Interorganizational Governance Value Creation: Coordinating for Information Visibility and Flexibility in Supply Chains

Eric T. G. Wang
Department of Information Management, School of Management, National Central University
Chung-Li, Taiwan 32054, R.O.C., e-mail: ewang@mgt.ncu.edu.tw

Hsiao-Lan Wei†
Department of Information Management, School of Management, National Taiwan University of Science and Technology, Taipe, Taiwan 106, R.O.C., e-mail: hlwei@cs.ntust.edu.tw

ABSTRACT

More thoroughly understanding how interorganizational governance value can be created by information technology and other governance mechanisms is critical for supply chain management. Based primarily on transaction-cost economics and supplemented by the resource-based view, this study investigates how interorganizational governance (i.e., relational governance and virtual integration) can create value (i.e., information visibility and supply chain flexibility) in the supply chain context. The findings show that both relational governance and virtual integration benefit information visibility. Those results also support both direct and indirect (via information visibility) effects of relational governance on supply chain flexibility. Although failing to affect supply chain flexibility directly, virtual integration can still improve supply chain flexibility with its ability to enhance information visibility. Thus, interorganizational governance mechanisms emphasizing both control and collaboration can influence the gain from collaboration-specific capabilities, leading to the competitive advantage of a supply chain. The results of the study suggest that firms can gain greater supply chain flexibility within existing interfirm relationships by enhancing information visibility through virtual integration and relational governance.

Subject Areas: Buyer–Supplier Relationships, Competitive Capabilities, Information Visibility, Relational Governance, Supply Chain, and Virtual Integration.

INTRODUCTION

As is widely recognized, the use of information technologies (IT) can enhance supply chain performance through higher levels of process and information integration. Many firms have adopted new practices based on IT to deliver better...
products/services to customers, including postponement and reconfiguration strategies, virtual integration, just-in-time purchasing, vendor-managed inventory, collaborative planning, and forecasting and replenishment programs (Magretta, 1998; Raghunathan, 1999; van Hoek, 1999; Waller, Johnson, & Davis, 1999). These practices are based on partnership building and IT linkage rather than arm’s-length transactions or vertical integration, and strengthening interorganizational relationships has become increasingly important for elevating competitiveness (Young-Ybarra & Wiersema, 1999). Therefore, improved understanding of how to generate interorganizational governance value is essential for supply chain partners when seeking advantages from interfirm collaboration.

Previous studies have identified information visibility and supply chain flexibility as the major advantages provided by IT supporting supply chain integration (Noordewier, John, & Nevin, 1990; van Hoek, 1998; Sahin & Robinson, 2002). Information visibility means that an information demander in a supply chain has accurate up-to-date information of the critical activities and processes, such as purchasing, manufacturing, and distribution (Gustin, Daugherty, & Stank, 1995). Information visibility is fundamental for enhancing the management of interfirm cooperation (Lee, Padmanabhan, & Whang, 1997) and can assist business process improvement and enable strategic organizational changes (Straub, Hoffman, Weber, & Steinfield, 2002; Saeed, Malhotra, & Grover, 2005). Supply chain flexibility, on the other hand, represents the willingness and capability of trading partners to modify their initial arrangements to improve their adaptability to new changes and challenges in supply chains (Evans, 1991; Young, Sapienza, & Baumer, 2003).

Although visibility and flexibility are critical for supply chain management, exactly how supply chain partners can govern transactions to create value from their collaboration has not been widely investigated. Moreover, many researchers have called for the need to improve the understanding of the concepts and working of supply chain visibility and flexibility (Tan, 2001; Sahin & Robinson, 2002; Straub et al., 2002). This study develops the construct of information visibility and theorizes and empirically tests the effects of hybrid governance mechanisms on supply chain visibility and flexibility. Our main research question is “What are the impacts of governance mechanisms on information visibility and supply chain flexibility?”

Transaction-cost economics (TCE) is a major theoretical perspective for analyzing interorganizational governance, including safeguarding specific investments (Jap & Anderson, 2003; Subramani & Venkatraman, 2003) and structuring purchasing relationships (Noordewier et al., 1990). Many investigations have examined the relationships between transaction attributes and governance mechanisms (Zaheer & Venkatraman, 1995; Subramani & Venkatraman, 2003), and various mechanisms have been identified, such as strategic alliances, incentives, bilateral governance, and asset safeguarding (Heide & John, 1990; Anderson & Weitz, 1992; Stump & Heide, 1996). Because governance mechanisms are typically dependent variables of transaction-cost analysis, the performance effect of governance is still mostly unknown (Rindfleisch & Heide, 1997). A mere cost-minimization calculus cannot elucidate the interorganizational governance value (Zajac & Olsen, 1993). Researchers have contended that integrating both the effectiveness and efficiency dimensions of governance forms and processes can improve understanding of
interorganizational value (Zajac & Olsen, 1993; Madhok & Tallman, 1998). Consequently, this study draws on TCE, supplemented by the resource-based view (RBV), to examine what governance mechanisms can improve information visibility and supply chain flexibility in supply chains. The study contributes to relevant literature in three ways. First, rather than focusing on classic contractual mechanisms, this work explores the importance of relational governance in supply chains. Second, we conclude that both control and collaboration mechanisms are significant in interorganizational governance. Third, this investigation reveals the positive mediating effect of information visibility on the relationship between governance mechanisms and supply chain flexibility.

The rest of this article is organized into four sections. The first explains the conceptual background based on the perspectives of TCE and RBV and then discusses the research constructs and derives the research model. The second section then describes the measures and the data collection procedures. The third section analyzes data and tests the research hypotheses. Conclusions are drawn in the final section, and recommendations for future research directions are provided.

CONCEPTUAL BACKGROUND AND MODEL

Interorganizational Governance in Supply Chains

Managing buyer-supplier relationships has received considerable interest among decision science researchers (Zhao, Flynn, & Roth, 2006). Uncertainties in a dyadic relationship require an appropriate governance structure for flexible adaptation to changing circumstances (Williamson, 1985). Sundaramurthy and Lewis (2003) concluded that rising environmental turbulence requires an approach to governance embracing the simultaneous need for control and collaboration.

Two prevailing theories have recommended several governance mechanisms for managing supply chain relationships. Mechanisms based on TCE concentrate on the efficiency of controlling opportunistic behaviors and economizing on transaction cost. Those from RBV emphasize the effectiveness of collaboration for generating value from relational resources. From a more integrative stance, transaction costs and relational resources are not independent but coexist within the dyad (Madhok & Tallman, 1998; Grover, Teng, & Fiedler, 2002).

TCE employs governance mechanisms to control opportunistic behaviors of transacting partners for safeguarding specific investment in transactions (Williamson, 1985; Rindfleisch & Heide, 1997). Several TCE-based studies have examined the effectiveness of hybrid governance mechanisms, which are between pure market and hierarchy, for governing interfirm relationships (Noordewier et al., 1990; Rindfleisch & Heide, 1997; Subramani & Venkatraman, 2003) as the transactional context becomes increasingly complex. In particular, Heide and John (1992) hold that relational governance is an important hybrid structure that allows exchange partners to adapt flexibly in responding to uncertainty. Many works also suggest that IT can reduce transaction cost and create hybrid governance forms between markets and hierarchies (Clemons, Reddi, & Row, 1993; Grover et al., 2002; Subramani, 2004). Therefore, relational governance and IT-enabled virtual integration have been recognized as two important hybrid mechanisms for
governing interfirm relationships, with one emphasizing the relationship aspect while the other the technology aspect. However, their effectiveness in governing supply chain operations in order to enhance supply chain information visibility and flexibility has not been sufficiently investigated, and this is the focus of this study.

