 91 | 62 | **46** | 29 |
| Greece | 60 | 35 | 57 | **112** | n/a |
| Portugal | 63 | 27 | 31 | **104** | n/a |
| Germany | 35 | 67 | 66 | **65** | 31 |
| United Kingdom | 35 | 89 | 66 | **35** | 25 |

This selection, also presented practical challenges. There were insufficient members in the panel from these countries. The final selection represents a compromise between availability (as indicated in Table 5) and cultural variance (Table 6). Germany, the U.S., and the U.K. present medium, medium low and low values of UAI, respectively, but at the same time also present more homogeneity on other cultural dimensions (Table 6). The following sections describe the development of the instrumentation, the final instrumentation and measures and the data collection.

## *4.2 Measures*

The instrumentation was developed in four stages: (1) a review of the theory informed the major constructs and existing measures were reused or adapted, (2) a draft version of the instrumentation was developed, (3) a pilot test was conducted and (4) the instrumentation was adapted as necessary. Whenever possible, existing measures were used. Some were taken as is, while others were adapted to the current context. New measures were also created from the original construct definitions. Some of the constructs defined in the present study are reflective, while others are formative (Table 7).

### 4.2.1 Digital Integration

Digital Integration (DI) is a second order formative construct. It is a **second order** construct based on the fact that we do not measure DI directly, but it is rather a combination of its dimensions, namely (1) inter-organizational systems and knowledge specificity (IOS&K), (2) information flow integration (IFI), (3) monitoring (AG), and (4) expectation of information exchange (ISN) (Table 8). Each of these dimensions is a first-order construct. DI is a **formative** second-order construct because "the items describe and define the construct rather than vice versa" (Petter *et al.* 2007 p. 623). More specifically, we model DI as a Type II second order construct where "the second order factor has first-order factors as formative indicators and the first-order factors themselves have reflective indicators" (Jarvis *et al.* 2003 p. 204). We utilize a hierarchical component approach using repeated indicators. In this case, the indicators of the first order construct are directly connected to the second order construct. This method works best with equal number of indicators for the first order constructs (Chin *et al.* 1996). For

this reason, each first-order component was operationalized as having three indicators each.

**Table 7. Determination of each construct as reflective**

| Construct | Theory | Predictor | Dropping | Change | Causality | F vs. R |
|---|---|---|---|---|---|---|
| Digital Integration | n/a | × | × | × | × | Formative |
| IOS&K Specificity | ✓* | ✓ | ✓ | ✓ | ✓ | Reflective |
| Information Flow Integration | ✓# | ✓ | ✓ | ✓ | ✓ | Reflective |
| Monitoring | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| Information Exchange (norm) | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| Perc. Environmental Uncertainty | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| Coordination Needs | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| Opportunism risks | × | × | × | × | ✓ | Formative |
| UAI (Espoused Values) | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| UAI (National Values) | n/a | n/a | n/a | n/a | n/a | Single-item |
| IT sophistication (benefits) | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| IT sophistication (management attitude) | n/a | n/a | n/a | n/a | n/a | Single-item |
| Ability to Influence (A→B) | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |
| Ability to Influence (B→A) | ✓ | ✓ | ✓ | ✓ | ✓ | Reflective |

Each column represents a response to each of the questions posited by Petter *et al. (2007)*:
1. Theory: Does the theory base typically view this as a formative construct?
2. Predictor: "Do the indicators predict the construct?" (Petter *et al.* 2007 p. 642)
3. Dropping: "Does dropping a measure change what the construct is measuring? "(Petter *et al.* 2007 p. 642)
4. Change: "Does a change in one measure of the construct not require a change in all other measures of the construct?" (Petter *et al.* 2007 p. 642)
5. Causality : "Do the measures have different antecedents and consequences?" (Petter *et al.* 2007 p. 642)

* Subramany and Venkatraman (2003) define asset specificity as formative. We argue that the items we selected may be conceptualized as reflective.

# Similarly, Rai *et al.* (2006) conceptualize information flow integration as formative. We argue that given the nature of the construct and their results it may be modeled as reflective.

**Table 8. Measurement of digital integration**

| Construct | Items | Reference | Modified/ New |
|---|---|---|---|
| Digital Integration [F; 2nd order] | Items below are based on dimensions of:<br>• Asset specificity<br>• Information flows integration<br>• Monitoring<br>• Expectation of information exchange | | New |
| IOS&K Specificity [R] | Software and applications (e.g., billing, ordering, inventory management, and EDI) are unique to our foreign customer. | Subramani and Venkatraman (2003) | Minor adaptation (two constructs merged) |
| | The knowledge needed for planning new products and programs is unique to our foreign customer | | |
| | The knowledge needed in product conception and design is unique to our foreign customer | | |
| Information Flows Integration [R] | Nearly all delivery schedules are shared electronically with our foreign customer | Rai *et al.* (2006) | Minor adaptation (two items dropped) |
| | Nearly all performance metrics are shared electronically with our foreign customer | | |
| | Inventory and/or service capacity data are electronically visible to our foreign customer | | |
| Monitoring [R] | Our firm regularly monitors the quality control maintained by our foreign customer | Aulakh *et al.* (1996) | Minor adaptation (one item dropped) |
| | Our firm frequently monitors the marketing activities performed by our foreign customer | | |
| | Our firm closely monitors the extent to which our foreign customer follows established procedures | | |
| Information exchange [R] | In this relationship, it is expected that nearly all information that might help our foreign customer will be provided to them | Heide and John (1992) | Minor adaptation (one item dropped) |
| | It is expected that our firm and our foreign customer will readily provide proprietary information if it can help the other party | | |
| | It is expected that our firm and our foreign customer will keep each other informed about events or changes that may affect the other party. | | |

#### 4.2.1.1 Inter-Organizational Systems and Knowledge Specificity

We used three reflective indicators using a semantic-differential scale to measure IOS&K specificity. The indicators were developed by Subramany and Venkatraman (2003). All items inquire about the extent to which relationship-specific assets customized to that particular customer or not. We measure specificity of software and applications used in the relationship and knowledge needed for planning and design products sold to the customer. We conceptualize these items as one reflective construct. This represents a slight departure from Subramani and Venkatraman's model.

Subramani and Venkatraman (2003) conceptualized asset specificity as two inter-correlated reflective constructs (business process specificity and domain knowledge specificity), each having three items. Of the three items that composed business process specificity, only one (software and applications) is relevant to the present context (i.e., informational in nature). We selected two items pertaining to domain knowledge specificity are relevant to the present context. We aggregate all three items into one reflective construct (Tables 7, 8 & 9).

Wording was adapted to shorten the item. An example of the modification is shown below. The original wording:

> "The extent to which the knowledge and understanding used in planning for new products, programs for RetCo is significantly specific to the relationship (i.e., customized for RetCo) or is relatively similar to what you use with other retailers" (Subramani and Venkatraman 2003).

was adapted to be:

> The knowledge needed for planning new products and programs is unique to our foreign customer.

Finally, we use a seven-point semantic-differential scale to measure the items. We adapted the original anchors: we changed "retailers" for "customers and, for technical reasons[3], we eliminated the middle points and only left the extremes:

> Relatively similar to other customers ↔ Customized for our foreign customer

**Table 9. Criteria for determination of *IOS&K specificity* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | Subramani and Venkatraman (2003) conceptualize specificity in terms of two second-order formative constructs (they actually measure them separately). Alternatively, we select only three of their six indicators and contend that they are reflective. We base our thinking on the assumption that the decision to invest in relationship-specific assets affects the different aspects measured equally. Also, we assume that the specificity of the relationship affects all its components similarly. |
| Predictor | ✓ | As indicated before, we posit that the construct predicts the items. |
| Dropping | ✓ | We posit that, given the nature of the decision to invest in relationship-specific assets, all items co-vary, and therefore, dropping one would not affect the overall measure. |
| Change | ✓ | We posit that the conceptualization of the construct as investment in relationship-specific assets precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that the antecedents of IOS&K specificity explain all its components equally well. |

[3] The survey application would allow only for little space for the anchors. Given the wording of the items, we opted for the latter.

#### 4.2.1.2 Information Flow Integration

We use a three-item reflective measure to gauge information flow integration (IFI). The measure was developed by Rai *et al.* (2006). We measure IFI as information sharing about inventories, schedules, and performance[4]. We model IFI as a reflective construct (Tables 7, 8 & 10).

**Table 10. Criteria for determination of *information flow integration* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | All constructs measure information sharing. In our context, it is reasonable to assume that the degree to which information is shared with partners varies from relationship to relationship equally. |
| Predictor | ✓ | Based on our earlier point, we assume that there is an underlying element (construct) that predicts whether more or less information is shared in the relationship. We expect relationships with greater IFI would have greater values across all indicators and vice versa. This is exemplified in figure 7. We posit that while the different items might "engage" at different levels of integration, they are in fact a function of integration and not the other way around. We propose that as the level of integration increases, the scores for all items increase. |
| Dropping | ✓ | Given the high reliability values presented by Rai *et al.*, we assert *a priori* that we will not lose information if we drop an item. |
| Change | ✓ | We posit that the conceptualization of the construct as information sharing precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that the antecedents of IFI explain all its components equally well. Figure 8 exemplifies this argument. According to our theoretical model, *uncertainty* affects all components of IFI. For example, it is intuitive that in uncertain markets, organizations will be more open to share inventory information in order to increase efficiencies and prevent the whiplash effect. But sharing delivery schedules is also important in high uncertain markets. Less intuitive but equally important is the sharing of performance metrics. Theory suggests that in uncertain situations organizations will seek strategic alliances in order to achieve competitive advantages. |

[4] We chose the three items that pertain to information flows (i.e., sharing), which also load heaviest on the latent construct. We discarded the following items:

- Supply chain members collaborate in arriving at demand forecasts
- Our downstream partners (e.g., distributors, wholesalers, retailers) share their actual sales data with us

Our focus is somewhat different from Rai *et al*'s in that we focus on information integration *per se*, while they also included collaboration measures.

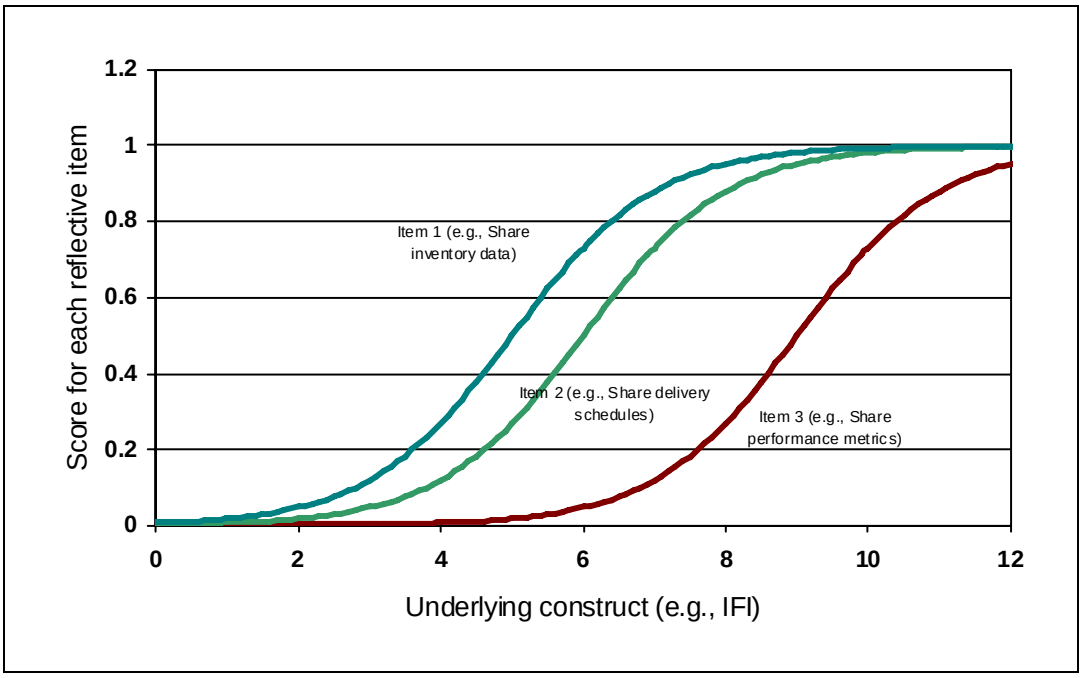


Figure 7. Example of *predictor* attribute for the determination of a construct as formative or reflective

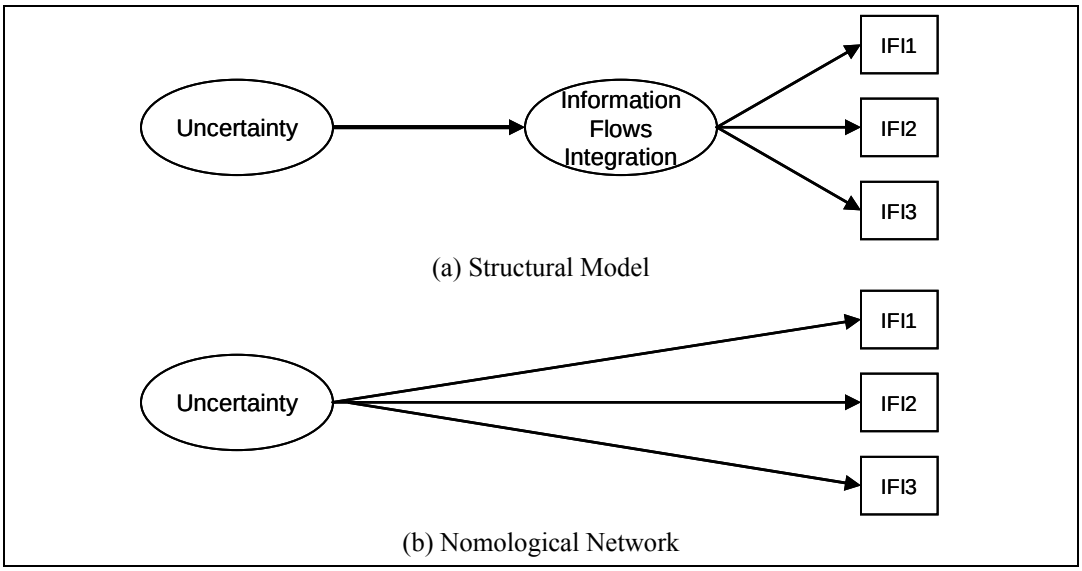


Figure 8. Example of *causality* attribute for the determination of a construct as formative or reflective

The adaptations are only meant to match the context better. We used a seven-point Likert scale to measure each item (Table 11).

**Table 11. Seven-point Likert scale utilized in the survey**

| Strongly agree | Agree | Slightly agree | Neither agree nor disagree | Slightly disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|---|

### 4.2.1.3 Monitoring

We measured monitoring using three reflective indicators developed by Aulakh *et al.* (1996). We measure the extent to which a firm monitors the activities of the other, more specifically, quality control, marketing, and follows procedures. We dropped one item for two reasons: (1) we need to narrow down the specification to three items, and (2) one item inquired about process specificity, which is not consistent with the conceptualization of the construct. We conceptualize the items as reflective of the degree of monitoring across the relationship (Tables 7, 8 & 12). We use seven-point Likert scale to measure the items.

**Table 12. Criteria for determination of *monitoring* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | All constructs measure regular monitoring of customer's activities. In our context, it is reasonable to assume that the degree to which a firm monitors its partners varies from relationship to relationship similarly across all items. |
| Predictor | ✓ | We assume that there is an underlying element (construct) that predicts whether a firm monitors its partners more or less. We expect relationships with greater monitoring would have greater values across all indicators and vice versa. |
| Dropping | ✓ | Given the high reliability values presented by Aulakh *et al.* (1996), we assert *a priori* that we will not lose information if we drop an item. |
| Change | ✓ | We posit that the conceptualization of the construct as the decision to monitor which precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that the antecedents of Monitoring explain all its components equally well. |

#### 4.2.1.4 Expectation of Information Exchange

We measured information exchange using three reflective indicators developed by Heide and John (1992). We measure the extent to which there is an expectation that information that would help the partner will be provided to them. We measure whether there is an expectation to share information: (1) if it helps the firm's customer, (2) if it can help the other party, and (3) if it helps keep each other informed of changes. We dropped one item in order to narrow down the specification to three items in order to keep with the *equal number of indicators per first order construct* rule. We conceptualize the items as reflective of the degree of expectation to share information (Tables 7, 8 & 13). We use seven-point Likert scale to measure the items.

**Table 13. Criteria for determination of *information sharing* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | It has been conceptualized in the theory as reflective (Aulakh *et al.* 1996; Heide and John 1992). All items share two important characteristics: there is an expectation to share information and the information shared will help the other party. |
| Predictor | ✓ | We assume that there is an underlying element (construct) that predicts whether an expectation to share information exists. We expect relationships with greater norms would have greater values across all indicators and vice versa. |
| Dropping | ✓ | Given the high loadings presented by Heide and John (1992), we assert *a priori* that we will not lose information if we drop an item. |
| Change | ✓ | We posit that the conceptualization of the construct as the presence of a norm precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that the antecedents of information sharing explain all its components equally well. |

### 4.2.2 Uncertainty

Uncertainty both has a direct effect and is moderated by coordination needs (+) and opportunism risks (-). Consistent with most research, uncertainty is measured through perceptions of environmental uncertainty, coordination needs through measures of interdependency, and opportunism risks through measures of opportunism (Table 14).

**Table 14. Measurement of uncertainty, coordination needs and opportunism risks**

| Construct | Items | Reference | Modified |
|---|---|---|---|
| Perceived Environmental Uncertainty [R] | Consumer demand is very predictable for those products that use the components we source to our foreign customer | Wathne and Heide (2004) | Rephrased |
| | Sales forecasts are very predictable for those products that use the components we source to our foreign customer | | |
| | Retail sales are very predictable for those products that use the components we source to our foreign customer | | |
| Coordination Needs [R] | Our company accomplishes our assigned tasks (i.e., production or service) independently from our foreign customer. | Mohr (1971) and Van de Ven (1976) | Adapted (converted to Likert, adapted to context, item rephrased) |
| | The companies in our supply network go to a lot of trouble to coordinate each task (i.e., production or service order). | | |
| Opportunism risks [R] | It is very difficult to evaluate accurately the quality of the resources or assets our foreign customer says it brings to the exchange. | Barney and Hansen (1994 p. 176) Shane (1998 p. 697) | New (created from definitions provided by previous research) |
| | It is very difficult to evaluate the quality of the resource or assets our foreign customer is actually offering in exchange. | | |
| | We cannot be sure if our foreign customer has put forth maximal effort. | | |

#### 4.2.2.1 Perceived Environmental Uncertainty

We follow TCE's conceptualization of uncertainty as an inability to predict future sales (Milliken 1987). In particular, for the present context, this is downstream uncertainty. We use three reflective items to measure environmental uncertainty (direct effect) adapted from Wathne and Heide (2004). We conceptualize environmental uncertainty as volume uncertainty[5]. In particular we measure whether sales (as consumer demand, retail sales, and sales forecasts) are predictable for the products sold to the international customer. We use seven-point Likert scale to measure the items.

**Table 15. Criteria for determination of *perceived environmental uncertainty* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | It has been conceptualized in the theory as reflective (Wathne and Heide 2004). All items ask about the same phenomenon (predictability of future sales) in different ways. |
| Predictor | ✓ | As said in the previous point, predictability of future sales predicts all three items. |
| Dropping | ✓ | Given the high loadings presented by Wathne and Heide (2004), we assert *a priori* that we will not lose information if we drop an item. |
| Change | ✓ | We posit that the conceptualization of the construct as the predictability of future sales precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that uncertainty avoidance explains all components of digital integration equally well. |

[5] Environmental uncertainty has been conceptualized in different ways, including volume uncertainty, demand uncertainty, dynamism, complexity, *et cetera*. Given the complexity of the concept, we adopt the conceptualization as volume uncertainty. This conceptualization provides a more specific definition.

#### 4.2.2.2 Coordination Needs

Coordination needs arise as a result of interdependencies (Galbraith 1973; Galbraith 1977; Kumar and van Diesel 1996). We use two reflective items to measure coordination needs based on the work of Mohr (1971) and Van de Ven (1976). We measure the extent to which firms work independently (reversed) and coordinate tasks. Each item uses a seven-point Likert scale.

**Table 16. Criteria for determination of *coordination needs* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | It has been conceptualized in the theory as reflective (Mohr 1971; Van de Ven *et al.* 1976). Both items inquire about the degree to which organizations work together and coordinate tasks. |
| Predictor | ✓ | Working together is the underlying phenomenon to this construct and predicts both items. |
| Dropping | ✓ | Given the high correlation presented by (Van de Ven *et al.* 1976), we assert *a priori* that we will not lose information if we drop an item. |
| Change | ✓ | We posit that the conceptualization of the construct as the task interdependence precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that coordination needs explains all components of digital integration equally well. |

#### 4.2.2.3 Opportunism Risks

Opportunism risks, on the other hand, are related to opportunistic use of decision rights by the partners. We use three formative seven-point Likert-scale items to measure opportunism risks. The items measure adverse selection and moral hazard. Adverse selection measures the extent to which parties can evaluate whether the other party is truthful about their abilities. Moral hazard occurs when the parties cannot evaluate whether the other party puts maximum effort (Eisenhardt 1989). These are usually considered separate items in the literature, and therefore, we consider opportunism risks formative.