From the RBV perspective, interorganizational governance is concerned with the management of resources in a supply chain to increase the competitive advantage of the partners. Madhok and Tallman (1998) found that the use of an interfirm collaborative organizational form can generate value and that the realization of such value depends largely on the quality of the interfirm relationship. The role of interorganizational governance can be further enhanced by strengthening its collaborative elements (Noordewier et al., 1990). Both interpersonal and formal communication channels, such as electronic communication networks, play significant roles in facilitating supply chain collaboration (Dyer & Singh, 1998; Magretta, 1998) and can be regarded as relational investments for collaborative value creation (Dyer & Singh, 1998; Madhok & Tallman, 1998). Accordingly, this study focuses on two essential mechanisms of interorganizational governance, namely, relational governance and virtual integration.

**Relational governance**

*Relational governance* is defined as the extent to which supply chain partners use mechanisms, such as relational norms and joint actions, to maintain their relationships based on common goals (Heide & John, 1992; Josi & Campbell, 2003). Relational governance involves the expectations of relationship continuity and mutuality, which can regulate opportunism by casting a visible future and moral controls (Josi & Campbell, 2003). By their very nature, mechanisms like trust, commitment, coordination, and joint problem solving constitute safeguards against the exploitation of transaction-specific assets. *Trust* requires partners to perceive each other as trustworthy, and willingness to forgo opportunistic behaviors, whereas *commitment* is an enduring desire to sustain a valued relationship. *Trust* has been defined as "an implicit or explicit pledge of relational continuity between exchange partners" (Dwyer, Schur, & Oh, 1987, p. 19). The expectations of relationship continuity motivate trading partners to invest in new technologies and forgo opportunistic behavior, as their relationships develop within the context of recurrent transactions. The parties come to rely on relational norms as safeguards (Zaheer & Venkatraman, 1995). Commitment to the relationships promotes supplier learning for requisite new technologies and procedures, enabling supply chain cooperation and flexibility (Josi & Campbell, 2003). Relational norms thus appear to both safeguard specialized assets and to enhance the collaboration within an exchange relationship.

Just as relational governance relies on cooperation, *joint action* is based on the interfirm relationship, which "involves the parties carrying out the focal activities in a cooperative or coordinated way" (Heide & John, 1990, p. 25). Joint action is viewed as a governance process with decision process mechanisms for the terms of exchange and serves as a safeguard for transaction-specific assets, because joint responsibility reduces the risks of opportunistic appropriation (Zaheer & Venkatraman, 1995), and joint decision making protects a firm’s own interests (Subramani...
Joint action also enhances the participative management of the interorganizational relationship and plays a vital role in cooperative strategies (Heide & John, 1990; Dyer & Singh, 1998). Joint problem solving may provide mutually satisfactory solutions and contribute to relationship success; it can thus serve as a governance process for controlling exchange relationships and encouraging interfirm collaboration.

**Virtual integration**

*Virtual integration* is the extent to which trading partners use IT to facilitate common operations between supply chain partners, such as purchasing and production and logistics, as well as to support collaborative decision making and performance control (Morash & Clinton, 1998). The use of interorganizational systems (IOS) within a dyad represents “[t]he duality of IT as both a control mechanism as well as a relationship building mechanism” (Grover et al., 2002, p. 223). Virtual integration thus represents not only a process mechanism but also the structural dimension of governance. An increased level of virtual integration is a departure from market governance as the relationship between partners becomes more important (Subramani & Venkatraman, 2003). However, coordination costs and the risk of opportunistic behaviors also rise in close relationships (Grover et al., 2002). Interorganizational information-processing capabilities provided by IT can reduce transaction costs and mitigate opportunism with decreased information asymmetry and increased monitoring capabilities. The result is that both virtual integration and relational governance can reduce transaction costs and promote collaborative relationships (Frohlich, 2002; Grover et al., 2002).

**Interorganizational Value Creation in Supply Chains**

By extending RBV to supply chain management, prior research has found that unique resources exist at the supply chain level (e.g., Holcomb & Hitt, 2007). Two important interorganizational capabilities, information visibility and supply chain flexibility, can be gained from a tightened exchange relationship (Noordewier et al., 1990; van Hoek, 1998; Sahin & Robinson, 2002). These two capabilities are valuable in creating competitive advantage due to three distinctive characteristics (Madhok & Tallman, 1998). First, no one firm can fully possess and develop these two capabilities. Supply chain information visibility can only be realized by exchanging firm-specific or transaction-specific information between supply chain partners, while supply chain flexibility relies on supply chain partners making appropriate and coordinated process adjustments. Second, both capabilities require a high degree of integration, virtually or physically, and are thus difficult to attain in arm’s-length relationships. Third, the capabilities are useful only when taken together and lose their value when a partner leaves the supply chain. The importance of information visibility and flexibility for supply chains is discussed below.

**Information visibility**

Timely, accurate, and relevant information is essential for the management of product and service flows in supply chains. *Information visibility* in a supply chain is
the degree to which the supply chain partners have on-hand information related to demand and supply for planning and control management (Mohr & Spekman, 1994). It is the outcome of interorganizational communication behaviors. Information visibility must be distinguished from constructs containing purely IT-related contents, because information sharing can be realized through different means, such as technology-based media, social contacts, and procedural venues (Wareham, 2003). Monitoring to control supply chain partners’ opportunism is very easy with high visibility or even unnecessary when the probability and the cost of their opportunistic behaviors being detected are sufficiently high. Exchanging information on forecasting, planning, product design, and production scheduling reduces information asymmetry and monitoring costs, thus lowering the incentives of transactors to behave opportunistically (Dyer, 1997).

Real-time demand data and inventory visibility are critical for effective supply chain forecasting, planning, scheduling, and execution. The visibility across organizational boundaries improves supply chain efficiency and helps reduce cycle time and stockouts (Kulp, Lee, & Ofek, 2004). The information flows between customers and suppliers can balance supply and demand across the network by reducing uncertainty and alleviating the bullwhip effect (Lee et al., 1997). Thus, increased visibility combined with other resources resident in a firm not only improves individual firms’ decision-making capabilities, but also is a cornerstone of improved supply chain performance (Mabert & Venkataramanan, 1998).

**Supply chain flexibility**

Supply chain flexibility is the degree to which a firm meets its end customers’ requirements speedily through effective management of the competencies of multiple organizations in the supply chain. Such flexibility permits a firm to respond quickly to changes in its manufacturing and market environments (Zhang, Vonderembse, & Lim, 2002) and becomes increasingly important as the diversity and uncertainty in the environment increase (Vickery, Calantone, & Droge, 1999). Two types of supply chain flexibility, namely offering flexibility and partnering flexibility, are identified in the literature (Gosain, Mahotra, & El Sawy, 2004). **Offering flexibility** refers to the ability of a supply chain to support changes in product offering with current partners, while **partnering flexibility** represents the ease of changing supply chain partners. This study focuses only on offering flexibility. Greater offering flexibility means that supply chain partners have a higher level of adaptability so that the resources in the chain are better explored and utilized. Consequently, supply chain flexibility can generate a holistic competitive advantage of the entire chain by pie-expansion (Vickery et al., 1999).

**Research Model**

Interfirm collaboration can create value for partners by pooling resources and capabilities (Ring & Van de Ven, 1992), which requires appropriate governance mechanisms. More appropriate governance facilitates promotion of more relationship-specific investments, thus achieving more efficient operations and greater value from the relationship (Williamson, 1995; Subramani & Venkatraman,
2003; Subramani, 2004). Figure 1 depicts the proposed model, which is derived below.

**Information visibility and interorganizational governance**

According to TCE, information exchange may be limited in supply chains as firms are threatened by the risk of opportunism. However, firms are most likely to devote effort and resources to information exchange if their partners can be trusted and demonstrate a long-term commitment to the relationship (Moberg, Culter, Gross, & Speh, 2002). RBV indicates that firms share capabilities in order to stimulate growth. Relational governance is based on the cooperation that pursues mutually compatible interests; such promises and expectations involve social processes that promote information exchange (Holcomb & Hitt, 2007). With formal or informal contacts in the coordination and joint problem-solving processes, supply chain partners can develop an appropriate supply chain configuration and the associated social structure through which resources are accessed, increasing information availability and exchange. Thus, in this study we hypothesize that the amount of information exchanged between trading partners is raised as they rely more on relational governance (Moberg et al., 2002), increasing the information visibility in the supply chain.

**H1: A higher level of relational governance leads to greater information visibility in supply chain partners.**

Increasing a firm’s information-processing capacity can mitigate the uncertainty faced by it (Galbraith, 1973) and can impact information visibility positively. Greater information-processing capacity provided by IT allows supply chain partners to exchange more data in more information-rich formats to improve coordination (Moberg et al., 2002). Virtual integration supporting common operations in supply chains thus can increase the level of information visibility as an important outcome. Furthermore, virtual integration represents the substitution of ownership with partnership to integrate a smaller set of suppliers through IT (Clemons et al., 1993) and extends the boundary a firm can access and control, thus making some unavailable resources (e.g., information) available. Electronic information exchanges between trading partners are generally standardized and institutionalized in a cost-effective manner, allowing complex product specifications and engineering
data to be quickly transferred along the supply chain, thus leading to the desired end result of improved interfirm coordination. Furthermore, virtual integration can provide a totally different information exchange structure. The concept of an information hub enables radial information flows among all supply chain partners (Lee & Whang, 2000). Practices, such as centralized or collaborative forecasting, raise the information visibility in the supply chain by using an information hub containing all relevant information within the supply chain.

**H2: A higher level of virtual integration leads to greater information visibility in supply chain partners.**

**Supply chain offering flexibility and interorganizational governance**

Relational governance is manifested in its flexibility-enabling feature as a form of cooperative behavior (Josi & Campbell, 2003; Johnston, McCutcheon, Stuart, & Kerwood, 2004). Relational norms and joint actions as mechanisms for reducing transaction costs also promote the willingness of partners to perform recurrent transactions and to enter long-term relationships (Heide & John, 1992). This willingness permits contractual flexibility when a trading partner introduces extra requirements (Johnston et al., 2004). Such flexibility allows efficient interfirm coordination and adaptation to environmental changes.

Because relational governance can both enhance cooperation confidence and reduce relational risk (Nooteboom & Noorderhaven, 1997), a higher level of relational governance increases the willingness of supply chain partners to exchange and adjust domain-specific and process-specific resources. Such a need also leads to development of new business processes and restructures physical flows. As a result of such improvements, supply chain activities can be rapidly adjusted in response to environmental changes, resulting in a more flexible supply chain.

**H3: A higher level of relational governance leads to greater supply chain offering flexibility.**

Virtual integration is the mechanism for integrating activities by reaching across organizational boundaries to satisfy customers (Zhang et al., 2002). It is one type of quasi-integration and is considered as part of the governance structure in many studies (Zaheer & Venkatraman, 1995; Subramani & Venkatraman, 2003). Virtual integration requires firms to invest specific assets in their supply chain relationships, including interorganizational information systems, business processes, and knowledge pertaining to the firm requirements in supply chain relationships. This specificity forces firms to try their best to continue the relationships in order to maintain or enhance the value of their investment in the relationships (Heide & John, 1992), making firms more willing to be flexible in modifying their actions when necessary. Moreover, bilateral investment in IT is a credible commitment in an exchange relationship (Zaheer & Venkatraman, 1995), thus reinforcing a stable and long-term relationship (Williamson, 1985; Anderson & Weitz, 1992) and generating joint motivation to encourage flexibility in response to changes (Young-Ybarra & Wiersema, 1999). Both the coordination and the commitment-enhancing
effects of virtual integration can help achieve a more adaptive and flexible supply chain.

\[ H4: \text{A higher level of virtual integration leads to greater supply chain offering flexibility.} \]

**Information visibility and supply chain offering flexibility**

Firms that engage in time-based competition are looking for ways to be agile and respond quickly to customer requirements (Ahmed, Hardaker, & Carpenter, 1996). Ahmed et al. (1996) concluded that integration is an antecedent to flexibility. Evgeniou (2002) asserted that information integration with high visibility could lead to adaptive enterprises. The enhanced information visibility in a supply chain enables the partners to integrate value-adding operations and support joint decision making, as information exchange precedes the movement of physical resources (Ahmed et al., 1996). Premovement information analysis enhances the viability of actions such as strategy changes or process adjustments. The speed of problem solving and timeliness of strategy development can also be improved when every partner knows the effect of an action on the entire chain process (Zhang et al., 2002), increasing the supply chain offering flexibility.

\[ H5: \text{A higher level of information visibility leads to greater supply chain offering flexibility.} \]

**RESEARCH METHODOLOGY**

**Survey Procedure**

A cross-sectional mail survey was administrated to collect data from randomly selected large and medium-sized manufacturing firms in Taiwan. The questionnaire was pretested with 18 senior managers (including purchasing, operation, sales, marketing, and information system managers and chief executive officers) for face and content validity, resulting in modifications in the wording of some survey items. A total of 980 manufacturing firms was randomly selected from the directories of *Top 5000 Largest Firms in Taiwan* published in 2000 by China Credit Information Services, Ltd, and the final version of the survey was distributed to the senior operations manager of each firm in December 2004. The unit of analysis of this research was the dyadic relationship in supply chains, with operations managers as the informant. Because the operations function plays a crucial role in supply chain management, and its senior managers should also have a good understanding of boundary-spanning activities, such as managing suppliers, the key informants were operations managers in buying firms.

**Sample**

After one follow-up mailing, a total of 153 surveys was returned, with 150 having completed data available for subsequent analysis, yielding an effective response rate of 15.3%. Table 1 shows the characteristics of the responding firms. As the production value of computer and electronics industries has contributed one-third
of Taiwan’s gross domestic product, 32.5% of respondents were from these industries. Approximately 10% of the sample was composed of companies from the metal, textile, and automobile industries. The sample included different types of businesses, with 32.5% of the firms from the computer and electronics industries, which reflects the significance of these sectors in Taiwanese manufacturing. Table 1 also demonstrates that the sample consisted of medium to large-sized firms, but mainly medium-sized firms. According to the survey published in 2004 Commonwealth Magazine (Commonwealth, 2004), the average number of employees of the largest 1,000 manufacturing firms in Taiwan is 850 and only approximately 5% of them have more than 3,000 employees. So, the distribution of the firm size in our data is reasonably representative considering the relatively small number of large firms in Taiwan. Additionally, 50% of the respondents were senior operations managers or directors. Their average work experience was 4.3 years in their current positions and 13.4 years in their companies, indicating adequate informant knowledge. To check for the potential bias of a single informant, the consistency of data from operations managers with the data from purchasing managers was verified. Matching data were gathered from purchasing managers for 32 of the 150
responding companies. Consistent with past research (e.g., Weil, 1992), intrarater reliabilities (IRR) (James, Demaree, & Wolf, 1984) were calculated to show the agreement level between the operations and purchasing managers. The average estimates of IRR were .91 for relational governance, .84 for virtual integration, .86 for information visibility, and .96 for supply chain flexibility constructs. All estimates were within the acceptable range (i.e., .7 or higher; Eby & Dobbins, 1997), indicating response consistency between the two groups.