**Table 17. Criteria for determination of *opportunism risks* as formative**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | × | It has been conceptualized in the theory as formative. Adverse selection and moral hazard are treated as separate phenomena. We merge them into one construct (coordination needs) |
| Predictor | × | We don't make any assumptions about how the construct predicts the items nor vise versa |
| Dropping | ✓ | Given the high correlation presented by (Van de Ven *et al.* 1976), we assert *a priori* that we will not lose information if we drop an item. |
| Change | × | The items are separate. A change in one item would require changes in other items only to maintain consistency, but not for theoretical reasons. |
| Causality (nomological network) | ✓ | We predict that opportunism risks explains all components of digital integration equally well. |

### 4.2.3 Uncertainty Avoidance (culture)

Culture may be assessed at two different levels: individual or national. In line with recent research, we adopt a two-item reflective measure of individual uncertainty avoidance developed by Srite and Karahanna (2006). The individual-level items inquire about the preference for rules and structure. These items are recorded through a seven-item Likert scale. This is consistent with the unit of analysis (the individual) and captures the individual's values better than the ecological variable (Srite and Karahanna 2006; Straub *et al.* 2002). Nevertheless, for purposes of comparison and consistency with past literature, we also utilize the ecological (national) value.

**Table 18. Measurement of Uncertainty Avoidance**

| Construct | Items | | Reference | Modified |
|---|---|---|---|---|
| UAI (Espoused Values) | Rules and regulations are important because they inform workers what the organization expects of them.<br>Order and structure are very important in a work environment. | | Srite and Karahanna (2006) | Original as is |
| UAI (National) | Respondents get assigned one of the following values for<br>• Headquarters<br>• Birth<br>• Residence | U.S.: 46<br>U.K.: 35<br>Germany: 65 | www.geert-hofstede.com | Original as is |

**Table 19. Criteria for determination of *uncertainty avoidance* (individual) as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | It has been conceptualized in the theory as reflective. Furthermore, both items query about the preference structure (rules, regulations, order and structure). |
| Predictor | ✓ | Uncertainty avoidance predicts the responses to the items. |
| Dropping | ✓ | Srite and Karahanna (2006) indicate high reliability of the measures. Dropping an item should not affect the overall measurement of the construct, except for the fact that we would end up with a one-item construct. |
| Change | ✓ | We posit that the conceptualization of the construct as the preference for structure precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that uncertainty avoidance explains all components of digital integration equally well. |

### 4.2.4 Power

As indicated above, power is a moderated effect (stimuli x ability to influence). IT sophistication represents the willingness to integrate (stimuli), while the ability to influence is measured in a straight forward way (Table 20).

**Table 20. Measurement of IT sophistication and power**

| Construct | Items | Reference | Modified |
|---|---|---|---|
| IT sophistication (perceived benefits of IT) | Information technology is important for the reduction of personnel in our organization. | Chwelos *et al.* (2001) | Adapted (reworded as independent items) |
| | Information technology is important for the reduction of operational costs in our organization. | | |
| | Information technology is important for the improvement of productivity in our organization. | | |
| | Information technology is important for the improvement of access to information in our organization. | | |
| | Information technology is important for the improvement of the quality of decision making in our organization. | | |
| | Information technology is important for the improvement of competitiveness in our organization. | | |
| | Information technology is important for the improvement of service to customers in our organization. | | |
| IT sophistication (management attitude) | Please rate the attitude of your top management toward the deployment of information technology in your organization. | Chwelos *et al.* (2001) | As is (middle anchor removed) |
| Power (us over them) | We can pretty much dictate how our foreign customer sells their product. | Mohr *et al.* (1996) | Adapted (language change) |
| | We can easily sell to other firms besides our customer. | Chatterjee , (2002) | |
| | We have a significant influence on our foreign customer's operations. | | |

#### 4.2.4.1 IT sophistication

We used eight reflective items to measure IT sophistication developed by Pare and Raymond (1991) and adapted by Chwelos *et al.* (2001) (Table 20 & 21). IT sophistication captures both the level of IT expertise and management in an organization (Chwelos *et al.* 2001; Iacovou 1995; Pare and Raymond 1991; Raymond and Pare 1992). In particular, we asked whether IT helps achieve efficiencies in the organization and the attitude of management towards IT. We used seven seven-point Likert items and one seven-point semantic-differential item to measure IT sophistication (all reflective).

**Table 21. Criteria for determination of *IT sophistication* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | It has been conceptualized in the theory as reflective. IT sophistication is conceptualized as expertise in IT use and management. |
| Predictor | ✓ | IT sophistication predicts the responses to the items. Higher levels of IT sophistication should relate to higher levels on the indicators. |
| Dropping | ✓ | Dropping an item should not affect the overall measure of the construct, except for the fact that we would end up with a one-item construct. |
| Change | ✓ | We posit that the conceptualization of the construct as the IT expertise precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that all IT sophistication items explain all components of digital integration equally well. |

#### 4.2.4.2 Ability to Influence (Power)

We use three reflective items (Tables 20 & 22) based on replaceability (Mohr *et al.* 1996) and ability to influence (Chatterjee 2002). We use seven-point Likert scales to measure the items.

**Table 22. Criteria for determination of *power* as reflective**

| Criterion | Result | Rationale |
|---|---|---|
| Theory | ✓ | It has been conceptualized in the theory as reflective. |
| Predictor | ✓ | Ability to influence predicts the responses to the items. Higher levels of Ability to influence should relate to higher levels on the indicators. |
| Dropping | ✓ | Dropping an item should not affect the overall measure of the construct. |
| Change | ✓ | We posit that the conceptualization of the construct as replaceability precedes the conceptualization of the items. |
| Causality (nomological network) | ✓ | We predict that all ability to influence (as a moderator) items explain all components of digital integration equally well. |

### 4.2.5 Control Variables

Besides the key, theoretical variables, we included two sets of control variables: one at the firm level and one at the individual level. At the firm level we included measures of focal and partner firm size. At the individual level we included measures of technological culturation.

**Table 23. Firm-level control variables**

| Construct | Items | Reference |
|---|---|---|
| Focal firm size<br><br>Partner firm size | Your firm revenues (roughly; in dollars*):<br><br>Revenues of your foreign customer (roughly; in dollars*):<br><br>Given the number of employees in your firm, your firm is a:<br>Given the number of employees in your foreign customer, they are a:<br><br>• Micro enterprise (1-9 employees)<br>• Small enterprise (10-49 employees)<br>• Medium enterprise (50-249 employees)<br>• Medium-large enterprise (250-1000 employees)<br>• Large enterprise (1000+ employees)# | Commission of the European Communities (2003) |

| US (US Dollars): | Germany (Euro) | UK (British Pounds): |
|---|---|---|
| Less than 3,000,000 | Less than 2,000,000 | Less than 1,500,000 |
| 3,000,000 – 14,999,999 | 2,000,000 – 9,999,999 | 1,500,000 – 7,500,000 |
| 15,000,000 – 74,999,999 | 10,000,000 – 49,999,999 | 7,500,000 – 39,999,999 |
| 75,000,000 – 399,999,999 | 50,000,000 – 249,999,999 | 40,000,000 – 199,999,999 |
| More than 400,000,000 | More than 250,000,000 | More than 200,000,000 |

* Only the values in one column were provided to respondents. We used dollars for the U.S., pounds for the U.K., and Euros for Germany. The scales were approximated to fit into *whole* values. The following scale was used: 1 pound – 1.33 Euro – 2 US dollars consistent with exchange rates at time of data collection (May/2008).

# We added the final category to distinguish medium-large from large enterprises. We did this to better reflect the configuration of enterprises in the U.S.

**Table 24. Individual-level control variables**

| Construct | Items | Reference |
|---|---|---|
| Technological Culturation | Number of trips abroad in last 10 years ___<br>How many years have you worked in an international division? ___ | Straub *et al.* (2002) |

# Chapter 5 Data collection and validation

## *5.1 Pilot*

A pilot study was conducted to test the survey instrumentation. The study took place at a major south-eastern U.S. university. Sixty-five (65) graduate students participated in the pilot study, with fifty-nine valid responses. F actor and reliability analyses were performed for measures, grammatical errors were corrected, and items were dropped.

**Table 25. Reliability of scales in pilot study**

| Construct | α |
|---|---|
| IOS&K Specificity | 0.848 |
| Information Flows Integration | 0.652 |
| Monitoring | 0.606 |
| Expectation of Information Sharing | 0.655 |
| Market Uncertainty | 0.865 |
| *Coordination Needs* | *0.122* |
| Opportunism Risks | n/a (formative) |
| UAI (espoused values) | 0.621 |
| UAI (national values) | n/a (single item) |
| IT sophistication (benefits) | 0.804 |
| IT sophistication (management attitude) | n/a (single item) |
| Power (us over them) | n/a (single item) |
| Power (them over us) | 0.655 |

- Item in italics presents reliability issues.
- α values over 0.6 are considered acceptable for early stages of research (Nunnally 1967)

### 5.1.1 Scales assessment

Measures proved to have medium to good reliability scores (Table25). Factor analysis of the criterion and predictor variables was performed to assess the integrity of the measures.

#### 5.1.1.1 Criterion variables

On the criterion side, IOS&K specificity shows good reliability, while IFI, Monitoring (agency), and relational norms show low values but acceptable for earlier stages of research

($\alpha > 0.6$ ;Nunnally, 1967). A factor analysis also shows a high degree of correlation between the four dimensions of digital integration. This was foreseeable given the characteristics of each of the dimensions: IOS&K specificity represents the conduit for information sharing; an expectation of information sharing should lead to greater information sharing; and information sharing is needed for monitoring. However, the factor analysis still shows four main components consistent with the dimensions (Table 26).

**Table 26. Criterion variable item pattern matrix (oblimin rotation)**

| | Component | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| **DISPEC1** | .807 | | | |
| **DISPEC2** | .924 | | | |
| **DISPEC3** | .838 | | | |
| **DIIFI1** | | .814 | | |
| **DIIFI2** | | .685 | | |
| **DIIFI3** | | | | .737 |
| **DIAG1** | | | .767 | |
| **DIAG2** | | .656 | | |
| **DIAG3** | | | .823 | |
| **DISN1** | | | | .715 |
| **DISN2** | | | -.447 | .717 |
| **DISN3** | | | | .706 |

Only values >0.35 are shown.

One component is consistent with IOS&K specificity and the uniqueness of applications (DISPECT1) and domain knowledge (DISPEC2 and DISPEC3). A second component groups information sharing items, including sharing of delivery schedules (DIIFI1), performance metrics (DIIFI2) and monitoring of marketing activities (DIAG2). A third component aggregates information sharing norms (DISN1, DISN2 and DISN3), plus carries along the sharing of inventory information. This analysis shows some cross-loadings. One item of IIF loads on information sharing norms and one item of monitoring loads on IIF. A graphic analysis shows that the items do cluster together (Figure 9).

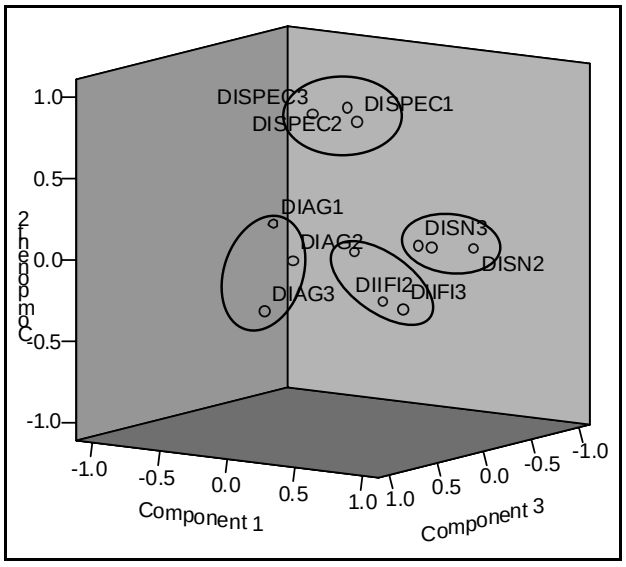


Figure 9. Loading plot of components of *digital integration*

#### 5.1.1.2 Predictor variables

On the predictor side, market uncertainty and IT sophistication show good reliabilities, UAI (espoused values) and power (ability to influence) shows lower reliability (but still acceptable by Nunnally's standards), while coordination shows poor reliability. These values are acceptable for all except coordination due to the fact that we used existing scales. Factor analyses were run to evaluate the discriminant characteristics of the measures. A first run included all predictor variables. A second run included only those predictor variables that presented issues: coordination had two separate items that loaded on other components, culture had an IT sophistication item loaded on its component, IT sophistication, and power (our customer's ability to influence us). Further runs were performed to understand the various interactions between the predictors. Following is the analysis:

(1) *Market uncertainty* loads on its own factor (only considered in the first run). No changes were made to this scale.

(2) *Coordination* seems to load on two different factors. Coordination has already shown reliability problems. Thus, it is not surprising that it does not load on one unique factor. One item interacts with culture, while the second one dominates its own component. Content analysis of the items show that one item refers to interdependencies, while the second refers to coordination *per se*. As a result, while the items remain as they are, the construct was modeled as formative.

(3) *Opportunism*, though a formative construct, loads on its own component (only considered in the first run). No changes were made to this scale.

(4) *Culture* loads on its own component. Other items (ITSPH7 and COOR2) also load on this component. A second factor analysis is performed to further discriminate this dimension. Since the scale is has already been tested in prior research, it will remain unchanged.

(5) Overall, *IT sophistication* shows acceptable loadings on six of seven items as shown in Table 27. The seventh item (technology is important for service improvement) seems to interact with culture. The management component conflicts with a component of power. Given the apparent interaction of item seven with culture, this item will not be considered in the final analysis. Other items remain unchanged.

(6) *Power* (as ability to influence) shows low reliability scores. This measure, however, loads cleanly on its own component. Additionally, when the data is filtered by the *degree of knowledge about B2B relationships* (N=49), the reliability score rises to 0.700.

**Table 27. Predictor variable item pattern matrix (oblimin rotation)**

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **MU1** | | .768 | | -.363 | | | |
| **MU2** | | .792 | | | | | |
| **MU3** | | .865 | | | | | |
| **COOR1** | | | | | | .780 | |
| **COOR2** | | | | | .534 | | |
| **OPPOR1** | | | .880 | | | | |
| **OPPOR2** | | | .889 | | | | |
| **OPPOR3** | | | .758 | | | | |
| **CUL1** | | | | | .623 | | |
| **CUL2** | | | | | .773 | | |
| **ITSPH1** | .662 | | | | | .477 | |
| **ITSPH2** | .806 | | | | | .384 | |
| **ITSPH3** | .788 | | | | | | |
| **ITSPH4** | .740 | | | | | | |
| **ITSPH5** | .663 | .479 | | | | | |
| **ITSPH6** | .590 | .495 | | | | | |
| **ITSPH7** | | | | | .684 | | |
| **ITSPH8** | | | | .350 | | | .615 |
| **PW1** | | | | | | | .815 |
| **PW2** | | | | -.718 | | | |
| **PW3** | | | | .746 | | | |
| **PW4** | | | | .688 | | | |
| Only values greater than 0.35 are shown. | | | | | | | |

## *5.2 Field Study*

For the final administration for the instrument, we hired a market research company to run the survey among their panel of members. The research company preselected candidates based on their self-reported demographics (Table 5 above). These candidates were sent invitation emails with a URL pointing to the survey. The participants are then asked two *screening questions* to verify their qualifications:

> What best describes your current functional role at work?
>
> - ⊙ Accounting / Finance
> - ⊙ Administration
> - ⊙ Communications / PR
> - ⊙ Customer Service
> - ⊙ Design / Engineering
> - ⊙ Human Resources
> - ⊙ Information Technology
> - ⊙ Marketing / Advertising
> - ⊙ Operations / Production
> - ⊙ Research and Development
> - ⊙ Sales / Business Development
> - ⊙ Other

Only participants that selected "Sales / Business Development" moved on to the second question:

Which of the following functions do you perform?

- ⊙ Sell products and/or services to Domestic clients ONLY
- ⊙ Sell products and/or services to International clients ONLY
- ⊙ Sell products and/or services to Domestic AND International clients (but mostly Domestic clients)
- ⊙ Sell products and/or services to Domestic AND International clients (but mostly International clients)
- ⊙ Sell products and/or services to a fairly even mix of Domestic AND International clients
- ⊙ I do not sell products and/or services – I am responsible for another aspect of business development within my company

Therefore, only those who have some degree of international contact (radio buttons 2, 3, 4, and 5) move on to the survey. The survey establishes a cut-off point after the necessary participants completed the surveys.

### 5.2.1 Sample

In toto, 215 people participated from 3 countries in June of 2008; twelve responses were discarded (details are given below). The final number of responses (203) is well within the recommended minimum of 10 respondents per item/predictor for the construct with the most items/predictors. In our case, DI has 12 items (all items as formative to the construct, this is explained later) and 12 predictors (UNC, COOR, OPPORT, UNC*COOR, UNC*OPPORT, CU_UAI, IT_SOPH, PWR_US, IT_SOPH*PWR_US, plus the control variables SZ_US, SZ_CU, and DEM_TC).

The demographics for the sample are reported in the following table.

**Table 28. Demographics for field study**

| Variable | Category/Values | N | % | N | Mean | S.D. |
|---|---|---|---|---|---|---|
| Country | U.S. | 61 | 30.0 | 203 | n/a | n/a |
| | U.K. | 71 | 35.0 | | | |
| | Germany | 71 | 35.0 | | | |
| Gender | Male | 161 | 79.3 | 203 | n/a | n/a |
| | Female | 42 | 20.7 | | | |
| Age | 20-25 | 2 | 1.0 | 203 | 40.0 | 9.1 |
| | 25-29 | 24 | 11.8 | | | |
| | 30-34 | 37 | 18.2 | | | |
| | 35-39 | 38 | 18.7 | | | |
| | 40-44 | 45 | 22.2 | | | |
| | 45-49 | 24 | 11.8 | | | |
| | 50-54 | 17 | 8.4 | | | |
| | 55-59 | 11 | 5.4 | | | |
| | 60-65 | 5 | 2.5 | | | |
| Education | High school | 57 | 28.1 | 203 | n/a | n/a |
| | Undergraduate | 82 | 40.4 | | | |
| | Master's | 60 | 29.6 | | | |
| | Doctorate | 4 | 2.0 | | | |
| Experience | 1-5 | 15 | 7.4 | 203 | 17.1 | 9.8 |
| | 6-10 | 52 | 25.6 | | | |
| | 11-15 | 42 | 20.7 | | | |
| | 16-25 | 58 | 28.6 | | | |
| | >25 | 36 | 17.7 | | | |
| Functional role (screener question) | Sell products and/or services to International clients ONLY | 26 | 12.8 | 203 | n/a | n/a |
| | Sell products and/or services to Domestic AND International clients (but mostly Domestic clients) | 88 | 43.3 | | | |
| | Sell products and/or services to Domestic AND International clients (but mostly International clients) | 49 | 24.1 | | | |
| | Sell products and/or services to a fairly even mix of Domestic AND International clients | 40 | 19.7 | | | |
| Position | Top Management | 11 | 5.4 | 203 | n/a | n/a |
| | Middle Management | 114 | 56.2 | | | |
| | Supervisory Management | 24 | 11.8 | | | |

**Table 28. Demographics for field study**

| Variable | Category/Values | N | % | N | Mean | S.D. |
|---|---|---|---|---|---|---|
| | Professional or Administrative position | 54 | 26.6 | | | |
| Subordinates | 0 | 58 | 28.6 | 203 | n/a | n/a |
| | 1-5 | 74 | 36.5 | | | |
| | 6-10 | 31 | 15.3 | | | |
| | 11-20 | 26 | 12.8 | | | |
| | >20 | 14 | 6.9 | | | |
| Revenues | Less than $3,000,000 | 5 | 2.5 | 203 | n/a | n/a |
| | $3,000,000 – $14,999,999 | 9 | 4.4 | | | |
| | $15,000,000 - $74,999,999 | 22 | 10.8 | | | |
| | $75,000,000 - $399,999,999 | 49 | 24.1 | | | |
| | More than $400,000,000 | 118 | 58.1 | | | |
| Revenues of Customer | Less than $3,000,000 | 41 | 20.2 | 203 | n/a | n/a |
| | $3,000,000 – $14,999,999 | 39 | 19.2 | | | |
| | $15,000,000 - $74,999,999 | 33 | 16.3 | | | |
| | $75,000,000 - $399,999,999 | 28 | 13.8 | | | |
| | More than $400,000,000 | 62 | 30.5 | | | |
| # of Employees | Micro enterprise (1-9 employees) | 6 | 3.0 | 203 | n/a | n/a |
| | Small enterprise( 10-49 employees) | 3 | 1.5 | | | |
| | Medium enterprise (50-249 employees) | 23 | 11.3 | | | |
| | Medium-large enterprise (250-1000 employees) | 34 | 16.7 | | | |
| | Large enterprise (1000+ employees) | 137 | 67.5 | | | |
| # of Employees of Customer | Micro enterprise (1-9 employees) | 14 | 6.9 | 203 | n/a | n/a |
| | Small enterprise( 10-49 employees) | 19 | 9.4 | | | |
| | Medium enterprise (50-249 employees) | 32 | 15.8 | | | |
| | Medium-large enterprise (250-1000 employees) | 41 | 20.2 | | | |
| | Large enterprise (1000+ employees) | 97 | 47.8 | | | |
| Industry | Agriculture, Forestry, Fishing and Hunting | 0 | 0.0 | 203 | n/a | n/a |
| | Mining, Quarrying, and Oil and Gas Extraction | 5 | 2.5 | | | |
| | Utilities | 1 | 0.5 | | | |
| | Construction | 2 | 1.0 | | | |
| | Manufacturing | 59 | 29.1 | | | |
| | Wholesale Trade | 9 | 4.4 | | | |

**Table 28. Demographics for field study**

| Variable | Category/Values | N | % | N | Mean | S.D. |
|---|---|---|---|---|---|---|
| | Retail Trade | 11 | 5.4 | | | |
| | Transportation and Warehousing | 11 | 5.4 | | | |
| | Information [communications] | 29 | 14.3 | | | |
| | Finance and Insurance | 15 | 7.4 | | | |
| | Real Estate and Rental and Leasing | 9 | 4.4 | | | |
| | Professional, Scientific, and Technical Services | 13 | 6.4 | | | |
| | Management of Companies and Enterprises | 2 | 1.0 | | | |
| | Administrative and Support [Services] and Waste Management and Remediation Services | 2 | 1.0 | | | |
| | Educational Services | 1 | 0.5 | | | |
| | Health Care and Social Assistance | 8 | 3.9 | | | |
| | Arts, Entertainment, and Recreation | 4 | 2.0 | | | |
| | Accommodation and Food Services | 8 | 3.9 | | | |
| | Other Services (except Public Administration) | 14 | 6.9 | | | |
| | Public Administration | 0 | 0.0 | | | |

## *5.3 Data Manipulation*

### 5.3.1 Invalid responses

Upon visual inspection, twelve responses were removed from the study. We calculated standard deviations within responses in two blocks of data consisting of 18 and 28 responses respectively. Twelve respondents presented zero variance in one or both blocks. Since the respondents were rewarded for their participation, it is assumed that they completed the survey without regard for the content. Figure 10 presents the distribution of response times and the discarded responses.