Nonresponse analyses were also applied to ensure the absence of nonresponse bias (Armstrong & Overton, 1977). Two statistical analyses were conducted to verify that the responding firms were representative. The responding and nonresponding firms were first compared in terms of company assets and number of employees, information available from 2002 Commonwealth Magazine, and no significant differences between the two groups were found based on the independent sample t test ($p = .17$ and .32, respectively). The respondents were then further divided into two groups based on the dates of return. The comparison on company assets and employee numbers of the two groups also showed no significant differences based on the independent sample t test ($p = .13$ and .12, respectively). Additionally, a comparison of the means of constructs used in this study in the two groups showed no significant differences. Accordingly, the nonresponse bias does not appear to be an issue.

**Variables and Measures**

Table 2 summarizes the measures of this study. Relational governance and information visibility are operationalized as multidimensional constructs. A detailed explanation of each construct is provided below.

**Relational governance**

Relational governance was operationalized as a formative construct with four dimensions, namely, trust, commitment, coordination, and joint problem solving. Because relational governance can be viewed as an index of the levels of relational mechanisms usage, and these levels are not necessarily similar, the construct is best treated as formative. The measures of the dimensions are nevertheless reflective. Trust was assessed with the scale developed by Hibbard, Kumar, and Stern (2001), commitment with items selected and modified from those developed by Hibbard et al. (2001) and Hart and Saunders (1998), coordination with the scale developed by Sivadas and Dwyer (2000), and joint problem solving with three items to capture the higher cooperative actions toward conflicts or problems encountered by one party (Mohr & Spekman, 1994). All the measurement items are listed in the Appendix.

**Virtual integration**

The virtual integration construct was operationalized as a formative construct, because different IT-based interfirm integration mechanisms can be implemented differently in a single firm. These mechanisms include IT-supported order processing, market information sharing, production-capacity coordination, inventory-level coordination, support for material or component design, and support for quality
<table>
<thead>
<tr>
<th>Construct</th>
<th>Dimensions</th>
<th>Item no.</th>
<th>Description</th>
<th>Key References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational Governance</td>
<td>Trust</td>
<td>3</td>
<td>The honesty and promises of suppliers</td>
<td>(Hibbard et al., 2001)</td>
</tr>
<tr>
<td></td>
<td>Commitment</td>
<td>4</td>
<td>Satisfaction of and long-term orientation toward the supply chain relationship</td>
<td>(Hibbard et al., 2001)</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td>3</td>
<td>Good interorganizational function based on the needs of the supply chain</td>
<td>(Sivadas &amp; Dwyer, 2000)</td>
</tr>
<tr>
<td></td>
<td>Joint problem solving</td>
<td>3</td>
<td>Cooperative actions toward problems within the supply chain</td>
<td>(Mohr &amp; Spekman, 1994)</td>
</tr>
<tr>
<td>Virtual Integration</td>
<td></td>
<td>6</td>
<td>IT-enabled integration in a supply chain to support common operation and joint process planning and control</td>
<td>(Morash &amp; Clinton, 1998; Angeles &amp; Nath, 2001; Frohlich &amp; Westbrook, 2001; Narasimhan &amp; Kim, 2001)</td>
</tr>
<tr>
<td>Information Visibility</td>
<td>Manufacturing</td>
<td>4</td>
<td>Supply chain partners have on-hand information related to demand and supply for planning and control management</td>
<td>(Richeson et al., 1995; Eggert &amp; Helm, 2000; Lancioni et al., 2000; Maltz, 2000; Vishwanath &amp; Kaufmann, 2001)</td>
</tr>
<tr>
<td></td>
<td>Transaction</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Planning</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplying</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Chain Offering Flexibility</td>
<td></td>
<td>6</td>
<td>Adjustment, adaptation, and modification of supply chain processes with current suppliers in response to changes and unexpected situation</td>
<td>(Young-Ybarra &amp; Wiersema, 1999)</td>
</tr>
</tbody>
</table>

IT = information technology

**Information visibility**

Information visibility means the ability to gain qualified pipeline information of manufacturer–supplier trading processes (Mason-Jones & Towill, 1997, 1999). To be relevant to the control and coordination in supply chains management, the domain contents should consist of product/material management, transaction, process status, planning/forecasting, and operational performance assessment information (Richeson, Lackey, & Starner, 1995; Eggert & Helm, 2000; Lancioni, Smith, & Oliva, 2000; Maltz, 2000; Vishwanath & Kaufmann, 2001). This construct was also operationalized as a formative construct, because the respondents were expected to report different information levels in different domain contents.

**Supply chain offering flexibility**

The supply chain offering flexibility construct was measured by the six-item scale developed by Young-Ybarra and Wiersema (1999), with minor modifications. The scale refers to the adaptability of firms in the supply chain to respond to unexpected change in the transaction processes.

**Control variables**

Three control variables, purchase amount, relational length, and firm size, were considered in the statistical analysis. Purchasing amount and relational length reflect the importance of the supply chain partner. Buvik and John (2000) observed that purchasing amount may affect ex post transaction cost and adaptation in the supply chain. Kalwani and Narayandas (1995) found that suppliers with long-term ties to their buyers have low inventory costs, indicating that suppliers have high flexibility to respond to environmental uncertainty without the need to keep more inventory as buffer. Additionally, large firms should have more resources to integrate and improve their supply chain performance.

**RESULTS**

Partial least squares (PLS), as implemented in PLS Graph version 3.0, was selected to analyze both measurement validity and the model, because it allows latent constructs to be modeled as either formative or reflective. The analysis strategy involved a two-stage approach. The psychometric properties of the measurement items (including those used to capture the dimensions of the two second-order constructs) were first assessed through factor analysis. The structural relationships were then examined using the factor scores representing the first-order dimensions of the two formative constructs, namely, relational governance and information visibility.

**Measurement Properties**

The psychometric properties of the scales were assessed in terms of item loadings, discriminant validity, and internal consistency. Item loadings and internal consistencies (also called composite reliability) greater than .70 are considered
acceptable (Fornell & Larcker, 1981). As shown in Table 3, all of the items were highly loaded (>.70) on their respective constructs. All of the constructs/subconstructs also exhibited good internal consistency, as demonstrated by the composite reliability scores (see Table 4).

Discriminant validity was assessed by two criteria (Chin, 1998): (i) items should load more highly on the construct they are intended to measure than on other constructs and (ii) the square root of the average variance extracted (AVE) should be larger than the interconstruct correlations. Cross-loadings were computed from the correlations between a construct’s component score and the manifest indicators of other constructs (Chin, 1998; Agarwal & Karahanna, 2000). As indicated in Table 3, all items loaded more highly on their own constructs than on other constructs. Table 4 also shows that the square root of the AVE of each construct was greater than .7 and was also greater than the correlations between the construct and other constructs, indicating that all constructs share more variances with their indicators than with other constructs. Overall, the self-report measures exhibited sufficiently strong psychometric properties for subsequent hypothesis testing.

Hypothesis Testing
The PLS structural model was assessed by examining the path coefficients (similar to the standardized beta weights in regression analysis) and their statistical significance. Figure 2 shows the path coefficients and the explained construct variances. Three of the four constructs were modeled as formative, formed either by measurement items or by the factor scores of the dimensions. This is necessary because PLS does not directly support second-order factor analysis (Agarwal & Karahanna, 2000). Following Chin (1998), bootstrapping with 200 resamples was performed to obtain the estimates of standard errors for testing the statistical significance of the path coefficients using the t test.