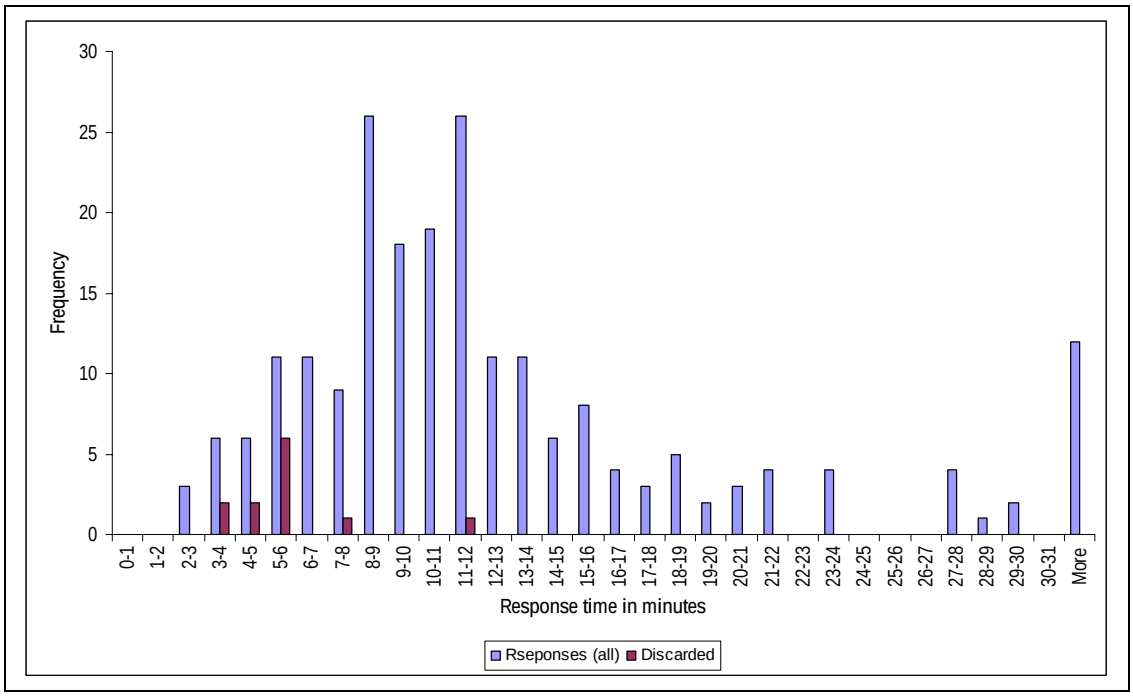


Figure 10. Distribution of Response Times

We also performed successive reliability analyses for subsamples that included responses with increasing completion times (for example, the first point represents the reliability for all constructs calculated using all (valid) responses, the second point, represents reliabilities for all constructs for responses with completion times greater than four minutes only, and so on). We utilized recoded values for this analysis (see below). Figure 11 shows the reliabilities for these subsamples. These analysis shows that reliabilities are stable for different completion times. PW_CU was discarded due to poor psychometric properties and COOR was modeled as formative. Lower reliabilities at higher response times might due to the lower responses left as a result of the filter.

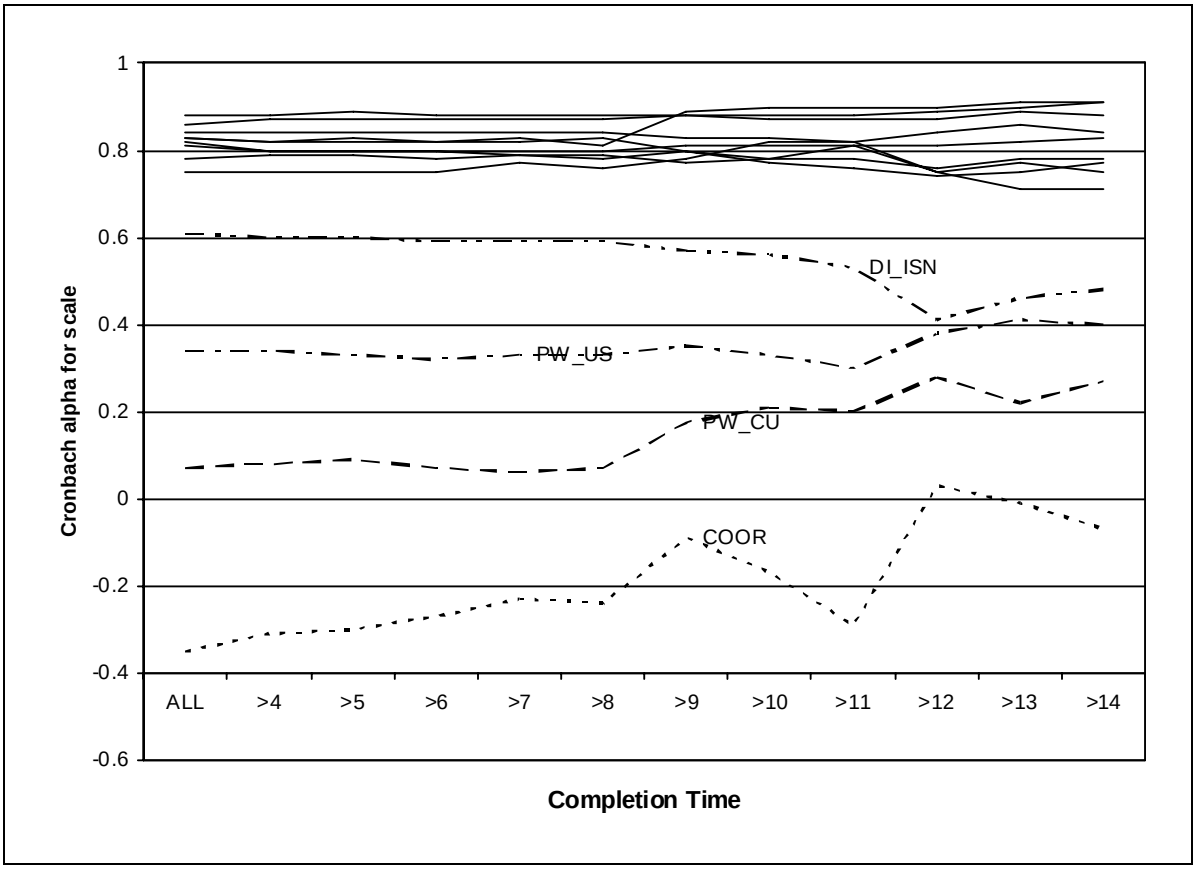


Figure 11. Distribution of Reliabilities as a Function of Response Times

### 5.3.2 Missing values

The survey did not allow for missing values. The system required that all items be responded to.

### 5.3.3 Re-coding

We recoded the data for three reasons: (1) most answers were recoded, (2) we reversed values for the items that were reverse-scaled, and (3) we added values for national culture. First, all answers provided by the vendor were coded as 1=strongly agree…7=strongly disagree. The items were rescaled to present increasing values for increasing levels of agreement. We utilized the following equation:

$x_i' = 8 - x_i$, where :

$x_i'$ is the new value, and
$x_i$ is the original value

Second, some items are reverse-scaled. While most methodologies can deal with such scales (including partial least squares or PLS), the internal workings of the algorithm recommend using scales with the same sign on all items. The calculation of reliability scales also calls for positive correlations between items.

Third, secondary data values are added based on the reported countries. Tables 29 and 30 present the descriptive statistics for the the latent scores and items respectively. Once the data is recoded we proceeded to perform the analysis. The analysis was performed in two stages: measurement validation and model testing.

**Table 29. Descriptive Statistics for Latent Variables (equal loadings)**

| Variable | N Valid | Mean | Median | Std. Deviation | Range | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| DI | 203 | 4.11 | 4.08 | 0.98 | 5.00 | 1.42 | 6.42 |
| DI_SPEC | 203 | 2.84 | 2.67 | 1.48 | 6.00 | 1.00 | 7.00 |
| DI_IFI | 203 | 4.20 | 4.33 | 1.69 | 6.00 | 1.00 | 7.00 |
| DI_AG | 203 | 4.73 | 5.00 | 1.32 | 6.00 | 1.00 | 7.00 |
| DI_ISN | 203 | 4.67 | 5.00 | 1.21 | 6.00 | 1.00 | 7.00 |
| UNC | 203 | 3.93 | 4.00 | 1.42 | 6.00 | 1.00 | 7.00 |
| COOR | 203 | 3.86 | 4.00 | 0.85 | 5.50 | 1.00 | 6.50 |
| OPPOR | 203 | 4.44 | 4.33 | 1.15 | 5.33 | 1.67 | 7.00 |
| CU_UAI | 203 | 6.25 | 6.50 | 0.72 | 4.50 | 2.50 | 7.00 |
| IT_SOPH | 203 | 5.73 | 5.83 | 0.81 | 4.33 | 2.67 | 7.00 |
| PW_US | 203 | 3.30 | 3.33 | 1.03 | 5.33 | 1.00 | 6.33 |
| PW_CU | 203 | 3.42 | 3.50 | 1.11 | 5.50 | 1.00 | 6.50 |
| UNCxCOOR | 203 | 15.15 | 15.00 | 6.21 | 32.00 | 1.00 | 33.00 |
| UNCxOP | 203 | 17.59 | 16.00 | 8.43 | 44.67 | 2.00 | 46.67 |
| PWxSPH | 203 | 18.91 | 18.67 | 6.79 | 38.28 | 5.00 | 43.28 |
| UNCxCOOR_std | 203 | 0.01 | 0.01 | 1.17 | 11.69 | -4.78 | 6.91 |
| UNCxOP_std | 203 | 0.10 | 0.02 | 1.10 | 8.83 | -4.56 | 4.27 |
| PWxSPH_std | 203 | 0.03 | 0.02 | 1.03 | 9.65 | -5.61 | 4.04 |
| CON_SZC | 203 | 3.54 | 3.50 | 1.26 | 4.00 | 1.00 | 5.00 |
| CON_SZU | 203 | 4.38 | 5.00 | 0.90 | 4.00 | 1.00 | 5.00 |
| DEM_TC | 203 | 78.67 | 40.00 | 96.79 | 500.00 | 0.00 | 500.00 |

**Table 30. Descriptive Statistics for Items**

| Variable | N Valid | Mean | Median | Std. Deviation | Range | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| DI_SPEC1 | 203 | 2.75 | 2 | 1.78 | 6 | 1 | 7 |
| DI_SPEC2 | 203 | 2.89 | 3 | 1.74 | 6 | 1 | 7 |
| DI_SPEC3 | 203 | 2.88 | 2 | 1.79 | 6 | 1 | 7 |
| DI_IFI1 | 203 | 4.60 | 5 | 1.79 | 6 | 1 | 7 |
| DI_IFI2 | 203 | 4.06 | 4 | 1.85 | 6 | 1 | 7 |
| DI_IFI3 | 203 | 3.93 | 4 | 2.08 | 6 | 1 | 7 |
| DI_AG1 | 203 | 4.81 | 5 | 1.56 | 6 | 1 | 7 |
| DI_AG2 | 203 | 4.74 | 5 | 1.56 | 6 | 1 | 7 |

**Table 30. Descriptive Statistics for Items**

| Variable | N Valid | Mean | Median | Std. Deviation | Range | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| DI_AG3 | 203 | 4.63 | 5 | 1.49 | 6 | 1 | 7 |
| DI_ISN1 | 203 | 4.63 | 5 | 1.78 | 6 | 1 | 7 |
| DI_ISN2 | 203 | 4.89 | 5 | 1.55 | 6 | 1 | 7 |
| DI_ISN3 | 203 | 4.49 | 5 | 1.51 | 6 | 1 | 7 |
| UNC1 | 203 | 4.01 | 4 | 1.61 | 6 | 1 | 7 |
| UNC2 | 203 | 3.98 | 4 | 1.54 | 6 | 1 | 7 |
| UNC3 | 203 | 3.78 | 4 | 1.57 | 6 | 1 | 7 |
| COOR1 | 203 | 2.70 | 2 | 1.39 | 6 | 1 | 7 |
| COOR2 | 203 | 5.01 | 5 | 1.21 | 6 | 1 | 7 |
| OPPOR1 | 203 | 4.40 | 5 | 1.37 | 6 | 1 | 7 |
| OPPOR2 | 203 | 4.32 | 4 | 1.40 | 6 | 1 | 7 |
| OPPOR3 | 203 | 4.60 | 5 | 1.30 | 6 | 1 | 7 |
| CU_UAI1 | 203 | 6.37 | 6 | 0.67 | 4 | 3 | 7 |
| CU_UAI2 | 203 | 6.13 | 6 | 0.90 | 5 | 2 | 7 |
| IT_SOPH1 | 203 | 4.41 | 5 | 1.66 | 6 | 1 | 7 |
| IT_SOPH2 | 203 | 5.73 | 6 | 1.14 | 6 | 1 | 7 |
| IT_SOPH3 | 203 | 6.10 | 6 | 1.06 | 6 | 1 | 7 |
| IT_SOPH4 | 203 | 6.24 | 6 | 0.89 | 4 | 3 | 7 |
| IT_SOPH5 | 203 | 5.82 | 6 | 1.10 | 5 | 2 | 7 |
| IT_SOPH6 | 203 | 6.07 | 6 | 0.96 | 6 | 1 | 7 |
| IT_SOPH7 | 203 | 6.24 | 6 | 0.94 | 5 | 2 | 7 |
| IT_SOPH8 | 203 | 5.63 | 6 | 1.30 | 6 | 1 | 7 |
| PW_US1 | 203 | 2.02 | 2 | 1.13 | 5 | 1 | 6 |
| PW_US2 | 203 | 4.63 | 5 | 1.63 | 6 | 1 | 7 |
| PW_US3 | 203 | 3.24 | 3 | 1.79 | 6 | 1 | 7 |
| PW_CU1 | 203 | 2.57 | 2 | 1.46 | 6 | 1 | 7 |
| PW_CU2 | 203 | 4.27 | 5 | 1.62 | 6 | 1 | 7 |
| CON_SZC1 | 203 | 3.15 | 3 | 1.53 | 4 | 1 | 5 |
| CON_SZC2 | 203 | 3.93 | 4 | 1.28 | 4 | 1 | 5 |
| CON_SZU1 | 203 | 4.31 | 5 | 1.00 | 4 | 1 | 5 |
| CON_SZU2 | 203 | 4.44 | 5 | 0.96 | 4 | 1 | 5 |
| DEM_TC | 203 | 78.67 | 40 | 96.79 | 500 | 0 | 500 |

## *5.4 Measurement Validation*

While content validity was determined in the design stage (i.e., theoretical review and pilot study), during this stage we seek to establish convergent and discriminant validity of the measures. Convergent validity tests whether the items that measure one particular construct are related to each other and work together (Trochim 2000). Discriminant validity, on the other hand, tests whether items work better with related items (i.e., other items in related to the same construct) than with non-related items (Trochim 2000).

### 5.4.1 Validation Techniques

We used two primary tools to assess construct validity: Cronbach's α and partial least squares path modeling (PLS). Cronbach's α is a technique specifically developed to test for reliability of measures (Cronbach 1951). PLS, on the other hand is a structural equation modeling based technique (SEM) which allows for the simultaneous testing of both the measurement and the theoretical model simultaneously. We used SPSS to measure Cronbach's α and SmartPLS (Ringle *et al.* 2005) for PLS structural model testing, validation, and component reliability.

We used different coefficients to assess convergent and discriminant validity of the reflective measures. To assess convergent validity, we used reliability coefficients (Cronbach's α), average variance extracted (AVE), and PLS's internal consistency coefficients. To test for discriminant validity, we used item-to-construct correlations, item-to-item correlations and average variance extracted (AVE). Reliability coefficients and AVE are scale-related tests, while internal consistency and item-to-construct

correlations are item-related tests. Recommended heuristics to include an item within a scale are shown in Table 31.

### 5.4.2 Assessment of Convergent Validity

**Table 31. Heuristics for the assessment of construct validity (convergent and discriminant)**

| Technique | Level | Validity | Heuristic | Reference |
|---|---|---|---|---|
| Cronbach's α | Construct | Convergent | >.60 | Nunnally (1967) |
| AVE (PLS) | Construct | Convergent | >.50 | Larcker and Lessig (1980), Fornell (1982) |
| Internal consistency (PLS) | Construct | Convergent | >.60 | |
| Outer loadings (PLS) | Item | Convergent | >.70 | Fornell (1982) |
| Item-to-construct correlations | Item | Convergent and Discriminant | Higher correlation to its own construct than to other constructs. | |
| Construct-to-construct correlations vs. Construct AVE | Construct | Discriminant | Square root of AVE should be higher than any construct-to-construct correlation | |

To evaluate the internal consistency we utilized a hierarchical component approach using repeated indicators: the indicators of the first order constructs (DISPEC, DIIFI, DIAG, and DIISN) are directly connected to the second order construct (DI). We also include model that includes DI as a second order construct as well asDI's its components (DISPEC, DIIFI, DIAG, and DIISN) as separate constructs, as shown in figure 12. Table 32 shows the convergent validity results for the reflective measures. Most of the measures present good reliability coefficients. (Cronbach α). On the other hand, some measures do present issues.

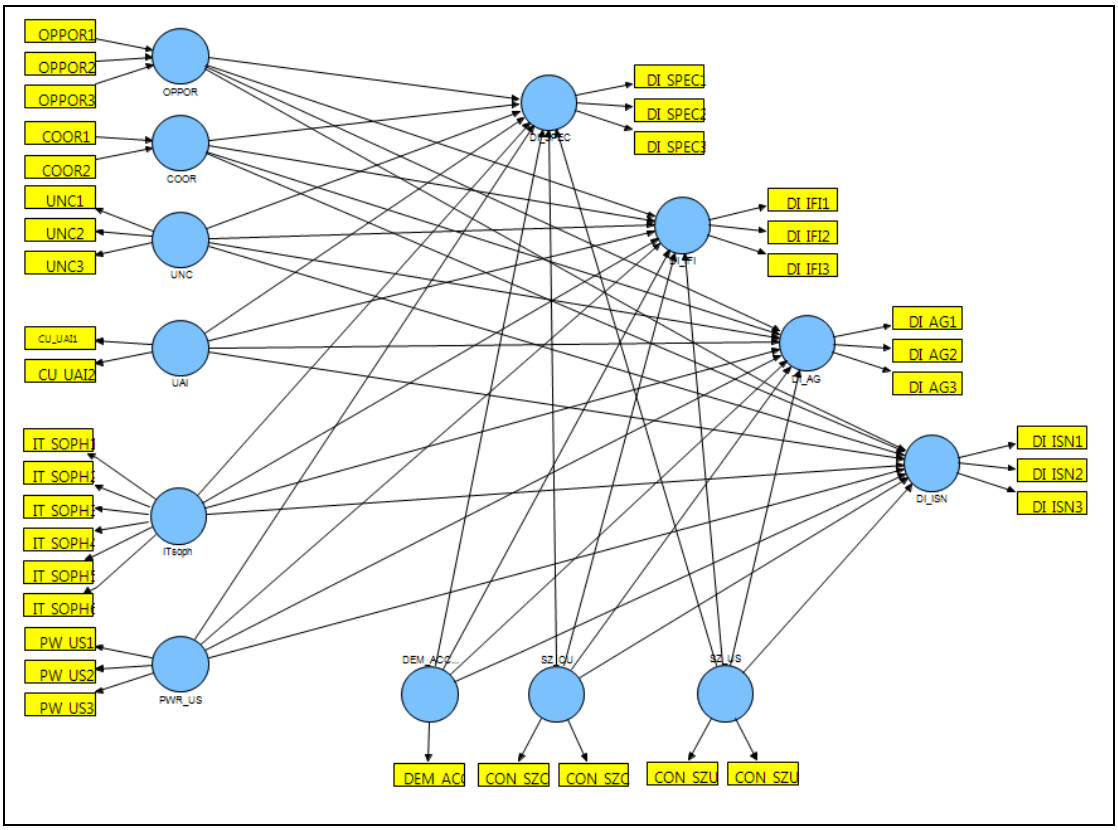


Figure 12. Model utilized to test construct validity

On the other hand, some measures do present issues. Power shows very poor reliability with all coefficients being under the recommended thresholds. The results for power are surprising. A possible explanation for the poor reliability of power is the *untested* change in language from suppliers to customers that took place after the pilot. We used item-level diagnostics to further investigate these issues.

**Table 32. Summary of convergent validity results**

| Construct | N of Items | Cronbach Alpha | AVE | Composite Reliability |
|---|---|---|---|---|
| IOS&K Specificity | 3 (DI_SPEC1, DI_SPEC2, DI_SPEC3) | 0.783 | 0.700 | 0.875 |
| Information Flow Integration | 3 (DI_IFI1, DI_IFI2, DI_IFI3) | 0.865 | 0.787 | 0.917 |
| Agency Mechanisms (monitoring) | 3 (DI_AG1, DI_AG2, DI_AG3) | 0.827 | 0.743 | 0.897 |
| *Information Sharing Norms* | *3 (DI_ISN1, DI_ISN2, DI_ISN3)* | 0.609 | 0.555 | 0.788 |
| Uncertainty | 3 (UNC1, UNC2, UNC3) | 0.884 | 0.812 | 0.928 |
| Culture (UAI) | 2 (CU_UAI1, CU_UAI2) | 0.815 | 0.844 | 0.915 |
| IT Sophistication | 6 (IT_SOPH1, IT_SOPH2, IT_SOPH3, IT_SOPH4, IT_SOPH5, IT_SOPH6) | 0.820 | 0.538 | 0.867 |
| *Power of Us (over customer)* | *3 (PW_US1, PW_US2, PW_US3)* | 0.343 | 0.447 | 0.597 |
| Size of Our Firm (control) | 2 (CON_SZU1, CON_SZU2) | 0.746 | 0.780 | 0.876 |
| Size of Customer (control) | 2 (CON_SZC1, CON_SZC2) | 0.783 | 0.700 | 0.875 |

Items in italics present reliability issues. Grayed cells highlight the problems.

PLS' outer model loadings are used to test convergent validity at the item-level. Table 33 presents the results for the model. Most items present acceptable loadings (above the 0.7 threshold and statistically significant). The loadings, however, point out problems with one IT-sophistication and one power item (Table 33).

Item-to-construct and item-to-item correlations were also utilized to test simultaneously convergent and discriminant validity, by showing that items do correlate with their construct more than with others (discriminant) (Table 34) and with "sibling" items (convergent) more than with unrelated items (discriminant) (Table 35).

**Table 33. PLS outer model loadings**

| Item | Sample Loadings | Bootstrap Mean Loadings | Standard Error | t-statistic |
|---|---|---|---|---|
| DI_SPEC1 | 0.7604 | 0.7237 | 0.0989 | 7.6849 ** |
| DI_SPEC2 | 0.8789 | 0.8913 | 0.0442 | 19.8819 ** |
| DI_SPEC3 | 0.8655 | 0.8700 | 0.0529 | 16.3727 ** |
| DI_IFI1 | 0.8852 | 0.8863 | 0.0176 | 50.1812 ** |
| DI_IFI2 | 0.9127 | 0.9093 | 0.0144 | 63.2770 ** |
| DI_IFI3 | 0.8632 | 0.8606 | 0.0241 | 35.8654 ** |
| DI_AG1 | 0.8117 | 0.8094 | 0.0409 | 19.8391 ** |
| DI_AG2 | 0.8606 | 0.8545 | 0.0275 | 31.3490 ** |
| DI_AG3 | 0.9112 | 0.9115 | 0.0133 | 68.7672 ** |
| DI_ISN1 | 0.8255 | 0.8220 | 0.0496 | 16.6261 ** |
| DI_ISN2 | 0.6438 | 0.6475 | 0.0892 | 7.2135 ** |
| DI_ISN3 | 0.7547 | 0.7344 | 0.0814 | 9.2698 ** |
| UNC1 | 0.8996 | 0.8984 | 0.0189 | 47.4740 ** |
| UNC2 | 0.9046 | 0.9018 | 0.0195 | 46.4620 ** |
| UNC3 | 0.8991 | 0.8967 | 0.0194 | 46.2349 ** |
| CU_UAI1 | 0.9269 | 0.9025 | 0.0971 | 9.5461 ** |
| CU_UAI2 | 0.9101 | 0.9002 | 0.0942 | 9.6619 ** |
| IT_SOPH1 | 0.2823 | 0.2623 | 0.2537 | 1.1129 n/s |
| IT_SOPH2 | 0.7270 | 0.6738 | 0.1860 | 3.9084 ** |
| IT_SOPH3 | 0.8024 | 0.7388 | 0.1806 | 4.4433 ** |
| IT_SOPH4 | 0.7372 | 0.6819 | 0.1814 | 4.0635 ** |
| IT_SOPH5 | 0.8389 | 0.7939 | 0.1284 | 6.5325 ** |
| IT_SOPH6 | 0.8548 | 0.8037 | 0.1357 | 6.3010 ** |
| PW_US1 | -0.0637 | -0.0648 | 0.1615 | 0.3945 n/s |
| PW_US2 | 0.8604 | 0.8540 | 0.0394 | 21.8569 ** |
| PW_US3 | 0.7723 | 0.7567 | 0.0653 | 11.8251 ** |
| CON_SZU1 | 0.9198 | 0.9149 | 0.0345 | 26.6322 ** |
| CON_SZU2 | 0.9256 | 0.9281 | 0.0225 | 41.1253 ** |
| CON_SZC1 | 0.8030 | 0.8103 | 0.1571 | 5.1104 ** |
| CON_SZC2 | 0.9567 | 0.9012 | 0.1413 | 6.7720 ** |
| DEM_TC | 1 | 1 | 0 | n/a |

** For 1-tailed tests, t>2.35 is significant at 0.01. (t>2.60 for 2-tailed test)

* For 1-tailed tests, t>1.65 is significant at 0.05. (t>1.97 for 2-tailed test)

**Table 34. PLS cross loadings (reflective constructs)**

| | DI_SPEC | DI_IFI | DI_AG | DI_ISN | UNC | UAI | ITsoph | PWR_US | SZ_CU | SZ_US |
|---|---|---|---|---|---|---|---|---|---|---|
| DI_SPEC1 | 0.760** | 0.157* | 0.157* | -0.033 | -0.042 | -0.043 | -0.054 | 0.098 | 0.001 | -0.037 |
| DI_SPEC2 | 0.879** | 0.144* | 0.077 | 0.023 | -0.008 | -0.002 | -0.013 | 0.109 | -0.092 | -0.015 |
| DI_SPEC3 | 0.866** | 0.124* | 0.041 | 0.066 | 0.095 | -0.073 | -0.024 | 0.189** | -0.075 | -0.012 |
| DI_IFI1 | 0.133* | 0.885** | 0.450** | 0.470** | 0.318** | 0.103 | 0.133* | 0.279** | 0.112 | 0.237** |
| DI_IFI2 | 0.156* | 0.913** | 0.447** | 0.531** | 0.316** | 0.050 | 0.156* | 0.334** | 0.126* | 0.246** |
| DI_IFI3 | 0.163** | 0.863** | 0.445** | 0.472** | 0.335** | 0.079 | 0.025 | 0.394** | 0.067 | 0.228** |
| DI_AG1 | 0.103 | 0.434** | 0.812** | 0.410** | 0.273** | 0.099 | 0.207** | 0.320** | -0.009 | 0.118* |
| DI_AG2 | 0.079 | 0.416** | 0.861** | 0.326** | 0.312** | 0.060 | 0.044 | 0.359** | 0.066 | 0.169** |
| DI_AG3 | 0.107 | 0.456** | 0.911** | 0.346** | 0.409** | 0.121* | 0.174** | 0.332** | 0.062 | 0.142* |
| DI_ISN1 | 0.028 | 0.638** | 0.369** | 0.825** | 0.361** | 0.070 | 0.135* | 0.351** | -0.005 | 0.168** |
| DI_ISN2 | 0.030 | 0.251** | 0.169** | 0.644** | 0.190** | 0.042 | 0.097 | 0.241** | -0.043 | 0.017 |
| DI_ISN3 | -0.008 | 0.259** | 0.351** | 0.755** | 0.285** | 0.013 | 0.047 | 0.319** | 0.020 | 0.091 |
| UNC1 | 0.023 | 0.326** | 0.335** | 0.357** | 0.900** | 0.070 | 0.181** | 0.560** | -0.032 | 0.156* |
| UNC2 | 0.016 | 0.322** | 0.326** | 0.355** | 0.905** | 0.102 | 0.187** | 0.504** | -0.035 | 0.154* |
| UNC3 | 0.009 | 0.336** | 0.383** | 0.338** | 0.899** | 0.064 | 0.101 | 0.505** | 0.007 | 0.145* |
| CU_UAI1 | -0.041 | 0.069 | 0.113 | 0.064 | 0.114 | 0.927** | 0.273** | 0.102 | -0.039 | 0.156* |
| CU_UAI2 | -0.047 | 0.092 | 0.082 | 0.043 | 0.043 | 0.910** | 0.246** | -0.057 | 0.008 | 0.033 |
| IT_SOPH1 | 0.103 | 0.055 | 0.038 | -0.021 | 0.146* | 0.074 | 0.282** | 0.115 | 0.040 | -0.019 |
| IT_SOPH2 | 0.026 | 0.067 | 0.131* | 0.040 | 0.113 | 0.176** | 0.727** | -0.002 | 0.048 | 0.049 |
| IT_SOPH3 | -0.040 | 0.020 | 0.144* | 0.117* | 0.101 | 0.177** | 0.802** | 0.040 | -0.005 | 0.014 |
| IT_SOPH4 | -0.105 | 0.097 | 0.054 | 0.111 | 0.126* | 0.322** | 0.737** | 0.014 | 0.040 | 0.085 |
| IT_SOPH5 | 0.006 | 0.126* | 0.155* | 0.067 | 0.154* | 0.227** | 0.839** | 0.099 | 0.024 | 0.087 |
| IT_SOPH6 | -0.045 | 0.134* | 0.141* | 0.156* | 0.165** | 0.230** | 0.855** | 0.120* | -0.033 | 0.104 |
| PW_US1 | 0.036 | -0.060 | 0.011 | -0.145* | 0.000 | -0.101 | -0.123* | -0.064 | -0.127* | -0.079 |
| PW_US2 | 0.210** | 0.362** | 0.325** | 0.336** | 0.434** | 0.023 | 0.138* | 0.860** | 0.094 | 0.129* |
| PW_US3 | 0.042 | 0.240** | 0.324** | 0.320** | 0.535** | 0.005 | -0.041 | 0.772** | -0.212** | -0.022 |
| CON_SZC1 | -0.003 | 0.087 | 0.005 | -0.019 | 0.018 | 0.021 | 0.005 | 0.019 | 0.803** | 0.390** |
| CON_SZC2 | -0.086 | 0.112 | 0.063 | -0.001 | -0.038 | -0.034 | 0.015 | -0.062 | 0.957** | 0.434** |
| CON_SZU1 | -0.007 | 0.248** | 0.143* | 0.129* | 0.135* | 0.102 | 0.101 | 0.113 | 0.434** | 0.920** |
| CON_SZU2 | -0.041 | 0.245** | 0.165** | 0.129* | 0.175** | 0.094 | 0.062 | 0.042 | 0.421** | 0.926** |

** For 1-tailed tests, t>2.34 is significant at 0.01. (t>2.60 for 2-tailed test)

* For 1-tailed tests, t>1.65 is significant at 0.05. (t>1.97 for 2-tailed test)

### 5.4.3 Assessment of Discriminant Validity

Discriminant validity at the construct level is assessed by comparing construct-to-construct correlations to the square root of the AVE. All constructs show acceptable comparative values (Table 36). Both cross-loadings (item-to-construct) and item-to-item correlation tables show acceptable levels for most indicators (Tables 34 and 35). Cross-loadings analysis shows that ITSOPH1 loads more with its own construct than with any other construct, while PW_US1 still presents problems. The item-to-item correlations shows that both IT_SOPH1 and PW_US1 present problems, so much so that the low correlations affect the rest of the items in the table. As such, we removed the items from the table and re-analyzed the results (Table 35). Additionally, DI_ISN1 and the remaining PW_US items show discriminant validity issues in the inter-item correlation table, but they present good discriminant results in the item-to-construct table. Finally, some items show significant correlations with items on other constructs, though lower than with their siblings. This is expected since it is a reflection of the theoretical model.

### 5.4.4 Assessment of Control Variables

Most of the control variables show good reliability scores. Of these, *customer's power over us* (PW_CU) presents problems. This item shows very low inter-item correlations and Cronbach $\alpha$. It does not pass the discriminant validity tests either. This is not surprising given that the language is similar to PW_US. Size of our firm and our customer (SZ_US and SZ_CU respectively) show good convergent and discriminant scores and pass all tests.

**Table 35. Item-to-item Pearson correlations**

| | DI_SPEC 1 | DI_SPEC 2 | DI_SPEC 3 | DI_IFI1 | DI_IFI2 | DI_IFI3 | DI_AG1 | DI_AG2 | DI_AG3 | DI_ISN1 | DI_ISN2 | DI_ISN3 | UNC1 | UNC2 | UNC3 | COOR1 | COOR2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DI_SPEC1 | -- | | | | | | | | | | | | | | | | |
| DI_SPEC2 | 0.46 ** | -- | | | | | | | | | | | | | | | |
| DI_SPEC3 | 0.42 ** | 0.75 ** | -- | | | | | | | | | | | | | | |
| DI_IFI1 | 0.13 | 0.12 | 0.08 | -- | | | | | | | | | | | | | |
| DI_IFI2 | 0.12 | 0.14 * | 0.14 | 0.74 ** | -- | | | | | | | | | | | | |
| DI_IFI3 | 0.18 * | 0.12 | 0.11 | 0.61 ** | 0.69 ** | -- | | | | | | | | | | | |
| DI_AG1 | 0.10 | 0.09 | 0.07 | 0.38 ** | 0.39 ** | 0.38 ** | -- | | | | | | | | | | |
| DI_AG2 | 0.14 * | 0.05 | 0.00 | 0.35 ** | 0.36 ** | 0.40 ** | 0.50 ** | -- | | | | | | | | | |
| DI_AG3 | 0.16 * | 0.06 | 0.04 | 0.43 ** | 0.41 ** | 0.38 ** | 0.65 ** | 0.69 ** | -- | | | | | | | | |
| DI_ISN1 | 0.03 | 0.04 | 0.06 | 0.54 ** | 0.59 ** | 0.56 ** | 0.37 ** | 0.27 ** | 0.33 ** | -- | | | | | | | |
| DI_ISN2 | 0.02 | 0.04 | 0.05 | 0.25 ** | 0.23 ** | 0.19 ** | 0.16 * | 0.12 | 0.16 * | 0.31 ** | -- | | | | | | |
| DI_ISN3 | 0.03 | 0.03 | 0.04 | 0.19 ** | 0.28 ** | 0.22 ** | 0.35 ** | 0.31 ** | 0.26 ** | 0.37 ** | 0.34 ** | -- | | | | | |
| UNC1 | 0.04 | 0.00 | 0.09 | 0.29 ** | 0.28 ** | 0.29 ** | 0.28 ** | 0.27 ** | 0.32 ** | 0.34 ** | 0.16 * | 0.27 ** | -- | | | | |
| UNC2 | 0.07 | 0.03 | 0.08 | 0.29 ** | 0.29 ** | 0.28 ** | 0.22 ** | 0.24 ** | 0.37 ** | 0.35 ** | 0.17 * | 0.24 ** | 0.73 ** | -- | | | |
| UNC3 | 0.01 | 0.05 | 0.08 | 0.28 ** | 0.28 ** | 0.33 ** | 0.24 ** | 0.33 ** | 0.42 ** | 0.29 ** | 0.18 ** | 0.27 ** | 0.70 ** | 0.72 ** | -- | | |
| COOR1 | 0.12 | 0.26 ** | 0.14 * | 0.12 | 0.09 | 0.11 | 0.10 | 0.06 | 0.00 | 0.32 ** | 0.16 * | 0.20 ** | 0.23 ** | 0.16 * | 0.17 * | -- | |
| COOR2 | 0.07 | 0.12 | 0.11 | 0.40 ** | 0.35 ** | 0.30 ** | 0.30 ** | 0.39 ** | 0.30 ** | 0.22 ** | 0.20 ** | 0.25 ** | 0.24 ** | 0.21 ** | 0.21 ** | 0.15 * | -- |
| OPPOR1 | 0.02 | 0.08 | 0.05 | 0.02 | 0.06 | 0.06 | 0.02 | 0.06 | 0.02 | 0.02 | 0.08 | 0.14 * | 0.09 | 0.05 | 0.07 | 0.13 | 0.23 ** |
| OPPOR2 | 0.04 | 0.03 | 0.00 | 0.01 | 0.08 | 0.02 | 0.01 | 0.12 | 0.04 | 0.00 | 0.12 | 0.19 ** | 0.07 | 0.03 | 0.05 | 0.10 | 0.21 ** |
| OPPOR3 | 0.09 | 0.11 | 0.07 | 0.12 | 0.04 | 0.10 | 0.00 | 0.07 | 0.06 | 0.15 * | 0.09 | 0.14 | 0.14 | 0.10 | 0.08 | 0.13 | 0.05 |
| CU_UAI1 | 0.05 | 0.00 | 0.05 | 0.08 | 0.04 | 0.07 | 0.13 | 0.07 | 0.10 | 0.08 | 0.03 | 0.03 | 0.10 | 0.11 | 0.10 | 0.14 * | 0.11 |
| CU_UAI2 | 0.02 | 0.01 | 0.09 | 0.12 | 0.05 | 0.07 | 0.05 | 0.04 | 0.12 | 0.05 | 0.05 | 0.00 | 0.03 | 0.07 | 0.01 | 0.04 | 0.11 |
| IT_SOPH2 | 0.00 | 0.03 | 0.04 | 0.07 | 0.11 | 0.01 | 0.18 ** | 0.04 | 0.13 | 0.03 | 0.01 | 0.06 | 0.16 * | 0.09 | 0.06 | 0.11 | 0.08 |
| IT_SOPH3 | 0.06 | 0.02 | 0.02 | 0.05 | 0.07 | 0.06 | 0.25 ** | 0.00 | 0.14 * | 0.08 | 0.10 | 0.09 | 0.12 | 0.11 | 0.04 | 0.14 * | 0.07 |
| IT_SOPH4 | 0.12 | 0.07 | 0.07 | 0.15 * | 0.11 | 0.00 | 0.07 | 0.00 | 0.07 | 0.12 | 0.12 | 0.01 | 0.16 * | 0.13 | 0.05 | 0.16 * | 0.03 |
| IT_SOPH5 | 0.00 | 0.02 | 0.00 | 0.12 | 0.16 * | 0.06 | 0.16 * | 0.04 | 0.20 ** | 0.12 | 0.05 | 0.04 | 0.17 * | 0.18 * | 0.08 | 0.09 | 0.15 * |
| IT_SOPH6 | 0.04 | 0.03 | 0.04 | 0.13 | 0.16 * | 0.07 | 0.16 * | 0.07 | 0.14 * | 0.17 * | 0.11 | 0.06 | 0.12 | 0.20 ** | 0.13 | 0.11 | 0.10 |
| PW_US2 | 0.11 | 0.20 ** | 0.22 ** | 0.29 ** | 0.32 ** | 0.35 ** | 0.29 ** | 0.26 ** | 0.29 ** | 0.29 ** | 0.19 ** | 0.26 ** | 0.39 ** | 0.41 ** | 0.38 ** | 0.03 | 0.24 ** |
| PW_US3 | 0.03 | 0.02 | 0.09 | 0.15 * | 0.21 ** | 0.28 ** | 0.23 ** | 0.33 ** | 0.27 ** | 0.25 ** | 0.19 ** | 0.27 ** | 0.55 ** | 0.43 ** | 0.47 ** | 0.18 ** | 0.21 ** |