Figure 2 summarizes the model-testing results. As described previously, relational governance, virtual integration, and information visibility were treated as formative constructs. The dependent variable, supply chain offering flexibility, is a reflective construct. Therefore, Figure 2 depicts both the weights and loadings of the forming dimensions or measurement items. Overall, four of the five hypotheses were supported after controlling for the effects of the three control variables on supply chain offering flexibility. The results support Hypothesis 1, relating relational governance to information visibility ($t = 6.56, p < .01$). Hypothesis 2, which posits that virtual integration would influence information visibility, is also supported ($t = 5.15, p < .01$). As for Hypothesis 3, the results demonstrate the positive association between relational governance and supply chain offering flexibility ($t = 5.29, p < .01$). Hypothesis 4, which posits that virtual integration would influence supply chain offering flexibility, is not supported ($t = 1.25, p > .01$). Hypothesis 5 is supported by the results, showing that information visibility is positively associated with supply chain offering flexibility ($t = 2.09, p < .05$). The explained variances for information visibility and supply chain offering flexibility were 63% and 59%, respectively.
### Table 3: Results of factor analysis.\(^a\)

<table>
<thead>
<tr>
<th>Items</th>
<th>RGTR</th>
<th>RGCM</th>
<th>RGCO</th>
<th>RGJP</th>
<th>VI</th>
<th>IVM</th>
<th>IVT</th>
<th>IVP</th>
<th>IVS</th>
<th>IVE</th>
<th>SCOF</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGTR1</td>
<td>.89</td>
<td>.57</td>
<td>.55</td>
<td>.42</td>
<td>.31</td>
<td>.27</td>
<td>.24</td>
<td>.33</td>
<td>.30</td>
<td>.42</td>
<td>.38</td>
</tr>
<tr>
<td>RGTR2</td>
<td>.92</td>
<td>.63</td>
<td>.62</td>
<td>.42</td>
<td>.29</td>
<td>.21</td>
<td>.26</td>
<td>.39</td>
<td>.30</td>
<td>.43</td>
<td>.54</td>
</tr>
<tr>
<td>RGTR3</td>
<td>.90</td>
<td>.65</td>
<td>.63</td>
<td>.49</td>
<td>.24</td>
<td>.25</td>
<td>.29</td>
<td>.38</td>
<td>.42</td>
<td>.52</td>
<td>.46</td>
</tr>
<tr>
<td>RGCM1</td>
<td>.58</td>
<td>.80</td>
<td>.65</td>
<td>.47</td>
<td>.24</td>
<td>.25</td>
<td>.24</td>
<td>.36</td>
<td>.32</td>
<td>.34</td>
<td>.45</td>
</tr>
<tr>
<td>RGCM2</td>
<td>.54</td>
<td>.83</td>
<td>.64</td>
<td>.43</td>
<td>.32</td>
<td>.30</td>
<td>.32</td>
<td>.40</td>
<td>.37</td>
<td>.41</td>
<td>.43</td>
</tr>
<tr>
<td>RGCM3</td>
<td>.59</td>
<td>.84</td>
<td>.55</td>
<td>.46</td>
<td>.27</td>
<td>.33</td>
<td>.31</td>
<td>.42</td>
<td>.40</td>
<td>.47</td>
<td>.45</td>
</tr>
<tr>
<td>RGCM4</td>
<td>.51</td>
<td>.78</td>
<td>.55</td>
<td>.57</td>
<td>.27</td>
<td>.27</td>
<td>.37</td>
<td>.38</td>
<td>.30</td>
<td>.35</td>
<td>.55</td>
</tr>
<tr>
<td>RGCO1</td>
<td>.60</td>
<td>.67</td>
<td>.90</td>
<td>.61</td>
<td>.38</td>
<td>.35</td>
<td>.33</td>
<td>.42</td>
<td>.41</td>
<td>.50</td>
<td>.54</td>
</tr>
<tr>
<td>RGCO2</td>
<td>.59</td>
<td>.66</td>
<td>.88</td>
<td>.55</td>
<td>.37</td>
<td>.31</td>
<td>.26</td>
<td>.44</td>
<td>.42</td>
<td>.52</td>
<td>.61</td>
</tr>
<tr>
<td>RGCO3</td>
<td>.56</td>
<td>.61</td>
<td>.86</td>
<td>.61</td>
<td>.30</td>
<td>.30</td>
<td>.35</td>
<td>.46</td>
<td>.48</td>
<td>.52</td>
<td>.64</td>
</tr>
<tr>
<td>RGJP1</td>
<td>.51</td>
<td>.55</td>
<td>.64</td>
<td>.85</td>
<td>.43</td>
<td>.45</td>
<td>.49</td>
<td>.51</td>
<td>.48</td>
<td>.51</td>
<td>.64</td>
</tr>
<tr>
<td>RGJP2</td>
<td>.38</td>
<td>.52</td>
<td>.55</td>
<td>.86</td>
<td>.37</td>
<td>.33</td>
<td>.49</td>
<td>.48</td>
<td>.46</td>
<td>.45</td>
<td>.49</td>
</tr>
<tr>
<td>RGJP3</td>
<td>.35</td>
<td>.48</td>
<td>.50</td>
<td>.79</td>
<td>.48</td>
<td>.50</td>
<td>.42</td>
<td>.55</td>
<td>.40</td>
<td>.43</td>
<td>.51</td>
</tr>
<tr>
<td>VI1</td>
<td>.23</td>
<td>.30</td>
<td>.28</td>
<td>.34</td>
<td>.80</td>
<td>.42</td>
<td>.37</td>
<td>.34</td>
<td>.41</td>
<td>.43</td>
<td>.24</td>
</tr>
<tr>
<td>VI2</td>
<td>.28</td>
<td>.35</td>
<td>.37</td>
<td>.43</td>
<td>.86</td>
<td>.53</td>
<td>.41</td>
<td>.43</td>
<td>.50</td>
<td>.50</td>
<td>.41</td>
</tr>
<tr>
<td>VI3</td>
<td>.27</td>
<td>.25</td>
<td>.36</td>
<td>.42</td>
<td>.85</td>
<td>.45</td>
<td>.40</td>
<td>.46</td>
<td>.43</td>
<td>.48</td>
<td>.41</td>
</tr>
<tr>
<td>VI4</td>
<td>.25</td>
<td>.21</td>
<td>.31</td>
<td>.45</td>
<td>.87</td>
<td>.50</td>
<td>.39</td>
<td>.45</td>
<td>.45</td>
<td>.51</td>
<td>.40</td>
</tr>
<tr>
<td>VI5</td>
<td>.35</td>
<td>.36</td>
<td>.41</td>
<td>.54</td>
<td>.86</td>
<td>.53</td>
<td>.49</td>
<td>.55</td>
<td>.48</td>
<td>.56</td>
<td>.51</td>
</tr>
<tr>
<td>VI6</td>
<td>.19</td>