**Table 35. Item-to-item Pearson correlations (continued)**

| | OPPOR1 | OPPOR2 | OPPOR3 | CU_UAI1 | CU_UAI2 | IT_SOPH2 | IT_SOPH3 | IT_SOPH4 | IT_SOPH5 | IT_SOPH6 | PW_US2 | PW_US3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OPPOR1 | -- | | | | | | | | | | | |
| OPPOR2 | 0.77 ** | -- | | | | | | | | | | |
| OPPOR3 | 0.47 ** | 0.50 ** | -- | | | | | | | | | |
| CU_UAI1 | 0.00 | 0.00 | 0.03 | -- | | | | | | | | |
| CU_UAI2 | 0.05 | 0.00 | 0.04 | 0.69 ** | -- | | | | | | | |
| IT_SOPH2 | 0.13 | 0.13 | 0.12 | 0.17 * | 0.16 * | -- | | | | | | |
| IT_SOPH3 | 0.06 | 0.03 | 0.09 | 0.17 * | 0.15 * | 0.65 ** | -- | | | | | |
| IT_SOPH4 | 0.00 | 0.03 | 0.03 | 0.30 ** | 0.29 ** | 0.44 ** | 0.49 ** | -- | | | | |
| IT_SOPH5 | 0.09 | 0.00 | 0.08 | 0.21 ** | 0.21 ** | 0.48 ** | 0.55 ** | 0.56 ** | -- | | | |
| IT_SOPH6 | 0.03 | 0.04 | 0.02 | 0.23 ** | 0.19 ** | 0.46 ** | 0.57 ** | 0.52 ** | 0.68 ** | -- | | |
| PW_US2 | 0.06 | 0.05 | 0.00 | 0.09 | 0.05 | 0.03 | 0.06 | 0.07 | 0.15 * | 0.17 * | -- | |
| PW_US3 | 0.03 | 0.07 | 0.13 | 0.06 | 0.06 | 0.05 | 0.03 | 0.09 | 0.01 | 0.01 | 0.36 ** | -- |

** t>2.60 is significant at 0.01 (two-tailed)

* t>1.97 is significant at 0.05 (two-tailed)

**Table 36. PLS AVE and construct-to-construct correlations**

| | DI_SPEC | DI_IFI | DI_AG | DI_ISN | UNC | COOR | OPPOR | UAI | ITsoph | PWR_US | TC | SZ_CU | SZ_US |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DI_SPEC | 0.837 | | | | | | | | | | | | |
| DI_IFI | 0.170 | 0.887 | | | | | | | | | | | |
| DI_AG | 0.111 | 0.504 | 0.862 | | | | | | | | | | |
| DI_ISN | 0.022 | 0.553 | 0.415 | 0.745 | | | | | | | | | |
| UNC | 0.018 | 0.364 | 0.387 | 0.388 | 0.901 | | | | | | | | |
| COOR | 0.064 | 0.400 | 0.370 | 0.356 | 0.282 | -- | | | | | | | |
| OPPOR | -0.124 | -0.123 | -0.117 | -0.113 | 0.081 | -0.090 | -- | | | | | | |
| UAI | -0.048 | 0.087 | 0.107 | 0.059 | 0.087 | 0.137 | 0.043 | 0.919 | | | | | |
| ITsoph | -0.037 | 0.119 | 0.160 | 0.127 | 0.173 | 0.142 | 0.090 | 0.283 | 0.734 | | | | |
| PWR_US | 0.158 | 0.378 | 0.391 | 0.414 | 0.580 | 0.293 | 0.000 | 0.029 | 0.083 | 0.669 | | | |
| TC | 0.080 | -0.131 | -0.023 | -0.089 | -0.156 | 0.068 | -0.130 | -0.099 | -0.001 | -0.028 | 1.000 | | |
| SZ_CU | -0.065 | 0.115 | 0.049 | -0.008 | -0.022 | 0.004 | 0.008 | -0.018 | 0.013 | -0.039 | 0.206 | 0.883 | |
| SZ_US | -0.026 | 0.267 | 0.167 | 0.140 | 0.168 | 0.179 | -0.051 | 0.106 | 0.088 | 0.083 | 0.060 | 0.463 | 0.923 |

In summary, most constructs present good convergent and discriminant validity. Only two items present serious problems: IT_SOPH1 and PW_US1. These two items are removed for the testing of the model. At the construct level, we removed customer's power from further analyses due to the issues mentioned above.

# Chapter 6 Results and Discussion

## *6.1 Analysis Techniques*

We used partial least square path modeling to test the hypotheses and multiple moderated regressions (MMR) for confirmation of results and additional statistical information. While PLS is a valid technique for testing paths/relationships, it does not provide model estimates beyond the $R^2$ for the criterion variable. MMR, on the other hand, provides an F-test and an overall significance value for the model, plus F-values for changes in $R^2$ for the direct and moderation effects. In both cases (PLS and MMR) we use hierarchical entry mode by testing a model that includes only the control variables first (figure 13a), a model that includes the control and the direct effects second (figure 13b) and the full model last (figure 13c). We calculated variance inflation factors (VIF) for all independent variables to determine if multicollinearity was present. We also similar analyses for all four components of digital integration.

First we analyzed a model with digital integration as the criterion variable, the same model used for measurement validation. This model allows us to test the hypotheses on the aggregate DI. Second, we tested the effect of the predictor variables on each of the dimensions separately. We do this to understand how the different predictors affect the different factors. For example, we expect that coordination needs will have a different effect on the agency aspect of the relationship than on the information flows. Tables 37 and 38 present summary results for changes in $R^2$ between the hierarchical models for PLS and regression respectively, while Tables 39 and 40 present summary results for path coefficients for PLS and regression respectively.

Detailed results are included in Appendices A and B for PLS and regression respectively. Additionally, we ran *post hoc* power analyses to evaluate the unsupported hypotheses. Table 40 summarizes the results from the *post hoc* power analyses.

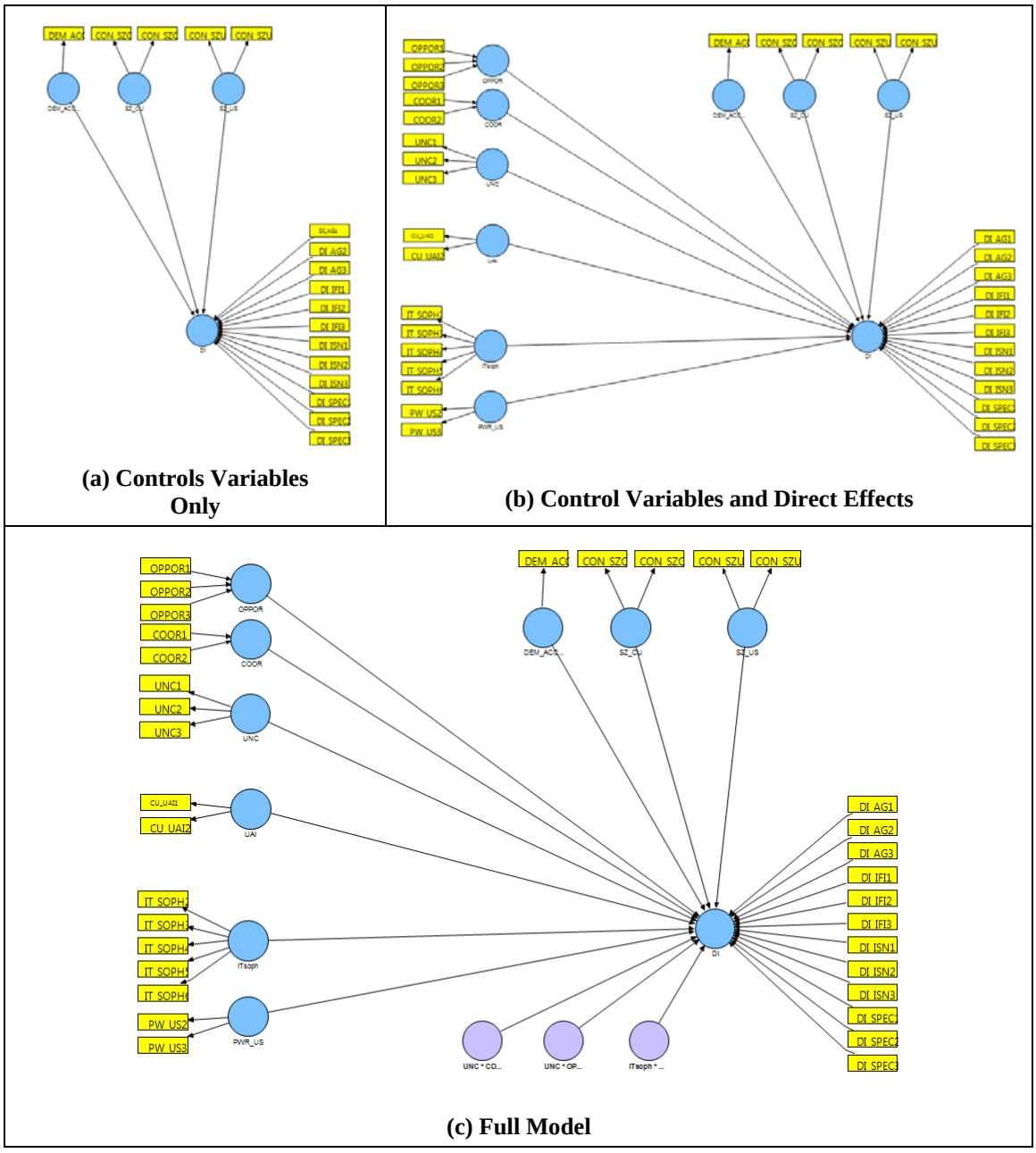


Figure 13. Hierarchical entry models for DI

**Table 37. $R^2$ differential for PLS hierarchical models**

| Model | | DI | | DI_SPEC | | DI_IFI | | DI_AG | | DI_ISN | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $R^2$ | $R^2$ diff. | $R^2$ | $R^2$ diff. | $R^2$ | $R^2$ diff. | $R^2$ | $R^2$ diff. | $R^2$ | $R^2$ diff. |
| 1 | Control Variables Only | 0.155 | 0.155 | 0.038 | 0.038 | 0.094 | 0.094 | 0.043 | 0.043 | 0.085 | 0.085 |
| 2 | Control Variables and Direct Effects | 0.459 | 0.303 | 0.170 | 0.133 | 0.338 | 0.245 | 0.295 | 0.253 | 0.312 | 0.227 |
| 3 | All | 0.473 | 0.014 | 0.201 | 0.030 | 0.351 | 0.013 | 0.333 | 0.038 | 0.349 | 0.037 |

**Table 38. $R^2$ differential for regression hierarchical models**

| Model | | $R^2$ | $R^2$ Change | F-change | df1 | df2 | Sig. F Change |
|---|---|---|---|---|---|---|---|
| **DI** | 1 | 0.037 | 0.037 | 2.7302 | 3 | 211 | 0.045 |
| | 2 | 0.286 | 0.249 | 11.8928 | 6 | 205 | 0.000 |
| | 3 | 0.300 | 0.014 | 1.3323 | 3 | 202 | 0.265 |
| **DI_SPEC** | 1 | 0.006 | 0.006 | 0.3927 | 3 | 211 | 0.758 |
| | 2 | 0.093 | 0.087 | 3.2922 | 6 | 205 | 0.004 |
| | 3 | 0.115 | 0.022 | 1.6640 | 3 | 202 | 0.176 |
| **DI_IFI** | 1 | 0.081 | 0.081 | 6.2030 | 3 | 211 | 0.000 |
| | 2 | 0.252 | 0.171 | 7.8031 | 6 | 205 | 0.000 |
| | 3 | 0.254 | 0.002 | 0.1820 | 3 | 202 | 0.909 |
| **DI_AG** | 1 | 0.028 | 0.028 | 2.0043 | 3 | 211 | 0.114 |
| | 2 | 0.251 | 0.223 | 10.1792 | 6 | 205 | 0.000 |
| | 3 | 0.265 | 0.014 | 1.3096 | 3 | 202 | 0.272 |
| **DI_ISN** | 1 | 0.020 | 0.020 | 1.4320 | 3 | 211 | 0.234 |
| | 2 | 0.184 | 0.164 | 6.8740 | 6 | 205 | 0.000 |
| | 3 | 0.212 | 0.028 | 2.3499 | 3 | 202 | 0.074 |

**Table 39. Path coefficients from PLS runs**

| Test | Relationship | DI | DI_SPEC | DI_IFI | DI_AG | DI_ISN |
|---|---|---|---|---|---|---|
| | DEM_TC -> DI | -0.329 * | 0.171 | -0.152 * | 0.189 | -0.218 + |
| | SZ_CU -> DI | 0.036 | -0.060 | 0.015 | 0.050 | -0.084 |
| | SZ_US -> DI | 0.226 * | -0.070 | 0.269 ** | 0.015 | 0.192 * |
| | DEM_TC -> DI | -0.122 + | 0.047 | -0.174 * | -0.016 | -0.112 |
| | SZ_CU -> DI | 0.061 | -0.149 | 0.090 + | 0.068 | -0.052 |
| | SZ_US -> DI | 0.101 + | 0.032 | 0.134 ** | 0.041 | 0.084 |
| H1a | UNC -> DI | 0.231 * | 0.111 | 0.129 + | 0.180 + | 0.161 * |
| H1d | COOR -> DI | 0.296 ** | 0.250 ** | 0.286 ** | 0.255 ** | 0.263 |
| H1e | OPPOR -> DI | 0.152 | -0.079 | -0.160 | 0.121 | 0.138 |
| H2 | UAI -> DI | -0.018 | 0.050 | 0.012 | 0.031 | -0.030 |
| H3a | ITsoph -> DI | 0.036 | -0.098 | 0.044 | 0.065 | 0.066 |
| H3c | PWR_US -> DI | 0.267 * | 0.225 * | 0.209 * | 0.216 * | 0.219 * |
| | DEM_TC -> DI | -0.098 | 0.086 | -0.155 * | 0.015 | -0.081 |
| | SZ_CU -> DI | 0.085 | -0.090 | 0.103 + | 0.095 | -0.042 |
| | SZ_US -> DI | 0.096 + | 0.020 | 0.129 * | 0.031 | 0.091 |
| H1a | UNC -> DI | 0.236 * | -0.097 | 0.129 * | 0.208 + | 0.180 * |
| H1d | COOR -> DI | 0.321 ** | 0.217 * | 0.300 ** | 0.274 ** | 0.240 |
| H1e | OPPOR -> DI | 0.158 | -0.086 | -0.134 | 0.116 | 0.143 |
| H2 | UAI -> DI | -0.030 | 0.015 | 0.000 | 0.026 | -0.023 |
| H3a | ITsoph -> DI | 0.037 | -0.081 | 0.046 | 0.051 | 0.065 |
| H3c | PWR_US -> DI | 0.244 * | 0.184 * | 0.191 * | 0.168 + | 0.213 * |
| H1b | UNC * COOR -> DI | 0.067 | -0.073 | 0.033 | 0.044 | 0.147 |
| H1c | UNC * OPPOR -> DI | 0.030 | 0.144 + | 0.048 | 0.131 + | -0.137 |
| H3b | ITsoph * PWR_US -> DI | 0.094 | 0.121 | 0.103 | 0.142 | 0.104 |

+ Significant at 0.10 (t>1.29, one tailed)
* Significant at 0.05 (t>1.65, one tailed)
** Significant at 0.01 (t>2.35, one tailed)

**Table 40. Summary of regression results**

| | Predictor | DI | DI_SPEC | DI_IFI | DI_AG | DI_ISN |
|---|---|---|---|---|---|---|
| **F** | | 7.2067 | 2.1837 | 5.7290 | 6.0748 | 4.5184 |
| **Sig.** | | 0.000 | 0.014 | 0.000 | 0.000 | 0.000 |
| **$R^2$** | | 0.300 | 0.115 | 0.254 | 0.265 | 0.212 |
| | (Constant) | 0.000 | 0.000 * | 0.000 | 0.000 | 0.000 * |
| | CON_SZC | 0.024 | -0.025 | 0.075 | 0.023 | -0.019 |
| | CON_SZU | 0.132 * | -0.009 | 0.174 ** | 0.108 + | 0.079 |
| | DEM_TC | -0.052 | 0.023 | -0.134 * | 0.003 | -0.016 |
| H1a | UNC | 0.246 ** | -0.088 | 0.234 ** | 0.244 ** | 0.315 ** |
| H1d | COOR | 0.224 ** | 0.220 ** | 0.182 ** | 0.198 ** | -0.021 |
| H1e | OPPOR | -0.039 | -0.077 | -0.060 | -0.027 | 0.083 + |
| H2 | CU_UAI | -0.005 | -0.097 + | 0.025 | 0.052 | 0.015 |
| H3a | IT_SOPH | 0.063 | 0.002 | 0.048 | 0.100 + | 0.025 |
| H3c | PW_US | 0.227 ** | 0.137 + | 0.169 * | 0.186 ** | 0.125 + |
| H1b | UNCxCOOR_std | 0.038 | -0.050 | 0.022 | 0.033 | 0.120 * |
| H1c | UNCxOP_std | 0.083 | 0.142 * | 0.037 | 0.114 * | -0.087 |
| H3b | PWxSPH_std | 0.053 | 0.027 | 0.005 | 0.005 | 0.123 * |

+ Significant at 0.10 (one tailed)
* Significant at 0.05 (one tailed)
** Significant at 0.01 (one tailed)

Only results for the full model are presented in this table. Detailed results for hierarchical regression are included in Appedix C.

These analyses show that all models (DI, DI_SPEC, DI_IFI, DI_AG, and DI_ISN) are statistically significant at the 0.01 level, with $R^2$ ranging between 0.201 and 0.473 for PLS (between 0.115 and 0.300 for MMR). The MMR analyses offer results that are more conservative. The reason for this may lie in the fact that PLS uses unequal loadings/weightings while for MMR the constructs are calculated as averages between the items (equal loadings), allowing for less flexibility in the parameter estimations. As such, the inequalities in PLS lead to more accurate parameter estimates, and better results. Moreover, MMR uses averages for constructs and thus has no sensitivity to measurement error. At the same time, the results for individual effects are more similar between PLS and MMR, with MMR offering more power for a few coefficients. VIFs were below 3 in all models, indicating that collinearity was not present.

These results are discussed in more detail in the following section.

## *6.2 Hypotheses Testing*

Three of the nine hypotheses are supported by the analyses (Table 41).

**Table 41. Summary of results for support of hypotheses**

| Determinants | Eff. | | Hypothesis | Support Aggregate | Support Individual |
|---|---|---|---|---|---|
| Uncertainty | Dir. | H1a: | Perceived environmental uncertainty is positively related to digital integration | YES | IFI<br>AG<br>ISN |
| ⊗ Coordination needs | Mod. | H1b: | The relationship between perceived environmental uncertainty and digital integration is moderated by the intensity of coordination needs. | NO | *Marginally for ISN* |
| ⊗ Opportunism | Mod. | H1c: | The relationship between perceived environmental uncertainty and digital integration is moderated by the intensity of opportunism risks. | NO | *Marginally for SPEC and AG* |
| Coordination needs | Dir. | H1b: | Coordination needs is positively related to digital integration. | YES | SPEC<br>IFI<br>AG |
| Opportunism | Dir. | H1c: | Opportunism is negatively related to digital integration. | NO | NO |
| Culture (UAI) | Dir. | H2: | Higher levels of national uncertainty avoidance are related to higher levels of digital integration | NO | NO |
| IT sophistication | Dir. | H3a: | Higher levels of IT sophistication are related to higher levels of digital integration. | NO | NO |
| ⊗ Ability to Influence | Mod. | H3b: | The impact of IT sophistication on digital integration is moderated by the ability to influence of the focus partner. | NO | *Marginally for ISN* |
| Ability to Influence | Dir. | H3b: | Ability to influence is related to digital integration. | YES | ALL |

### 6.2.1 Cognitive Embeddedness (Uncertainty)

Cognitive embeddedness refers to the effect of uncertainty, coordination needs and opportunism risks on digital integration. We tested five hypotheses (H1a, H1b, H1c, H1d, and H1e). H1a, H1d and H1e are direct effects, while H1b and H1c are moderation effects.

#### 6.2.1.1 Direct effects

H1a (the main hypothesis in the group) posits that *uncertainty* directly impacts *digital integration*. H1a is supported at the aggregate (DI) level ($p<0.05$). At the dimension level, H1a is supported for DI_IFI ($p<.05$) and both governance dimensions (DI_AG ($p<0.10$), DI_ISN ($p<0.05$)). H1a is not supported for DI_SPEC. These results suggest that market uncertainty influences the adoption of digital integration mechanisms, but different mechanisms are affected differently (e.g., monitoring and social norms are affected while relation-specific assets are not). At the same time, uncertainty does lead to information sharing, but not necessarily to investment in relation-specific assets.

H1d posits that *coordination needs* directly affects *digital integration*. H1d is supported at the aggregate level ($p<0.01$) and at the dimension level for DI_SPEC ($p<0.05$), DI_IFI ($p<0.01$) and DI_AG ($p<0.01$). H1d is not supported for DI_ISN. Moreover, PLS estimates the path coefficient with the hypothesized sign while MMR estimates the opposite.

H1e posits that *opportunism risks* negatively affects *digital integration*. H1e is not supported at any level. This result is somewhat surprising. In the presence of opportunism risks we would expect organizations to increase monitoring mechanisms and decrease investment in relationship-specific assets. The results do not support this viewpoint.

#### 6.2.1.2 Moderation effects

H1b posits that the relationship between *uncertainty* and *digital integration* is moderated by *coordination needs*. This hypothesis is not supported at any level (with the exception of the regression coefficient for DI_ISN). While uncertainty and coordination do have separate effects on digital integration, they do not seem to interact. That is, the impact of uncertainty on digital integration seems to be independent of the degree of coordination needs, and *vice versa.* The one spurious coefficient merits further study in the future.

H1c posits that the relationship between *uncertainty* and *digital integration* is moderated by *opportunism risks*. This hypothesis is marginally supported for DI_SPEC ($p<0.1$) and DI_AG ($p<0.1$), while it's not supported for DI_IFI and DI_ISN. While significant at the 'coefficient' level, the change in $R^2$ by the moderators in the hierarchical regressions is not significant at the model level (Table 45). These results also merit further analysis.

### 6.2.2 Cultural Embeddedness (UAI)

We posited that *uncertainty avoidance* directly impacts *digital integration* (H2). H2 is not supported at any level. Of all the predictors, UAI had the lowest path coefficients. UAI is also the variable with the lowest variance (mean: 6.25/7, mode: 6.5/7, std. dev.: 0.72) as depicted in Figure 14. To further test culture, we ran analysis of variance (ANOVA) for both espoused UAI values items between the three countries. The test shows that there are no significant differences between the countries (Table 42). Moreover, the relative means do not correspond with Hofstede's relative scores (Figure 15). While using *espoused values* present the advantage that we have a measure that is consistent with the unit of analysis, the language in the questions seems to be too strong and to lead to a ceiling effect and low variance.

In this context, we retested for culture. We ran two MMR: one with Hofstede's scores for the country (US: 46, UK: 35, Germany: 65) and the second with dummy variables for country (anchored in UK, the country with the lowest UAI), instead of espoused values. In neither model UAI is significant (UAI, t-stat = 0.005, sig. = 0.99; dummy USA, t-stat = 0.712, sig. = 0.48, dummy Germany, t-stat = 1.694, sig = 0.09). All dimensions of digital integration (DI_SPEC, DI_IFI, DI_AG and DI_ISN) show similar results. Tables 43 and 44 present the results of MMR for digital integration for the two models (Hofstede's scores and dummy variables for countries).

**Table 42. ANOVA for Cultural Items between countries.**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| CU_UAI (latent) | 0.2290 | 2 | 0.1145 | 0.2171 | 0.805 |
| CU_UAI1 | 0.6261 | 2 | 0.3131 | 0.6906 | 0.502 |
| CU_UAI2 | 0.7254 | 2 | 0.3627 | 0.4459 | 0.641 |

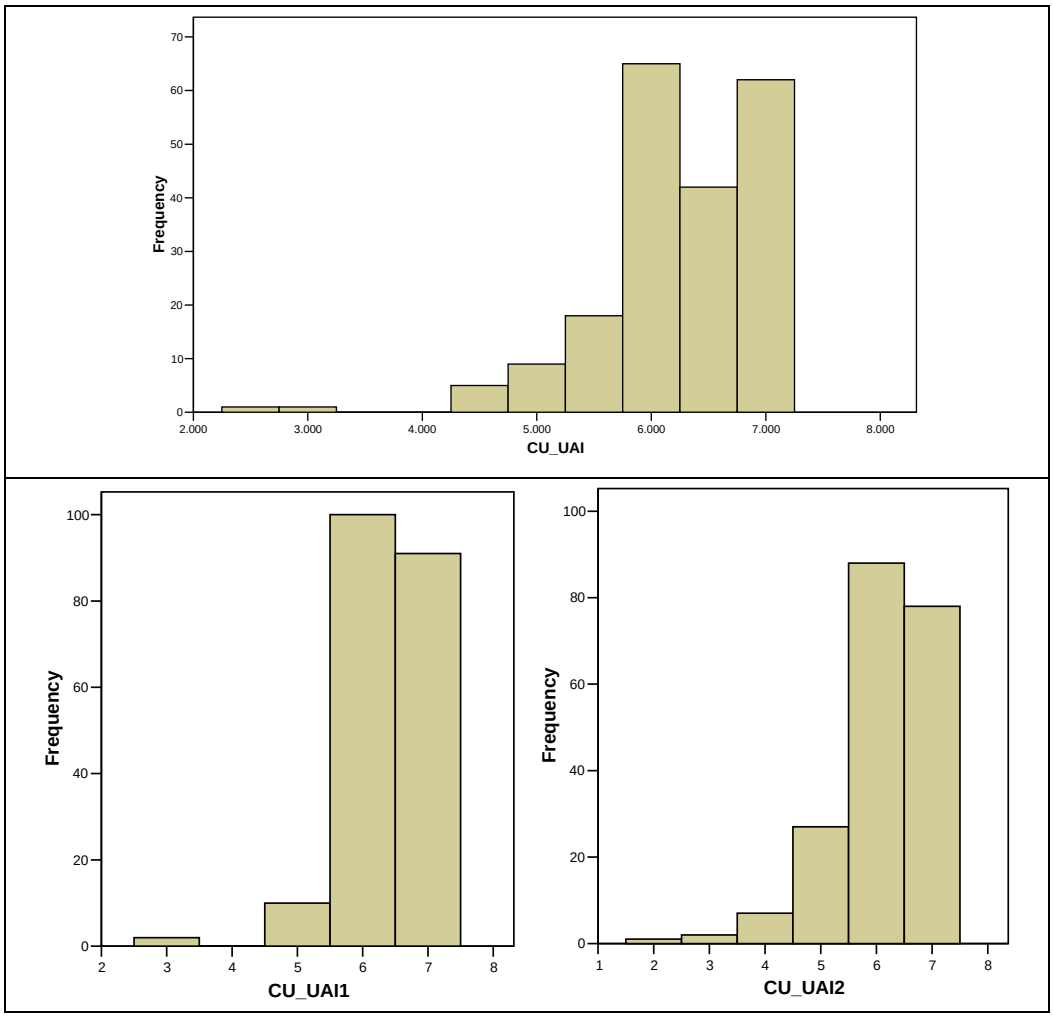


Figure 14. Distribution of Culture Scores and Items

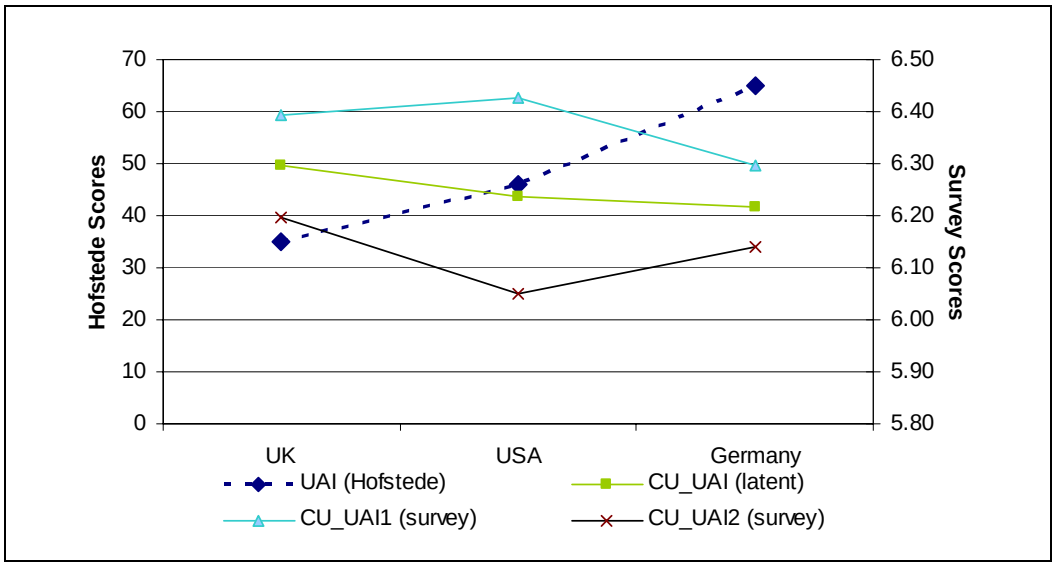


Figure 15. Means for UAI.

**Table 43. Regression results for post-hoc analysis of UAI with Hofstede's scores (CNW_UAI)**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.4087 | 0.0186 | 0.221 | (Constant) | | 9.262 | 0.000 | 0.000 |
| | | | | CON_SZC | -0.052 | -0.636 | 0.526 | 1.374 |
| | | | | CON_SZU | 0.234 | 3.005 | 0.003 | 1.269 |
| | | | | LOG_ACC | -0.069 | -0.946 | 0.345 | 1.103 |
| 2 | 8.7530 | 0.0000 | 0.538 | (Constant) | | 1.380 | 0.169 | 0.000 |
| | | | | CON_SZC | -0.002 | -0.025 | 0.980 | 1.395 |
| | | | | CON_SZU | 0.155 | 2.215 | 0.028 | 1.324 |
| | | | | LOG_ACC | -0.055 | -0.830 | 0.408 | 1.206 |
| | | | | UNC | 0.231 | 3.004 | 0.003 | 1.608 |
| | | | | COOR | 0.209 | 3.350 | 0.001 | 1.062 |
| | | | | OPPOR | -0.060 | -0.965 | 0.336 | 1.038 |
| | | | | IT_SOPH | 0.082 | 1.309 | 0.192 | 1.076 |
| | | | | PW_US | 0.247 | 3.338 | 0.001 | 1.488 |
| | | | | CNW_UAI | -0.005 | -0.077 | 0.939 | 1.037 |
| 3 | 7.0969 | 0.0000 | 0.556 | (Constant) | | 1.093 | 0.276 | 0.000 |
| | | | | CON_SZC | -0.007 | -0.095 | 0.925 | 1.397 |
| | | | | CON_SZU | 0.178 | 2.516 | 0.013 | 1.378 |
| | | | | LOG_ACC | -0.047 | -0.702 | 0.484 | 1.223 |
| | | | | UNC | 0.224 | 2.888 | 0.004 | 1.652 |
| | | | | COOR | 0.230 | 3.546 | 0.000 | 1.157 |
| | | | | OPPOR | -0.060 | -0.981 | 0.328 | 1.039 |
| | | | | IT_SOPH | 0.077 | 1.206 | 0.229 | 1.118 |
| | | | | PW_US | 0.239 | 3.163 | 0.002 | 1.571 |
| | | | | CNW_UAI | 0.000 | 0.005 | 0.996 | 1.066 |
| | | | | UNCxCOOR_std | 0.048 | 0.735 | 0.463 | 1.194 |
| | | | | UNCxOP_std | 0.102 | 1.570 | 0.118 | 1.169 |
| | | | | PWxSPH_std | 0.056 | 0.838 | 0.403 | 1.216 |

**Table 44. Regression results for post-hoc analysis of UAI with dummy variables for countries**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.4087 | 0.0186 | 0.221 | (Constant) | | 9.262 | 0.000 | 0.000 |
| | | | | CON_SZC | -0.052 | -0.636 | 0.526 | 1.374 |
| | | | | CON_SZU | 0.234 | 3.005 | 0.003 | 1.269 |
| | | | | LOG_ACC | -0.069 | -0.946 | 0.345 | 1.103 |
| 2 | 8.4359 | 0.0000 | 0.552 | (Constant) | | 1.315 | 0.190 | 0.000 |
| | | | | CON_SZC | 0.002 | 0.028 | 0.978 | 1.394 |
| | | | | CON_SZU | 0.131 | 1.873 | 0.063 | 1.359 |
| | | | | LOG_ACC | 0.036 | 0.401 | 0.689 | 2.184 |
| | | | | UNC | 0.223 | 2.882 | 0.004 | 1.652 |
| | | | | COOR | 0.222 | 3.564 | 0.000 | 1.074 |
| | | | | OPPOR | -0.044 | -0.706 | 0.481 | 1.057 |
| | | | | IT_SOPH | 0.068 | 1.092 | 0.276 | 1.086 |
| | | | | PW_US | 0.224 | 2.996 | 0.003 | 1.545 |
| | | | | DUMMY_USA | 0.070 | 0.791 | 0.430 | 2.182 |
| | | | | DUMMY_GE | -0.116 | -1.586 | 0.114 | 1.473 |
| 0 | 7.0185 | 0.0000 | 0.571 | (Constant) | | 1.084 | 0.280 | 0.000 |
| | | | | CON_SZC | -0.002 | -0.032 | 0.975 | 1.397 |
| | | | | CON_SZU | 0.154 | 2.165 | 0.032 | 1.416 |
| | | | | LOG_ACC | 0.040 | 0.452 | 0.652 | 2.199 |
| | | | | UNC | 0.217 | 2.790 | 0.006 | 1.690 |
| | | | | COOR | 0.246 | 3.799 | 0.000 | 1.174 |
| | | | | OPPOR | -0.043 | -0.707 | 0.481 | 1.057 |
| | | | | IT_SOPH | 0.060 | 0.945 | 0.346 | 1.139 |
| | | | | PW_US | 0.214 | 2.816 | 0.005 | 1.623 |
| | | | | DUMMY_USA | 0.063 | 0.712 | 0.477 | 2.188 |
| | | | | DUMMY_GE | -0.124 | -1.694 | 0.092 | 1.498 |
| | | | | UNCxCOOR_std | 0.053 | 0.818 | 0.414 | 1.188 |
| | | | | UNCxOP_std | 0.094 | 1.454 | 0.148 | 1.173 |

### 6.2.3 Political Embeddedness (Power)

Political embeddedness refers to the effect of power structures on digital integration. We conceptualized power as consisting of two main factors: stimuli and ability to influence (power *per se*). IT sophistication is a proxy for the stimulus to integrate digitally. We tested three hypotheses: H3a and H3c represent the direct effects of stimuli and power. H1b posits an interaction effect between stimuli and power.

#### 6.2.3.1 Direct effects

H3a posits that *IT sophistication* directly impacts *digital integration*. H3a is not supported at any level. This is the most surprising result. Not only because it makes sense intuitively, but also because a similar effect has been confirmed in previous research.

H3c posits that the *ability to influence the customer's operations* directly impacts *digital integration*. H3c is supported at the aggregate level ($p<0.01$). At the individual dimension level, H3c is supported for all dimensions (DI_SPEC ($p<0.05$), DI_IFI ($p<0.05$), DI_AG ($p<0.1$), DI_ISN ($p<0.05$)).

#### 6.2.3.2 Moderation effects

H3c posits that the relationship between *IT sophistication* and *digital integration* is moderated by *power*. This hypothesis is not supported at any level (except one spurious result for DI_ISN in regression analysis only). MMR confirms these results. In line with the null effect of IT sophistication, the lack of interaction effect is also surprising. This result suggests that power has an effect on digital integration regardless

of the degree of IT sophistication, while IT sophistication does not seem to have any (direct nor moderated) effect on digital integration.

### 6.2.4 Control Variables

Technological Culturation is significant for DI (on the controls-only model) and for DI_IFI. Interestingly, in both cases TC presents a negative sign, which is opposite to prediction. Company size is significant for DI ($p<0.1$) and DI_IFI ($p<0.05$).

### 6.2.5 Power Analysis

*Post hoc* power analyses are used to test whether we can reject an unsupported null hypothesis. In other words, is there an effect that we cannot see (Type II error) or because it is not there? Statistical power is related to the Type II error rate by the equation:

$$P = 1 - \beta$$

That is, the greater the power, the lower the probability of committing a Type II error. Power answers the question: assuming that there is in fact an effect, what is the probability of not finding it? With high power, we assume that if there was an effect, we should have found it. A *power* equal or greater than 0.8 is the accepted standard. In order to test for the lack of an effect in these hypotheses, we must first remove all confirmed (or supported) effects. We then re-run the models (using MMR). We then input the results into a statistical power calculator (Soper, D.S., 2008). The results are presented in Table 45. All models are non-significant ($p>0.5$) ; two of the models, however, do not meet the standards for power ($p>.80$).

**Table 45. Summary of results from power analyses**

| | Predict. | Sample Size | R2 | Sig. | Power | Predictors |
|---|---|---|---|---|---|---|
| DI | 9 | 203 | 0.067 | 0.325 | 0.955 | Const., DEM_TC, CON_SZC, CU_UAI, OPPOR, IT_SOPH, UNCxCOOR, UNCxOP, PWxSPH |
| DI_SPEC | 9 | 203 | 0.035 | 0.484 | 0.885 | Const., DEM_TC, CON_SZC, CU_UAI, OPPOR, UNC, IT_SOPH, UNCxCOOR, PWxSPH. |
| DI_IFI | 8 | 203 | 0.050 | 0.149 | 0.792 | Const., CON_SZC, CU_UAI, OPPOR, IT_SOPH, UNCxOP, UNCxCOOR, PWxSPH |
| DI_AG | 9 | 203 | 0.068 | 0.063 | 0.785 | Const., DEM_TC, CON_SZU, CON_SZC, OPPOR, CU_UAI, IT_SOPH, UNCxCOOR, PWxSPH |
| DI_ISN | 9 | 203 | 0.051 | 0.206 | 0.835 | Const, DEM_TC, CON_SZU, CON_SZC, OPPOR, CU_UAI, COOR, IT_SOPH, UNCxOP |

1) We used Daniel Soper Post-hoc Statistical Power Calculator for Multiple Regression for the calculation of power (http://www.danielsoper.com/statcalc/calc09.aspx).
2) Predictors: Constant, CON_SZC, DEM_TC, IT_SOPH, OPPOR, CU_UAI, UNCxOP, UNCxCOOR, PWxSPH. Where any of these predictors was significant in a regression model, it was removed from the respective model here (e.g., DEM_TC was removed from DI_IFI power calculation)
3) We excluded UNC, COOR, and PW_US from most models because these constructs were significant and on their own provide power upwards of .99 (UNC is included in the calculation of power for DI_SPEC, while COOR is included in the calculation of power for DI_ISN)
4) As indicated by the significance, no model that includes unsupported hypotheses is significant.

# Chapter 7 Conclusions and Limitations

## *7.1 Conclusions*

In this study we examined how the environment influences the degree of digital integration between supplier and customer. More specifically, we looked at the impact of cognitive factors (market uncertainty, coordination needs and opportunism risks), cultural factors (uncertainty avoidance), and political factors (ability to influence and stimuli) on the adoption of inter-organizational informational mechanisms. We further delved into the structure of digital integration. We conceptualized it in terms of four distinct dimensions: relation-specific assets, information flows integration, agency mechanisms (monitoring), and information sharing norms.

Our results show that *uncertainty*, *coordination*, and *the ability to influence the customer* have the most influence on digital integration, while *uncertainty avoidance (culture)* seems to have the least effect (Figure 16). None of the interaction effects were supported by the data (except some spurious results which deserve further analysis). Also, we found different effects on different DI factors.

For example, our results suggest that in conditions of high market uncertainty, organizations seek to establish tighter governance mechanisms (both formal and informal), while uncertainty seems to have no effect on investment in relationship-specific informational assets. We could speculate that in conditions of high market uncertainty, relationship-specific assets are risky investments, and organizations focus on governance mechanisms instead.

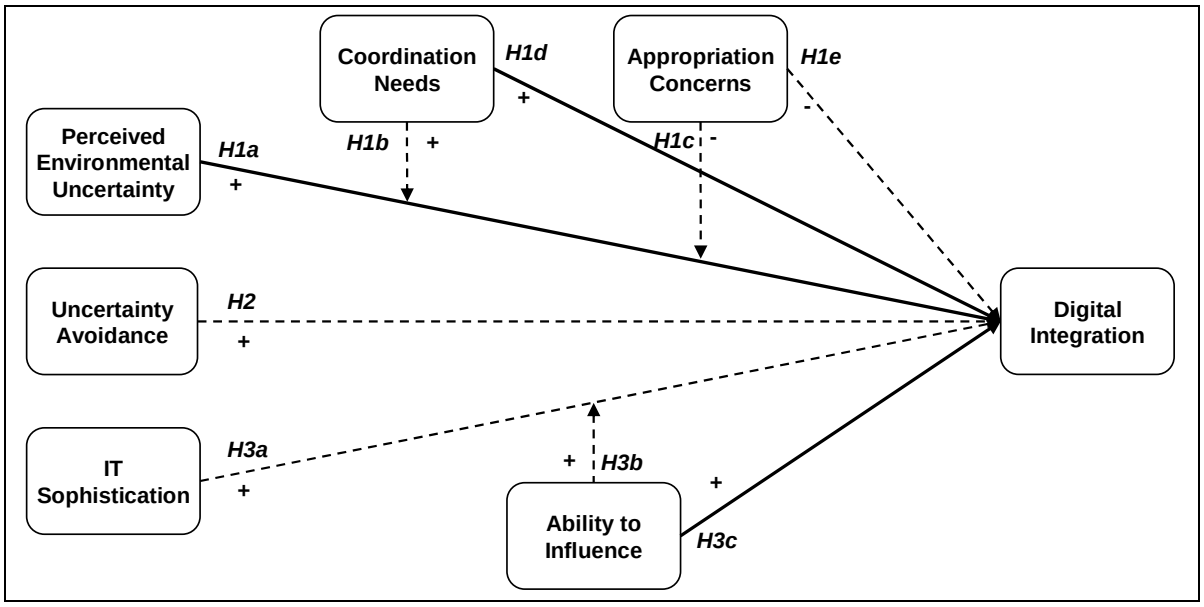


Figure 16. Summary of results

Similarly, coordination needs seems to affect the existence of relation-specific informational assets, information flows integration and monitoring mechanisms, but not information sharing norms. One possible explanation for the latter might be that high levels of coordination change the nature of "extraordinary" information. Information sharing norms refers to the expectation of sharing information that is not normally shared in the relationship. In conditions of high coordination (tighter relationships), only the most strategic information might be considered extraordinary, and therefore not shared.