<td>.25</td>
<td>.29</td>
<td>.41</td>
<td>.83</td>
<td>.45</td>
<td>.42</td>
<td>.47</td>
<td>.50</td>
<td>.51</td>
<td>.35</td>
</tr>
<tr>
<td>IVM1</td>
<td>.29</td>
<td>.32</td>
<td>.33</td>
<td>.52</td>
<td>.52</td>
<td>.90</td>
<td>.60</td>
<td>.53</td>
<td>.46</td>
<td>.43</td>
<td>.35</td>
</tr>
<tr>
<td>IVM2</td>
<td>.26</td>
<td>.33</td>
<td>.30</td>
<td>.46</td>
<td>.56</td>
<td>.93</td>
<td>.63</td>
<td>.54</td>
<td>.41</td>
<td>.43</td>
<td>.32</td>
</tr>
<tr>
<td>IVM3</td>
<td>.15</td>
<td>.27</td>
<td>.27</td>
<td>.39</td>
<td>.49</td>
<td>.89</td>
<td>.58</td>
<td>.51</td>
<td>.34</td>
<td>.28</td>
<td>.29</td>
</tr>
<tr>
<td>IVM4</td>
<td>.26</td>
<td>.32</td>
<td>.38</td>
<td>.42</td>
<td>.41</td>
<td>.77</td>
<td>.53</td>
<td>.46</td>
<td>.40</td>
<td>.41</td>
<td>.43</td>
</tr>
<tr>
<td>IVT1</td>
<td>.25</td>
<td>.28</td>
<td>.29</td>
<td>.47</td>
<td>.47</td>
<td>.67</td>
<td>.86</td>
<td>.61</td>
<td>.43</td>
<td>.42</td>
<td>.35</td>
</tr>
<tr>
<td>IVT2</td>
<td>.24</td>
<td>.33</td>
<td>.32</td>
<td>.50</td>
<td>.46</td>
<td>.63</td>
<td>.91</td>
<td>.63</td>
<td>.50</td>
<td>.38</td>
<td>.36</td>
</tr>
<tr>
<td>IVT3</td>
<td>.25</td>
<td>.33</td>
<td>.31</td>
<td>.55</td>
<td>.45</td>
<td>.52</td>
<td>.91</td>
<td>.63</td>
<td>.48</td>
<td>.39</td>
<td>.45</td>
</tr>
<tr>
<td>IVT4</td>
<td>.26</td>
<td>.41</td>
<td>.33</td>
<td>.44</td>
<td>.39</td>
<td>.53</td>
<td>.83</td>
<td>.58</td>
<td>.46</td>
<td>.41</td>
<td>.45</td>
</tr>
<tr>
<td>IVT5</td>
<td>.26</td>
<td>.28</td>
<td>.29</td>
<td>.46</td>
<td>.34</td>
<td>.55</td>
<td>.82</td>
<td>.58</td>
<td>.41</td>
<td>.29</td>
<td>.39</td>
</tr>
<tr>
<td>IVP1</td>
<td>.30</td>
<td>.38</td>
<td>.42</td>
<td>.56</td>
<td>.45</td>
<td>.54</td>
<td>.68</td>
<td>.85</td>
<td>.52</td>
<td>.47</td>
<td>.55</td>
</tr>
<tr>
<td>IVP2</td>
<td>.39</td>
<td>.45</td>
<td>.46</td>
<td>.55</td>
<td>.48</td>
<td>.49</td>
<td>.60</td>
<td>.90</td>
<td>.52</td>
<td>.54</td>
<td>.51</td>
</tr>
<tr>
<td>IVP3</td>
<td>.38</td>
<td>.43</td>
<td>.44</td>
<td>.53</td>
<td>.48</td>
<td>.51</td>
<td>.58</td>
<td>.89</td>
<td>.53</td>
<td>.50</td>
<td>.51</td>
</tr>
<tr>
<td>IVP1</td>
<td>.40</td>
<td>.40</td>
<td>.45</td>
<td>.50</td>
<td>.54</td>
<td>.43</td>
<td>.51</td>
<td>.52</td>
<td>.91</td>
<td>.69</td>
<td>.47</td>
</tr>
<tr>
<td>IVP2</td>
<td>.34</td>
<td>.38</td>
<td>.45</td>
<td>.49</td>
<td>.48</td>
<td>.42</td>
<td>.48</td>
<td>.57</td>
<td>.93</td>
<td>.70</td>
<td>.50</td>
</tr>
<tr>
<td>IVP3</td>
<td>.32</td>
<td>.37</td>
<td>.46</td>
<td>.49</td>
<td>.45</td>
<td>.37</td>
<td>.46</td>
<td>.54</td>
<td>.92</td>
<td>.64</td>
<td>.48</td>
</tr>
<tr>
<td>IVE1</td>
<td>.33</td>
<td>.42</td>
<td>.45</td>
<td>.46</td>
<td>.52</td>
<td>.45</td>
<td>.48</td>
<td>.54</td>
<td>.89</td>
<td>.67</td>
<td>.48</td>
</tr>
<tr>
<td>IVE2</td>
<td>.44</td>
<td>.39</td>
<td>.50</td>
<td>.47</td>
<td>.55</td>
<td>.41</td>
<td>.40</td>
<td>.53</td>
<td>.67</td>
<td>.91</td>
<td>.52</td>
</tr>
<tr>
<td>IVE3</td>
<td>.43</td>
<td>.44</td>
<td>.49</td>
<td>.50</td>
<td>.47</td>
<td>.32</td>
<td>.36</td>
<td>.47</td>
<td>.63</td>
<td>.89</td>
<td>.51</td>
</tr>
<tr>
<td>IVE4</td>
<td>.45</td>
<td>.43</td>
<td>.55</td>
<td>.48</td>
<td>.51</td>
<td>.37</td>
<td>.35</td>
<td>.46</td>
<td>.65</td>
<td>.90</td>
<td>.53</td>
</tr>
<tr>
<td>IVE5</td>
<td>.44</td>
<td>.44</td>
<td>.53</td>
<td>.51</td>
<td>.49</td>
<td>.42</td>
<td>.43</td>
<td>.58</td>
<td>.67</td>
<td>.84</td>
<td>.53</td>
</tr>
<tr>
<td>IVE6</td>
<td>.44</td>
<td>.41</td>
<td>.45</td>
<td>.46</td>
<td>.56</td>
<td>.39</td>
<td>.37</td>
<td>.46</td>
<td>.59</td>
<td>.81</td>
<td>.46</td>
</tr>
<tr>
<td>SCOF1</td>
<td>.43</td>
<td>.46</td>
<td>.53</td>
<td>.59</td>
<td>.39</td>
<td>.25</td>
<td>.38</td>
<td>.46</td>
<td>.44</td>
<td>.51</td>
<td>.74</td>
</tr>
<tr>
<td>SCOF2</td>
<td>.34</td>
<td>.34</td>
<td>.50</td>
<td>.47</td>
<td>.38</td>
<td>.25</td>
<td>.34</td>
<td>.48</td>
<td>.42</td>
<td>.42</td>
<td>.77</td>
</tr>
<tr>
<td>SCOF3</td>
<td>.43</td>
<td>.45</td>
<td>.54</td>
<td>.58</td>
<td>.43</td>
<td>.35</td>
<td>.37</td>
<td>.51</td>
<td>.48</td>
<td>.52</td>
<td>.87</td>
</tr>
<tr>
<td>SCOF4</td>
<td>.47</td>
<td>.56</td>
<td>.61</td>
<td>.50</td>
<td>.37</td>
<td>.31</td>
<td>.43</td>
<td>.48</td>
<td>.41</td>
<td>.51</td>
<td>.85</td>
</tr>
<tr>
<td>SCOF5</td>
<td>.38</td>
<td>.49</td>
<td>.58</td>
<td>.55</td>
<td>.38</td>
<td>.40</td>
<td>.40</td>
<td>.51</td>
<td>.46</td>
<td>.51</td>
<td>.85</td>
</tr>
<tr>
<td>SCOF6</td>
<td>.45</td>
<td>.50</td>
<td>.54</td>
<td>.53</td>
<td>.29</td>
<td>.32</td>
<td>.30</td>
<td>.44</td>
<td>.38</td>
<td>.38</td>
<td>.81</td>
</tr>
</tbody>
</table>

\(^a\) Bold items represent item loadings on their respective constructs.  
\(\text{RGTR} = \) Relational Governance: Trust;  
\(\text{RGCM} = \) Relational Governance: Commitment;  
\(\text{RGCO} = \) Relational Governance: Coordination;  
\(\text{RGJP} = \) Relational Governance: Joint Problem Solving;  
\(\text{VI} = \) Virtual Integration;  
\(\text{IVM} = \) Information Visibility: Manufacturing;  
\(\text{IVT} = \) Information Visibility: Transaction;  
\(\text{IVP} = \) Information Visibility: Planning;  
\(\text{IVS} = \) Information Visibility: Supplying;  
\(\text{IVE} = \) Information Visibility: Evaluation;  
\(\text{SCOF} = \) Supply Chain Offering Flexibility.
Table 4: Correlation matrix and composite factor reliability scores.

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Composite Reliability</th>
<th>(\alpha)</th>
<th>Mean</th>
<th>STD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational Governance (RG):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Trust (RG)</td>
<td>.93</td>
<td>.89</td>
<td>4.06</td>
<td>.60</td>
<td>.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Commitment (RG)</td>
<td>.89</td>
<td>.83</td>
<td>3.92</td>
<td>.68</td>
<td>.68</td>
<td>.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Coordination (RG)</td>
<td>.91</td>
<td>.85</td>
<td>3.78</td>
<td>.68</td>
<td>.66</td>
<td>.74</td>
<td>.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Join Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solving (RG)</td>
<td>.88</td>
<td>.78</td>
<td>3.93</td>
<td>.68</td>
<td>.49</td>
<td>.62</td>
<td>.67</td>
<td>.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Virtual Integration</td>
<td>.94</td>
<td>.92</td>
<td>3.34</td>
<td>.85</td>
<td>.31</td>
<td>.34</td>
<td>.40</td>
<td>.51</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Visibility (IV):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Manufacturing (IV)</td>
<td>.93</td>
<td>.90</td>
<td>3.42</td>
<td>.87</td>
<td>.27</td>
<td>.35</td>
<td>.36</td>
<td>.52</td>
<td>.57</td>
<td>.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Transaction (IV)</td>
<td>.94</td>
<td>.92</td>
<td>3.95</td>
<td>.76</td>
<td>.29</td>
<td>.38</td>
<td>.35</td>
<td>.56</td>
<td>.49</td>
<td>.67</td>
<td>.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Planning (IV)</td>
<td>.91</td>
<td>.86</td>
<td>3.83</td>
<td>.78</td>
<td>.41</td>
<td>.48</td>
<td>.50</td>
<td>.62</td>
<td>.53</td>
<td>.58</td>
<td>.70</td>
<td>.88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Supplying (IV)</td>
<td>.95</td>
<td>.93</td>
<td>3.84</td>
<td>.78</td>
<td>.38</td>
<td>.43</td>
<td>.50</td>
<td>.53</td>
<td>.55</td>
<td>.46</td>
<td>.53</td>
<td>.59</td>
<td>.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Evaluation (IV)</td>
<td>.94</td>
<td>.92</td>
<td>3.70</td>
<td>.70</td>
<td>.51</td>
<td>.48</td>
<td>.58</td>
<td>.56</td>
<td>.59</td>
<td>.44</td>
<td>.44</td>
<td>.57</td>
<td>.74</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>11. Supply Chain Offering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>.92</td>
<td>.90</td>
<td>3.86</td>
<td>.63</td>
<td>.51</td>
<td>.57</td>
<td>.67</td>
<td>.66</td>
<td>.46</td>
<td>.39</td>
<td>.46</td>
<td>.59</td>
<td>.53</td>
<td>.58</td>
<td>.82</td>
</tr>
</tbody>
</table>

*Items on diagonal (shaded) represent the square root of the average variance extracted scores.
**DISCUSSION AND CONCLUSION**

In line with Holcomb and Hitt (2007), this study contributes to theory by integrating TCE and RBV to study the interorganizational governance in supply chains. We extend current theory by highlighting the role of collaboration mechanisms in value creation from the perspective of RBV. Our theorizing presents a view that, by linking supply chain activities for gaining access to valuable capabilities, firms can create value beyond the cost economization available through more efficient governance mechanisms. The findings reveal that both relational governance and virtual integration have significant and positive effects on information visibility, and also that relational governance is beneficial to supply chain offering flexibility. These results confirm the performance implications of previous TCE empirical research, that hybrid governance in response to transaction hazards has a significant effect on performance (Geyskens, Steenkamp, & Kumar, 2006). While virtual integration does not show any significant, direct effect on supply chain offering flexibility, it nonetheless can enhance supply chain offering flexibility through the mediation of information visibility. Thus, the findings are generally supportive to the proposed research model. In sum, supply chain advantages can be accrued more effectively from relational mechanisms than from legal contracts and from virtual integration than from vertical integration.

The dominant goal most often cited in supply chain management is cost efficiency. According to this perspective, prior TCE-based research has mainly emphasized the control mechanisms for reducing transaction cost (Heide & John, 1990). This study argues that the best supply chains are not just cost efficient, but are also adaptable to managing transitions, such as changing market conditions, evolving technology, and varying product-life-cycle requirements (Beth, Burt, & Copacino, 2003; Lee, 2004). Supply chain flexibility is one important goal in supply chain management, and IT enables this goal to be achieved. Building a trustful and aligned relationship also facilitates information exchange, eventually leading to greater supply chain flexibility. This study, therefore, concentrates on the role of
information visibility as a critical interorganizational value creator that enables an adaptive supply chain to compete in a dynamic environment.

The proposed information visibility construct, though preliminary, is a critical metric for net-enabled organizations. When information creates links between organizations, it can replace or enhance physical processes and then generate productivity gains (Straub et al., 2002). Information visibility is the outcome of interfirm information-sharing behaviors, which can be realized through different means. Therefore, information visibility is the desired end and virtual integration is just one of the mechanisms that help reaching such an end in supply chains. Thus, distinguishing between these two constructs permits a better understanding of the influence of information systems and IT on information visibility in the supply chain context. While formal collaboration mechanisms can bring external information into firms, informal information exchange relying on various relational networks is also important, especially when firms have built a good long-term relationship. Noncodifiable information and tacit knowledge can also be easily acquired from such a channel. This study demonstrates the importance of both relational governance and virtual integration in enhancing information visibility in the supply chain context. However, even though IT can be helpful in leading to an adaptive supply chain through increased information visibility, relationship building between firms remains to be a more important driver for supply chain adaptability.

As shown in Table 5, virtual integration affects supply chain offering flexibility only indirectly through information visibility. Thus, supply chain offering flexibility can be increased by virtual integration through greater information visibility, demonstrating the importance of information visibility in mediating the effect of virtual integration on supply chain offering flexibility. This might explain why the results do not support our postulated direct effect of virtual integration on supply chain offering flexibility, because virtual integration can facilitate supply chain flexibility mainly through enhanced information visibility while the main purpose of interorganizational information systems is to enable information visibility. Even though virtual integration could be a powerful strategy for supply chain management, it is still impeded by many barriers, such as supplier, customer, and internal barriers (Frohlich, 2002). Supply chain partners can increase their responsiveness to changes only when the barriers are resolved and information visibility is improved. Thus, the value of the hybrid governance mechanisms is manifested not only in their ability to reduce transaction costs but also in their ability to create flexibility in exchange relationships through superior information visibility (Dyer & Chu, 2003).