A surprising result was that DI was affected by power but not by IT Sophistication. Two factors might lie behind this result: the prevalence of information technologies and the international context of our study. Given these two factors, one might speculate that a good deal of the relationship is already electronically mediated. As such, IT sophistication loses its role as a stimulus, and the ability to influence the customer is enough to implement DI mechanisms.

### 7.1.1 Contributions for Theory

The proposed study offers contributions to both theory and practice. For theory, the study clarifies the concept of electronic integration. Studies on integration in general and electronic integration in particular adopt a loose definition of integration. They all agree in that integration is the opposite of markets, but they define this opposite in different terms: relationship contracting, long-term contracting, coordination, etc. We, in turn, define it further in terms of four components: informational relation-specific assets, information flows integration, informational agency mechanisms and information sharing norms. Two of these represent governance mechanisms, while the other two are process oriented (assets and flows).

Additionally, we investigate some of its environmental predictors. We found that market uncertainty, coordination needs and power have significant effects on the extent of digital integration. Furthermore, these predictors have somewhat different effects on the different components of digital integration.

Finally, the study also responds to Wathne and Heide's (2004) call for a more comprehensive study of governance mechanisms in B2B, with emphasis on monitoring mechanisms.

### 7.1.2 Contributions for Practice

For practice, the study offers a better understanding of the factors that enable or inhibit information-based B2B relationships. In particular, the study shows that suppliers

are more likely to digitally integrate with those customers over whom they have power and in conditions of high uncertainty.

## *7.2 Limitations of the Study*

This study presents limitations that are inherent to the context as well as the methodology. Contextually, the study has three limitations: it is based on one side of the relationship (supplier), the study is conducted in three western countries, and the participants are sourced from an existing panel with the stratification issues that arise from that. Methodologically, the study has two limitations: all constructs are measured at once in the same instrument and the sample size.

First, while some methodologists recommend having matching information from both sides of the relationship, we only had access to one side in our study. This affects both the measurement of digital integration as a relationship-level construct as well as the generalizability of the study to the purchaser side. While this approach is consistent with the vast majority of the literature in this area, it is still a limitation.

Second, the fact that the study was conducted in only three western countries is both an advantage and a disadvantage of the study. It is an advantage because it maximizes the variance in the selected cultural attribute while it minimizes the variance in all others. At the same time, it is a disadvantage because the results are not generalizable to cultures that are significantly different from the west (i.e., Southern and Eastern Asia).

Third, the participants in the study all come from a single panel. While the panel spans several industries and has a variety of firm sizes represented, there is a certain degree of self-selection in the makeup of the panel. Additionally, because the data was gathered over a 2-week span, there is no way to test for non-response bias. These characteristics present external validity challenges.

Methodologically, the first limitation relates to the instrument. The study presents the potential for *mono-method bias* (Cook and Campbell 1979) because all measures are included in the same instrument and gathered at the same time. It is possible that the answers to some questions might affect the answers to others, not because of the underlying theoretical relations, but rather because of psychological reasons. This is known as common methods bias, of course.

The second (and final) methodological limitation is the sample size. While the number of respondents is well above the recommended minimums for PLS to show significant results, they are not large enough to reject the unsupported hypotheses. In our case, the minimum recommended sample size is 140 (10 x 14). Fourteen is the number of predictors (between main, moderated and control effects) going into digital integration. This number yields a ratio of 1.4 observations per path. A recent study by Goodhue *et al.* (2006) shows that PLS may not have more power than other statistical techniques.

## *7.3 Future Research*

This study leaves as many open questions as it provides answers. This research did give a first look into many of the issues explored and there are many venues of future exploration. The first would be to refine the definition of digital integration. Possible areas of refinement include: finding better indicators, as some of those developed in this study suffered from discriminant validity issues. Also a better definition of the process/coordination components would be helpful.

A second venue of research could be to run a comparison between "domestic" and "international" B2B relationships. We would expect to achieve stronger effects and maybe find significance in some of the unsupported hypotheses.

A third venue of research might focus on furthering our understanding of individual types of environmental effects. For example, of the cognitive factors, future studies might re-analyze the nature and role of opportunism risks and information sharing. Alternatively, future research may also focus on a search for the nature of the stimuli to adopt digital integration mechanisms.

# Appendix A: Detailed Coefficients for PLS Analysis

**Table 46. Detailed results for DI**

| Model | R2 | Predictor | Sample Loadings | Bootstrap Mean Loadings | Standard Error | t-statistic |
|---|---|---|---|---|---|---|
| 1 | 0.155 | DEM_TC | -0.329 | -0.327 | 0.193 | 1.702 |
| | | SZ_CU | 0.036 | 0.020 | 0.177 | 0.203 |
| | | SZ_US | 0.226 | 0.237 | 0.125 | 1.799 |
| 2 | 0.459 | DEM_TC | -0.122 | -0.118 | 0.086 | 1.418 |
| | | SZ_CU | 0.061 | 0.040 | 0.092 | 0.661 |
| | | SZ_US | 0.101 | 0.108 | 0.062 | 1.620 |
| | | UNC | 0.231 | 0.228 | 0.116 | 1.982 |
| | | COOR | 0.296 | 0.305 | 0.079 | 3.725 |
| | | OPPOR | 0.152 | -0.044 | 0.185 | 0.824 |
| | | UAI | -0.018 | 0.002 | 0.065 | 0.270 |
| | | ITsoph | 0.036 | 0.055 | 0.071 | 0.510 |
| | | PWR_US | 0.267 | 0.265 | 0.115 | 2.315 |
| 3 | 0.473 | DEM_TC | -0.098 | -0.070 | 0.104 | 0.950 |
| | | SZ_CU | 0.085 | 0.046 | 0.102 | 0.831 |
| | | SZ_US | 0.096 | 0.085 | 0.064 | 1.509 |
| | | UNC | 0.236 | 0.201 | 0.112 | 2.099 |
| | | COOR | 0.321 | 0.294 | 0.094 | 3.402 |
| | | OPPOR | 0.158 | -0.022 | 0.179 | 0.883 |
| | | UAI | -0.030 | 0.003 | 0.070 | 0.431 |
| | | ITsoph | 0.037 | 0.060 | 0.073 | 0.507 |
| | | PWR_US | 0.244 | 0.237 | 0.118 | 2.065 |
| | | UNC * COOR | 0.067 | -0.018 | 0.146 | 0.461 |
| | | UNC * OPPOR | 0.030 | 0.080 | 0.106 | 0.286 |
| | | ITsoph * PWR_US | 0.094 | 0.105 | 0.125 | 0.752 |

For N=203, t > 1.29 is significant at 0.10 (one tailed)
For N=203, t > 1.65 is significant at 0.05 (one tailed)
For N=203, t > 2.35 is significant at 0.01 (one tailed)

**Table 47. Detailed results for DI_SPEC**

| Model | R2 | Predictor | Sample Loadings | Bootstrap Mean Loadings | Standard Error | t-statistic |
|---|---|---|---|---|---|---|
| 1 | 0.038 | DEM_TC | 0.171 | 0.115 | 0.150 | 1.136 |
| | | SZ_CU | -0.060 | -0.085 | 0.152 | 0.392 |
| | | SZ_US | -0.070 | -0.023 | 0.117 | 0.598 |
| 2 | 0.170 | DEM_TC | 0.047 | 0.044 | 0.103 | 0.455 |
| | | SZ_CU | -0.149 | -0.097 | 0.124 | 1.205 |
| | | SZ_US | 0.032 | 0.001 | 0.093 | 0.346 |
| | | UNC | 0.111 | -0.018 | 0.121 | 0.917 |
| | | COOR | 0.250 | 0.239 | 0.077 | 3.269 |
| | | OPPOR | -0.079 | -0.093 | 0.127 | 0.618 |
| | | UAI | 0.050 | -0.004 | 0.103 | 0.483 |
| | | ITsoph | -0.098 | -0.054 | 0.130 | 0.752 |
| | | PWR_US | 0.225 | 0.187 | 0.109 | 2.070 |
| 3 | 0.201 | DEM_TC | 0.086 | 0.063 | 0.101 | 0.845 |
| | | SZ_CU | -0.090 | -0.057 | 0.115 | 0.785 |
| | | SZ_US | 0.020 | 0.007 | 0.095 | 0.207 |
| | | UNC | -0.097 | -0.028 | 0.123 | 0.795 |
| | | COOR | 0.217 | 0.182 | 0.096 | 2.262 |
| | | OPPOR | -0.086 | -0.073 | 0.127 | 0.676 |
| | | UAI | 0.015 | -0.019 | 0.090 | 0.161 |
| | | ITsoph | -0.081 | -0.041 | 0.116 | 0.696 |
| | | PWR_US | 0.184 | 0.152 | 0.094 | 1.954 |
| | | UNC * COOR | -0.073 | -0.101 | 0.084 | 0.870 |
| | | UNC * OPPOR | 0.144 | 0.179 | 0.091 | 1.581 |
| | | ITsoph * PWR_US | 0.121 | 0.109 | 0.113 | 1.068 |

For N=203, t > 1.29 is significant at 0.10 (one tailed)
For N=203, t > 1.65 is significant at 0.05 (one tailed)
For N=203, t > 2.35 is significant at 0.01 (one tailed)

**Table 48. Detailed results for DI_IFI**

| Model | R2 | Predictor | Sample Loadings | Bootstrap Mean Loadings | Standard Error | t-statistic |
|---|---|---|---|---|---|---|
| 1 | 0.094 | DEM_TC | -0.152 | -0.163 | 0.079 | 1.939 |
| | | SZ_CU | 0.015 | 0.030 | 0.099 | 0.152 |
| | | SZ_US | 0.269 | 0.269 | 0.073 | 3.702 |
| 2 | 0.338 | DEM_TC | -0.174 | -0.162 | 0.074 | 2.341 |
| | | SZ_CU | 0.090 | 0.088 | 0.070 | 1.287 |
| | | SZ_US | 0.134 | 0.139 | 0.056 | 2.405 |
| | | UNC | 0.129 | 0.114 | 0.086 | 1.499 |
| | | COOR | 0.286 | 0.291 | 0.073 | 3.918 |
| | | OPPOR | -0.160 | -0.123 | 0.152 | 1.053 |
| | | UAI | 0.012 | 0.013 | 0.065 | 0.188 |
| | | ITsoph | 0.044 | 0.073 | 0.071 | 0.619 |
| | | PWR_US | 0.209 | 0.213 | 0.094 | 2.218 |
| 3 | 0.351 | DEM_TC | -0.155 | -0.132 | 0.073 | 2.139 |
| | | SZ_CU | 0.103 | 0.101 | 0.071 | 1.446 |
| | | SZ_US | 0.129 | 0.125 | 0.058 | 2.242 |
| | | UNC | 0.129 | 0.111 | 0.078 | 1.661 |
| | | COOR | 0.300 | 0.293 | 0.071 | 4.235 |
| | | OPPOR | -0.134 | -0.090 | 0.156 | 0.857 |
| | | UAI | 0.000 | 0.014 | 0.062 | 0.004 |
| | | ITsoph | 0.046 | 0.063 | 0.077 | 0.596 |
| | | PWR_US | 0.191 | 0.191 | 0.091 | 2.104 |
| | | UNC * COOR | 0.033 | -0.002 | 0.082 | 0.403 |
| | | UNC * OPPOR | 0.048 | 0.069 | 0.084 | 0.573 |
| | | ITsoph * PWR_US | 0.103 | 0.069 | 0.117 | 0.878 |

For N=203, t > 1.29 is significant at 0.10 (one tailed)
For N=203, t > 1.65 is significant at 0.05 (one tailed)
For N=203, t > 2.35 is significant at 0.01 (one tailed)

**Table 49. Detailed results for DI_AG**

| Model | R2 | Predictor | Sample Loadings | Bootstrap Mean Loadings | Standard Error | t-statistic |
|---|---|---|---|---|---|---|
| 1 | 0.043 | DEM_TC | 0.189 | -0.035 | 0.202 | 0.935 |
| | | SZ_CU | 0.050 | -0.002 | 0.146 | 0.343 |
| | | SZ_US | 0.015 | 0.141 | 0.119 | 0.124 |
| 2 | 0.295 | DEM_TC | -0.016 | -0.013 | 0.086 | 0.190 |
| | | SZ_CU | 0.068 | 0.036 | 0.116 | 0.587 |
| | | SZ_US | 0.041 | 0.055 | 0.080 | 0.514 |
| | | UNC | 0.180 | 0.153 | 0.123 | 1.468 |
| | | COOR | 0.255 | 0.251 | 0.099 | 2.574 |
| | | OPPOR | 0.121 | -0.010 | 0.157 | 0.774 |
| | | UAI | 0.031 | 0.045 | 0.062 | 0.497 |
| | | ITsoph | 0.065 | 0.094 | 0.093 | 0.702 |
| | | PWR_US | 0.216 | 0.228 | 0.105 | 2.056 |
| 3 | 0.333 | DEM_TC | 0.015 | 0.011 | 0.073 | 0.210 |
| | | SZ_CU | 0.095 | 0.048 | 0.117 | 0.807 |
| | | SZ_US | 0.031 | 0.044 | 0.073 | 0.430 |
| | | UNC | 0.208 | 0.146 | 0.134 | 1.550 |
| | | COOR | 0.274 | 0.244 | 0.082 | 3.329 |
| | | OPPOR | 0.116 | -0.017 | 0.141 | 0.823 |
| | | UAI | 0.026 | 0.046 | 0.061 | 0.426 |
| | | ITsoph | 0.051 | 0.085 | 0.090 | 0.565 |
| | | PWR_US | 0.168 | 0.187 | 0.106 | 1.581 |
| | | UNC * COOR | 0.044 | -0.027 | 0.104 | 0.428 |
| | | UNC * OPPOR | 0.131 | 0.165 | 0.101 | 1.304 |
| | | ITsoph * PWR_US | 0.142 | 0.064 | 0.175 | 0.808 |

For N=203, t > 1.29 is significant at 0.10 (one tailed)
For N=203, t > 1.65 is significant at 0.05 (one tailed)
For N=203, t > 2.35 is significant at 0.01 (one tailed)

**Table 50. Detailed results for DI_ISN**

| Model | R2 | Predictor | Sample Loadings | Bootstrap Mean Loadings | Standard Error | t-statistic |
|---|---|---|---|---|---|---|
| 1 | 0.085 | DEM_TC | -0.218 | -0.192 | 0.133 | 1.647 |
| | | SZ_CU | -0.084 | -0.054 | 0.134 | 0.629 |
| | | SZ_US | 0.192 | 0.208 | 0.098 | 1.954 |
| 2 | 0.312 | DEM_TC | -0.112 | -0.117 | 0.092 | 1.222 |
| | | SZ_CU | -0.052 | -0.020 | 0.096 | 0.545 |
| | | SZ_US | 0.084 | 0.080 | 0.070 | 1.188 |
| | | UNC | 0.161 | 0.152 | 0.093 | 1.730 |
| | | COOR | 0.263 | -0.021 | 0.275 | 0.957 |
| | | OPPOR | 0.138 | 0.128 | 0.161 | 0.857 |
| | | UAI | -0.030 | -0.004 | 0.071 | 0.425 |
| | | ITsoph | 0.066 | 0.078 | 0.071 | 0.934 |
| | | PWR_US | 0.219 | 0.215 | 0.096 | 2.286 |
| 3 | 0.349 | DEM_TC | -0.081 | -0.092 | 0.093 | 0.878 |
| | | SZ_CU | -0.042 | -0.004 | 0.085 | 0.490 |
| | | SZ_US | 0.091 | 0.064 | 0.078 | 1.177 |
| | | UNC | 0.180 | 0.152 | 0.093 | 1.934 |
| | | COOR | 0.240 | 0.023 | 0.235 | 1.020 |
| | | OPPOR | 0.143 | 0.129 | 0.160 | 0.898 |
| | | UAI | -0.023 | -0.006 | 0.068 | 0.337 |
| | | ITsoph | 0.065 | 0.077 | 0.078 | 0.832 |
| | | PWR_US | 0.213 | 0.196 | 0.104 | 2.054 |
| | | UNC * COOR | 0.147 | 0.106 | 0.155 | 0.947 |
| | | UNC * OPPOR | -0.137 | -0.017 | 0.118 | 1.166 |
| | | ITsoph * PWR_US | 0.104 | 0.083 | 0.127 | 0.817 |

For N=203, t > 1.29 is significant at 0.10 (one tailed)
For N=203, t > 1.65 is significant at 0.05 (one tailed)
For N=203, t > 2.35 is significant at 0.01 (one tailed)

# Appendix B: Detailed Coefficients for Regression Analysis

**Table 51. Detailed results for DI**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.7302 | 0.045 | 0.037 | (Constant) | | 10.854 | 0.000 | |
| | | | | CON_SZC | -0.010 | -0.128 | 0.898 | 1.328 |
| | | | | CON_SZU | 0.185 | 2.425 | 0.016 | 1.280 |
| | | | | DEM_TC | -0.083 | -1.208 | 0.229 | 1.046 |
| 2 | 9.1205 | 0.000 | 0.286 | (Constant) | | 1.155 | 0.249 | |
| | | | | CON_SZC | 0.030 | 0.433 | 0.666 | 1.357 |
| | | | | CON_SZU | 0.115 | 1.689 | 0.093 | 1.343 |
| | | | | DEM_TC | -0.065 | -1.037 | 0.301 | 1.118 |
| | | | | UNC | 0.253 | 3.380 | 0.001 | 1.603 |
| | | | | COOR | 0.207 | 3.404 | 0.001 | 1.063 |
| | | | | OPPOR | -0.035 | -0.586 | 0.559 | 1.044 |
| | | | | CU_UAI | 0.007 | 0.107 | 0.915 | 1.140 |
| | | | | IT_SOPH | 0.073 | 1.135 | 0.258 | 1.186 |
| | | | | PW_US | 0.237 | 3.267 | 0.001 | 1.516 |
| 3 | 7.2067 | 0.000 | 0.300 | (Constant) | | 1.207 | 0.229 | |
| | | | | CON_SZC | 0.024 | 0.351 | 0.726 | 1.361 |
| | | | | CON_SZU | 0.132 | 1.898 | 0.059 | 1.395 |
| | | | | DEM_TC | -0.052 | -0.827 | 0.409 | 1.136 |
| | | | | UNC | 0.246 | 3.232 | 0.001 | 1.666 |
| | | | | COOR | 0.224 | 3.536 | 0.001 | 1.155 |
| | | | | OPPOR | -0.039 | -0.649 | 0.517 | 1.046 |
| | | | | CU_UAI | -0.005 | -0.084 | 0.933 | 1.157 |
| | | | | IT_SOPH | 0.063 | 0.950 | 0.343 | 1.255 |
| | | | | PW_US | 0.227 | 3.060 | 0.003 | 1.592 |
| | | | | UNCxCOOR_std | 0.038 | 0.591 | 0.555 | 1.186 |
| | | | | UNCxOP_std | 0.083 | 1.279 | 0.202 | 1.217 |
| | | | | PWxSPH_std | 0.053 | 0.800 | 0.424 | 1.249 |

**Table 52. Detailed results for DI_SPEC**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.3927 | 0.758 | 0.006 | (Constant) | | 6.459 | 0.000 | |
| | | | | CON_SZC | -0.044 | -0.555 | 0.579 | 1.328 |
| | | | | CON_SZU | -0.030 | -0.384 | 0.702 | 1.280 |
| | | | | DEM_TC | 0.052 | 0.746 | 0.457 | 1.046 |
| 2 | 2.3342 | 0.016 | 0.093 | (Constant) | | 1.988 | 0.048 | |
| | | | | CON_SZC | -0.023 | -0.292 | 0.771 | 1.357 |
| | | | | CON_SZU | -0.018 | -0.233 | 0.816 | 1.343 |
| | | | | DEM_TC | 0.006 | 0.083 | 0.934 | 1.118 |
| | | | | UNC | -0.065 | -0.767 | 0.444 | 1.603 |
| | | | | COOR | 0.228 | 3.326 | 0.001 | 1.063 |
| | | | | OPPOR | -0.071 | -1.048 | 0.296 | 1.044 |
| | | | | CU_UAI | -0.092 | -1.302 | 0.194 | 1.140 |
| | | | | IT_SOPH | 0.021 | 0.283 | 0.777 | 1.186 |
| | | | | PW_US | 0.146 | 1.788 | 0.075 | 1.516 |
| 3 | 2.1837 | 0.014 | 0.115 | (Constant) | | 2.213 | 0.028 | |
| | | | | CON_SZC | -0.025 | -0.318 | 0.751 | 1.361 |
| | | | | CON_SZU | -0.009 | -0.110 | 0.913 | 1.395 |
| | | | | DEM_TC | 0.023 | 0.330 | 0.742 | 1.136 |
| | | | | UNC | -0.088 | -1.033 | 0.303 | 1.666 |
| | | | | COOR | 0.220 | 3.086 | 0.002 | 1.155 |
| | | | | OPPOR | -0.077 | -1.138 | 0.256 | 1.046 |
| | | | | CU_UAI | -0.097 | -1.364 | 0.174 | 1.157 |
| | | | | IT_SOPH | 0.002 | 0.024 | 0.981 | 1.255 |
| | | | | PW_US | 0.137 | 1.641 | 0.102 | 1.592 |
| | | | | UNCxCOOR_std | -0.050 | -0.696 | 0.487 | 1.186 |
| | | | | UNCxOP_std | 0.142 | 1.939 | 0.054 | 1.217 |
| | | | | PWxSPH_std | 0.027 | 0.371 | 0.711 | 1.249 |