<table>
<thead>
<tr>
<th>Table 5: Direct and indirect effect of relational governance, virtual integration, information visibility, and supply chain offering flexibility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect on Supply Chain Offering Flexibility</td>
</tr>
<tr>
<td>Effect of Relational Governance</td>
</tr>
<tr>
<td>Effect of Virtual Integration</td>
</tr>
<tr>
<td>Effect of Information Visibility</td>
</tr>
</tbody>
</table>
Consistent with the emphasis on the relational or social aspects for obtaining adaptive supply chains (Beth et al., 2003), the study empirically demonstrates that relational governance can increase supply chain flexibility. Buyer–supplier relationships very often are governed by formal contracts. However, no contract is complete. Relying on formal contracts thus does not fit the adaptation requirements of a long-term relationship in a dynamic environment, such as a supply chain partnership. A partnership with long-term commitment provides a flexible cooperative relationship to control resources and to create value (Young et al., 2003). Without a good relationship, members in a supply chain may have to duplicate many management and control mechanisms for monitoring the activities and performance of the others (Beth et al., 2003). In addition to facilitating information exchange (Moberg et al., 2002), mutual trust can replace mutual monitoring and thereby eliminate duplicated management burdens, leading to a leaner and more agile supply chain. Relational governance should, therefore, be seen as a key driver of supply chain flexibility.

This study illustrates several directions along which businesses can create value from existing interfirm relationships. First, firms can rely more on relational governance mechanisms than on formal contracts, thus enhancing supply chain flexibility to deal with the increasingly uncertain business environment. Second, information visibility is a valuable resource to improving supply chain flexibility. Information related to manufacturing, transaction, planning, supplying, and performance evaluation must be exchanged to achieve high performance and a flexible supply chain. Timely and accurate information exchanges facilitate rapid interfirm decision making and coordination in response to the adaptation needs. To be effective, supply chain partners should assess the gaps between their needs and the current status in various dimensions of information visibility and invest in the areas that require enhancement. Finally, both virtual integration and relational governance can increase information visibility. Managers must consider carefully information-visibility aspects they intend to improve by IOS and make appropriate decisions regarding IOS adoption and use with different functionalities. The role of supply chain partners has changed from transactional to collaborative. Thus, managers should rethink the role of their supply chain partners and exert sufficient effort in building relationships.

Future research will involve determining whether virtual integration and relational governance are complementary or mutually reinforcing in improving supply chain visibility and flexibility. Future research may also examine the interaction effect of different governance mechanisms. The concept and measure of information visibility proposed in this study require further development. Collecting data from both buyers and suppliers would advance our understanding of the working of interorganizational governance and its effect on supply chain operations and performance. [Received: December 2005. Accepted: September 2007.]

REFERENCES


**APPENDIX: SURVEY QUESTIONS USED IN STUDY**

While answering the questions in the following sections, please choose the major supplier of your company as the responding target.

**Relational Governance**

This section describes the relationship quality between the supplier and your company. Please respond to the questions by circling the most appropriate response according to your assessment. (Scale: strongly disagree 1–2–3–4–5 strongly agree)

**Trust**

(RGTR1) We could rely on the supplier to keep promises they made to us.

(RGTR2) We could count on the supplier to be sincere in their dealings with our firm.

(RGTR3) The supplier was a company that stood by its word.

**Commitment**

(RGCM1) We remained with the supplier because we felt like part of the supplier family.

(RGCM2) We remained with the supplier because we were attracted to the things the supplier stood for as a company.

(RGCM3) We expect the relationship with the supplier to last a lifetime.

(RGCM4) It is assumed that renewal of agreements in our relationship with the supplier would occur.

**Coordination**

(RGCO1) The different job and work activities between our company and the supplier fit together very well.

(RGCO2) People from our company and the supplier who had to work together did their jobs properly and efficiently.

(RGCO3) The routines between our company and the supplier were well established.
Joint Problem Solving

(RGJP1) When conflicts arose, our company and the supplier would find out a proper solution jointly.

(RGJP2) When the supplier’s performance did not match our expectation, we would help it or provide suggestion.

(RGJP3) When our company encountered some difficulties in product design, the supplier would provide helpful opinions.

Virtual Integration

This section describes the supply chain activities that the supplier and your company rely on interorganizational information systems and Internet applications. Please respond to the questions by circling the most appropriate response according to your assessment. (Scale: very low 1–2–3–4–5 very high)

The supplier and your company rely on interorganizational information systems and Internet applications to:

(VI1) Process order
(VI2) Exchange product price and market information
(VI3) Implement quality control on purchased goods
(VI4) Collaborate in the aspects of new material and component testing periodically
(VI5) Coordinate production plan with each other
(VI6) Coordinate inventory level with each other

Information Visibility

This section describes the information visibility of your supply chain. Please respond to the questions by circling the most appropriate response according to your assessment of the completeness (including reliability and timeliness) of the information. (Scale: very low 1–2–3–4–5 very high)

The complete information that your company provides to the supplier:

Manufacturing

(IVM1) New product information
(IVM2) Product design information (e.g., PDM)
(IVM3) Bill-of-Material (BOM) information
(IVM4) Request for proposal (RFP) information

Transaction

(IVT1) Ordering information (e.g., PO/SO)
(IVT2) Change order information
(IVT3) Shipping notices and acknowledgement
(IVT4) Payment processing information
(IVT5) Product returns information
Planning
  (IVP1) Material requirement
  (IVP2) Order forecasting
  (IVP3) Production schedule

Supplying
The complete information that your supplier provides to your company:
  (IVS1) Order processing status
  (IVS2) Shipping schedule
  (IVS3) Transportation schedule
  (IVS4) Shipment tracking

Evaluation
The supply chain performance evaluation information your company obtained:
  (IVE1) Order processing performance
  (IVE2) Order fulfillment performance
  (IVE3) Inventory management performance
  (IVE4) Product quality assessment information
  (IVE5) Product cost assessment information

Supply Chain Offering Flexibility
This section describes the interactions between the supplier and your company. Please respond to the questions by circling the most appropriate response according to your assessment. (Scale: strongly disagree 1–2–3–4–5 strongly agree)
  (SCOF1) Our company and the supplier made adjustments in the ongoing relationship to cope with changing circumstances.
  (SCOF2) Our company and the supplier flexibly dealt with complicated problems that neither party could account for.
  (SCOF3) Our company and the supplier were flexible in response to requests for changes
  (SCOF4) When unexpected situation arises, our company and the supplier would solve problems adequately.
  (SCOF5) When an unexpected situation arises, our company and the supplier would rather modify the agreement than hold each other to the original terms.
  (SCOF6) When disagreement arises in transaction process, our company and the supplier would reevaluate the ongoing situation to achieve mutually satisfied solution.

Eric T.G. Wang is a professor and Dean of School of Management at National Central University, Taiwan (R.O.C.). He received the PhD degree in business administration, specializing in computer and information systems, from the William

**Hsiao-Lan Wei** is an assistant professor in the Department of Information Management at National Taiwan University of Science and Technology. She received her MBA and PhD in information management from National Central University, Taiwan (R.O.C.). Her research interests include enterprise resource planning, organizational learning, and supply chain management. Her research has appeared in *Journal of Management Information Systems, European Journal of Information Systems, Total Quality Management and Business Excellence, International Journal of Project Management*, and others.