**Table 53. Detailed results for DI_IFI**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 6.2030 | 0.000 | 0.081 | (Constant) | | 4.772 | 0.000 | |
| | | | | CON_SZC | 0.042 | 0.556 | 0.579 | 1.328 |
| | | | | CON_SZU | 0.231 | 3.094 | 0.002 | 1.280 |
| | | | | DEM_TC | -0.161 | -2.388 | 0.018 | 1.046 |
| 2 | 7.6698 | 0.000 | 0.252 | (Constant) | | -0.989 | 0.324 | |
| | | | | CON_SZC | 0.077 | 1.096 | 0.275 | 1.357 |
| | | | | CON_SZU | 0.166 | 2.371 | 0.019 | 1.343 |
| | | | | DEM_TC | -0.140 | -2.184 | 0.030 | 1.118 |
| | | | | UNC | 0.239 | 3.122 | 0.002 | 1.603 |
| | | | | COOR | 0.174 | 2.801 | 0.006 | 1.063 |
| | | | | OPPOR | -0.059 | -0.951 | 0.343 | 1.044 |
| | | | | CU_UAI | 0.029 | 0.456 | 0.649 | 1.140 |
| | | | | IT_SOPH | 0.048 | 0.733 | 0.464 | 1.186 |
| | | | | PW_US | 0.168 | 2.265 | 0.025 | 1.516 |
| 3 | 5.7290 | 0.000 | 0.254 | (Constant) | | -0.962 | 0.337 | |
| | | | | CON_SZC | 0.075 | 1.057 | 0.292 | 1.361 |
| | | | | CON_SZU | 0.174 | 2.429 | 0.016 | 1.395 |
| | | | | DEM_TC | -0.134 | -2.070 | 0.040 | 1.136 |
| | | | | UNC | 0.234 | 2.985 | 0.003 | 1.666 |
| | | | | COOR | 0.182 | 2.780 | 0.006 | 1.155 |
| | | | | OPPOR | -0.060 | -0.963 | 0.337 | 1.046 |
| | | | | CU_UAI | 0.025 | 0.386 | 0.700 | 1.157 |
| | | | | IT_SOPH | 0.048 | 0.704 | 0.482 | 1.255 |
| | | | | PW_US | 0.169 | 2.198 | 0.029 | 1.592 |
| | | | | UNCxCOOR_std | 0.022 | 0.326 | 0.744 | 1.186 |
| | | | | UNCxOP_std | 0.037 | 0.555 | 0.580 | 1.217 |
| | | | | PWxSPH_std | 0.005 | 0.073 | 0.942 | 1.249 |

**Table 54. Detailed results for DI_AG**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.0043 | 0.114 | 0.028 | (Constant) | | 8.887 | 0.000 | |
| | | | | CON_SZC | -0.005 | -0.058 | 0.954 | 1.328 |
| | | | | CON_SZU | 0.167 | 2.179 | 0.030 | 1.280 |
| | | | | DEM_TC | -0.037 | -0.538 | 0.591 | 1.046 |
| 2 | 7.6286 | 0.000 | 0.251 | (Constant) | | -0.284 | 0.777 | |
| | | | | CON_SZC | 0.028 | 0.396 | 0.693 | 1.357 |
| | | | | CON_SZU | 0.088 | 1.251 | 0.212 | 1.343 |
| | | | | DEM_TC | -0.013 | -0.196 | 0.845 | 1.118 |
| | | | | UNC | 0.262 | 3.418 | 0.001 | 1.603 |
| | | | | COOR | 0.186 | 2.980 | 0.003 | 1.063 |
| | | | | OPPOR | -0.023 | -0.375 | 0.708 | 1.044 |
| | | | | CU_UAI | 0.061 | 0.939 | 0.349 | 1.140 |
| | | | | IT_SOPH | 0.103 | 1.558 | 0.121 | 1.186 |
| | | | | PW_US | 0.186 | 2.493 | 0.013 | 1.516 |
| 3 | 6.0748 | 0.000 | 0.265 | (Constant) | | -0.285 | 0.776 | |
| | | | | CON_SZC | 0.023 | 0.329 | 0.743 | 1.361 |
| | | | | CON_SZU | 0.108 | 1.518 | 0.131 | 1.395 |
| | | | | DEM_TC | 0.003 | 0.047 | 0.963 | 1.136 |
| | | | | UNC | 0.244 | 3.141 | 0.002 | 1.666 |
| | | | | COOR | 0.198 | 3.048 | 0.003 | 1.155 |
| | | | | OPPOR | -0.027 | -0.434 | 0.665 | 1.046 |
| | | | | CU_UAI | 0.052 | 0.798 | 0.426 | 1.157 |
| | | | | IT_SOPH | 0.100 | 1.477 | 0.141 | 1.255 |
| | | | | PW_US | 0.186 | 2.450 | 0.015 | 1.592 |
| | | | | UNCxCOOR_std | 0.033 | 0.506 | 0.613 | 1.186 |
| | | | | UNCxOP_std | 0.114 | 1.720 | 0.087 | 1.217 |
| | | | | PWxSPH_std | 0.005 | 0.069 | 0.945 | 1.249 |

**Table 55. Detailed results for DI_ISN**

| Model | F | Sig. | $R^2$ | Predictor | Std. β | t | Sig. | VIF |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.4320 | 0.234 | 0.020 | (Constant) | | 10.471 | 0.000 | |
| | | | | CON_SZC | -0.030 | -0.380 | 0.705 | 1.328 |
| | | | | CON_SZU | 0.135 | 1.754 | 0.081 | 1.280 |
| | | | | DEM_TC | -0.073 | -1.046 | 0.297 | 1.046 |
| 2 | 5.1397 | 0.000 | 0.184 | (Constant) | | 2.436 | 0.016 | |
| | | | | CON_SZC | -0.012 | -0.161 | 0.872 | 1.357 |
| | | | | CON_SZU | 0.071 | 0.977 | 0.329 | 1.343 |
| | | | | DEM_TC | -0.011 | -0.160 | 0.873 | 1.118 |
| | | | | UNC | 0.283 | 3.540 | 0.000 | 1.603 |
| | | | | COOR | -0.063 | -0.961 | 0.338 | 1.063 |
| | | | | OPPOR | 0.082 | 1.273 | 0.204 | 1.044 |
| | | | | CU_UAI | 0.032 | 0.477 | 0.634 | 1.140 |
| | | | | IT_SOPH | 0.031 | 0.453 | 0.651 | 1.186 |
| | | | | PW_US | 0.147 | 1.891 | 0.060 | 1.516 |
| 3 | 4.5184 | 0.000 | 0.212 | (Constant) | | 2.292 | 0.023 | |
| | | | | CON_SZC | -0.019 | -0.267 | 0.790 | 1.361 |
| | | | | CON_SZU | 0.079 | 1.071 | 0.286 | 1.395 |
| | | | | DEM_TC | -0.016 | -0.234 | 0.815 | 1.136 |
| | | | | UNC | 0.315 | 3.912 | 0.000 | 1.666 |
| | | | | COOR | -0.021 | -0.313 | 0.754 | 1.155 |
| | | | | OPPOR | 0.083 | 1.296 | 0.196 | 1.046 |
| | | | | CU_UAI | 0.015 | 0.216 | 0.829 | 1.157 |
| | | | | IT_SOPH | 0.025 | 0.359 | 0.720 | 1.255 |
| | | | | PW_US | 0.125 | 1.587 | 0.114 | 1.592 |
| | | | | UNCxCOOR_std | 0.120 | 1.759 | 0.080 | 1.186 |
| | | | | UNCxOP_std | -0.087 | -1.261 | 0.209 | 1.217 |
| | | | | PWxSPH_std | 0.123 | 1.767 | 0.079 | 1.249 |

# Appendix C: Survey Instrument (U.S.A.)

## *Notes*

General

- Numbers in parentheses represent question number or coding scores and are not shown to subjects.
- Question categories (e.g., cqS1) are shown. Titles next to categories aren't.
- Questions not pertinent to the present study are not shown.

Screening question 1 (cqS1)

- Items are randomized.
- Only those respondents who select "Sales/Business Development" move on to the next question and survey.

Screening question 1 (cqS1)

- Only those respondents who select items 2, 3, 4 or 5 move on to the next question and survey.

Consent form (agreement)

- Only those respondents who select "I agree" move on to the next question and survey.

## *Screening questions*

### cqS1

What best describes your current functional role at work?

❍ Accounting / Finance (1)
❍ Administration (2)
❍ Communications / PR (3)
❍ Customer Service (4)
❍ Design / Engineering (5)
❍ Human Resources (6)
❍ Information Technology (7)
❍ Marketing / Advertising (8)
❍ Operations / Production (9)
❍ Research and Development (10)
❍ Sales / Business Development (11)
❍ Other (12)

### cqS2

Which of the following functions do you perform?

❍ Sell products and/or services to Domestic clients ONLY (1)
❍ Sell products and/or services to International clients ONLY (2)
❍ Sell products and/or services to Domestic AND International clients (but mostly Domestic clients) (3)
❍ Sell products and/or services to Domestic AND International clients (but mostly International clients) (4)
❍ Sell products and/or services to a fairly even mix of Domestic AND International clients (5)
❍ I do not sell products and/or services – I am responsible for another aspect of business development within my company (6)

## *Agreement – Consent Form*

**cqS3**

### Digital integration: an international study

**Introduction:**

The goal of this study is to understand what factors impact information sharing between companies and across borders.

**Risks and Benefits:**

The following survey is similar to other e-Rewards surveys. The risks and benefits that would result from completing the survey are comparable to those. There is no risk in participating in this study. There will not be any direct benefits for you other than the e-Reward dollars.

You can choose not to answer any question. If you choose to withdraw from the study, we will not use any data we have collected from you to that point. Compensation will be based on the completion of the survey as per the Membership Agreement.

The study will hopefully lead to improvements in inter-organizational processes. It should also help organizations to better assess their inter-organizational systems and procedures.

**Voluntary Participation and Withdrawal:**

Participation in research is voluntary. You have the right to refuse to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or discontinue participation at any time. Any data collected to that point will not be used.

**Confidentiality:**

As per e-Rewards policy, your name will not be shared with the requestor of the survey. Your name will not be associated to your responses. The findings of this study will be summarized and reported in group form.

**Consent:**

If you agree to the terms indicated above, please click "I agree". Otherwise, click I disagree.

❍ I agree (1)
❍ I disagree (2)

## *Non-relationship Questions*

### cq1

Answer the questions that relate to your company from your firm's perspective rather than your own. Please note that you don't have to provide your company's name. Please indicate your level of agreement with each of the following:

| | Strongly agree (1) | Agree (2) | Slightly agree (3) | Neither agree nor disagree (4) | Slightly disagree (5) | Disagree (6) | Strongly disagree (7) |
|---|---|---|---|---|---|---|---|
| Rules and regulations are important because they inform workers what the organization expects of them. (1) | □ | □ | □ | □ | □ | □ | □ |
| Order and structure are very important in a work environment. (2) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the reduction of personnel in our organization. (12) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the reduction of operational costs in our organization. (13) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the improvement of productivity in our organization. (14) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the improvement of access to information in our organization. (15) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the improvement of the quality of decision making in our organization. (16) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the improvement of competitiveness in our organization. (17) | □ | □ | □ | □ | □ | □ | □ |
| Information technology is important for the improvement of service to customers in our organization. (18) | □ | □ | □ | □ | □ | □ | □ |

**cq2**

Please indicate what best represents your situation:

| | Very Negative (1) | (2) | (3) | (4) | (5) | (6) | Very Positive (7) |
|---|---|---|---|---|---|---|---|
| Please rate the attitude of your top management toward the deployment of information technology in your organization. (19) | □ | □ | □ | □ | □ | □ | □ |

## *Relationship-related Questions*

**cq3**

For the following questions: Please select your most critical foreign customer and answer questions using it as a reference point. A foreign customer is an organization from another country that provides your company with a good or service. Answer the questions that relate to your company from the firm's perspective rather than your own. Please note that you don't have to provide your company's name. Please indicate your level of agreement with each of the following:

| | Strongly agree (1) | Agree (2) | Slightly agree (3) | Neither agree nor disagree (4) | Slightly disagree (5) | Disagree (6) | Strongly disagree (7) |
|---|---|---|---|---|---|---|---|
| Nearly all delivery schedules are shared electronically with our foreign customer. (23) | □ | □ | □ | □ | □ | □ | □ |
| Nearly all performance metrics are shared electronically with our foreign customer. (24) | □ | □ | □ | □ | □ | □ | □ |
| Inventory and/or service capacity data are electronically visible to our foreign customer (25) | □ | □ | □ | □ | □ | □ | □ |
| In this relationship, it is expected that nearly all information that might help our foreign customer will be provided to them. (26) | □ | □ | □ | □ | □ | □ | □ |
| It is expected that our firm and our foreign customer will readily provide proprietary information if it can help the other party. (28) | □ | □ | □ | □ | □ | □ | □ |

| | Strongly agree (1) | Agree (2) | Slightly agree (3) | Neither agree nor disagree (4) | Slightly disagree (5) | Disagree (6) | Strongly disagree (7) |
|---|---|---|---|---|---|---|---|
| It is expected that our firm and our foreign customer will keep each other informed about events or changes that may affect the other party. (29) | □ | □ | □ | □ | □ | □ | □ |
| Our firm regularly monitors the quality control maintained by our foreign customer. (30) | □ | □ | □ | □ | □ | □ | □ |
| Our firm frequently monitors the marketing activities performed by our foreign customer. (31) | □ | □ | □ | □ | □ | □ | □ |
| Our firm closely monitors the extent to which our foreign customer follows established procedures. (32) | □ | □ | □ | □ | □ | □ | □ |
| Our foreign customer can easily buy from other firms besides us. (33) | □ | □ | □ | □ | □ | □ | □ |
| We can easily sell to other firms besides our customer. (34) | □ | □ | □ | □ | □ | □ | □ |
| We have a significant influence on our foreign customer's operations. (35) | □ | □ | □ | □ | □ | □ | □ |
| Our foreign customer has a significant influence on our operations. (36) | □ | □ | □ | □ | □ | □ | □ |
| We can pretty much dictate how our foreign customer sells their product. (37) | □ | □ | □ | □ | □ | □ | □ |
| Consumer demand is very predictable for those products that use the components we source to our foreign customer. (38) | □ | □ | □ | □ | □ | □ | □ |
| Sales forecasts are very predictable for those products that use the components we source to our foreign customer. (39) | □ | □ | □ | □ | □ | □ | □ |
| Retail sales are very predictable for those products that use the components we source to our foreign customer. (40) | □ | □ | □ | □ | □ | □ | □ |
| Our company accomplishes our assigned tasks (i.e., production or service) independently from our foreign customer. (42) | □ | □ | □ | □ | □ | □ | □ |

| | Strongly agree (1) | Agree (2) | Slightly agree (3) | Neither agree nor disagree (4) | Slightly disagree (5) | Disagree (6) | Strongly disagree (7) |
|---|---|---|---|---|---|---|---|
| The companies in our supply network go to a lot of trouble to coordinate each task (i.e., production or service order). (43) | □ | □ | □ | □ | □ | □ | □ |
| It is very difficult to evaluate accurately the quality of the resources or assets our foreign customer says it brings to the exchange. (44) | □ | □ | □ | □ | □ | □ | □ |
| It is very difficult to evaluate the quality of the resource or assets our foreign customer is actually offering in exchange. (45) | □ | □ | □ | □ | □ | □ | □ |
| We cannot be sure if our foreign customer has put forth maximal effort. (46) | □ | □ | □ | □ | □ | □ | □ |

## *IOS&K Specificity*

### cq5

For the following quetions: Please select your most critical foreign customer and answer questions using it as a reference point. A foreign customer is an organization from another country that provides your company with a good or service. Answer the questions that relate to your company from the firm's perspective rather than your own. Please note that you don't have to provide your company's name. Please indicate what best represents your situation:

| | Relatively similar to other customers (1) | (2) | (3) | (4) | (5) | (6) | Customized for our foreign customer (7) |
|---|---|---|---|---|---|---|---|
| Software and applications (e.g., billing, ordering, inventory management, and EDI) are unique to our foreign customer. (48) | □ | □ | □ | □ | □ | □ | □ |
| The knowledge needed for planning new products and programs is unique to our foreign customer. (49) | □ | □ | □ | □ | □ | □ | □ |
| The knowledge needed in product conception and design is unique to our foreign customer. (50) | □ | □ | □ | □ | □ | □ | □ |

## *Customer Size*

### cq9

Revenues of your foreign customer (roughly; in dollars):

- ❍ Less than $3,000,000 (1)
- ❍ $3,000,000 – $14,999,999 (2)
- ❍ $15,000,000 - $74,999,999 (3)
- ❍ $75,000,000 - $399,999,999 (4)
- ❍ More than $400,000,000 (5)

### cq10

Given the number of employees in your foreign customer, they are a:

- ❍ Micro enterprise (1-9 employees) (1)
- ❍ Small enterprise( 10-49 employees) (2)
- ❍ Medium enterprise (50-249 employees) (3)
- ❍ Medium-large enterprise (250-1000 employees) (4)
- ❍ Large enterprise (1000+ employees) (5)

## *Demographics: Organization*

### cq18

Please provide the following information: Your  firm revenues (roughly; in dollars):

- ❍ Less than $3,000,000 (1)
- ❍ $3,000,000 – $14,999,999 (2)
- ❍ $15,000,000 - $74,999,999 (3)
- ❍ $75,000,000 - $399,999,999 (4)
- ❍ More than $400,000,000 (5)

### cq19

Given the number of employees in your firm, your firm is a:

- ❍ Micro enterprise (1-9 employees) (1)
- ❍ Small enterprise (10-49 employees) (2)
- ❍ Medium enterprise (50-249 employees) (3)
- ❍ Medium-large enterprise (250-1000 employees) (4)
- ❍ Large enterprise (1000+ employees) (5)

### cq21

In which country is your company's headquarters located?

(1) _____

**cq26**

Industry

- ❍ Agriculture, Forestry, Fishing and Hunting (1)
- ❍ Mining, Quarrying, and Oil and Gas Extraction (2)
- ❍ Utilities (3)
- ❍ Construction (4)
- ❍ Manufacturing (5)
- ❍ Wholesale Trade (6)
- ❍ Retail Trade (7)
- ❍ Transportation and Warehousing (8)
- ❍ Information [communications] (9)
- ❍ Finance and Insurance (10)
- ❍ Real Estate and Rental and Leasing (11)
- ❍ Professional, Scientific, and Technical Services (12)
- ❍ Management of Companies and Enterprises (13)
- ❍ Administrative and Support [Services] and Waste Management and Remediation Services (14)
- ❍ Educational Services (15)
- ❍ Health Care and Social Assistance (16)
- ❍ Arts, Entertainment, and Recreation (17)
- ❍ Accommodation and Food Services (18)
- ❍ Other Services (except Public Administration) (19)
- ❍ Public Administration (20)

## *Demographics: Professional*

**cq15**
Please provide the following information: Work experience (years):

(1) _____

**cq16**
How many people report to you?

(1) _____

**cq17**
Current or last position :

- ❍ Top Management (1)
- ❍ Middle Management (2)
- ❍ Supervisory Management (3)
- ❍ Professional or Administrative position (4)

**cq22**
In which country are you currently working?

(1) _____

**cq23**
How many years have you worked in an international division?

(1) _____

**cq25**
In how many countries have you worked?

(1) _____

## *Demographics: Personal*

**cq11**
Please provide the following information: Age

(1) _____

**cq12**
Gender:

❍ Male (1)
❍ Female (2)

**cq13**

| | Country of birth: | Years lived: |
|---|---|---|
| (1) | _____ | _____ |

**cq14**

| | Current country where you live: | Years lived: |
|---|---|---|
| (1) | _____ | _____ |

**cq20**
Highest degree obtained:

❍ High school (1)
❍ Undergraduate (2)
❍ Master's (3)
❍ Doctorate (4)

**cq24**
Number of trips abroad in last 10 years:

(1) _____

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