Relational Antecedents of Information Flow Integration for Supply Chain Coordination

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ABSTRACT: A new model of competition, where competition is among supply chain networks rather than individual firms, is transforming traditional market-based buyer–supplier relations to one of competition among cooperative sets. In order to integrate and realize performance gains from participating in cooperative supply networks, the importance of information sharing across the supply chain has been emphasized in different literature streams. In this study, we examine the relational antecedents of this critical aspect of supply chain integration—that is, information flow integration.

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Our objective is to investigate the relationship between relational orientation of the focal firm, as characterized by (1) long-term orientation of its supply chain relationships, (2) asset specificity, and (3) interaction routines and the information flow integration between a firm and its supply chain partners. A research model was developed and data were collected from 110 supply chain and logistics managers in manufacturing and retail organizations. Our results suggest that tangible and intangible resources invested in supply chain relationships enable the integration of information flows with supply chain partners. Specifically, formal and informal interaction routines that take time and effort to develop enable integration of informational flows across a firm's supply chain. Investments in relation-specific assets and long-term orientation in relationships enable the development of these interaction routines.

KEY WORDS AND PHRASES: information flow integration, information sharing, relational orientation, supply chain management, supply chain relationships.

A NUMBER OF RESEARCHERS HAVE HIGHLIGHTED the emergence of new competitive structures based on cooperative networks and interfirm collaboration [34, 53, 56]. They suggest that "value chains" or production and distribution networks, rather than individual firms, compete in marketplaces [50]. Managing capabilities and resources across the extended enterprise becomes increasingly important as firms need to manage their production and distribution networks rather than just firm resources [50, 53, 56]. Consequently, firms can accrue rents from membership in cooperative networks, in addition to rents generated from capabilities resident within the firm [95].

Key capabilities that may emerge from network membership include the ability of an organization to sense supply and demand signals across the supply chain. Delays in information transfer, often attributed to the distributed location of information across the supply chain and its inaccessibility, lead to reduced information visibility, poor forms of interaction, and mismatches between demand and supply [34, 99]. Referred to as the bullwhip[1] effect, the divergence between demand and supply is amplified as downstream members interpret demand signals independent of context and add a factor of safety before it is transmitted upstream. This amplified order variation results in significant market mediation costs that manifest in the form of stock-outs and stockpiles at different stages in the supply chain [137, 139]. Moreover, in hypercompetitive environments where historic patterns of buying behavior to anticipate demand are not readily available, near real-time information sharing across the supply chain is considered critical for effectively matching supply capabilities and capacities with emergent demand patterns [58, 137, 142].

Organizational information sharing has been studied from a variety of perspectives, from organization design approaches that can enable information sharing [60] to the impact of generic and specific technologies on information flows and information sharing in organizations [46, 84, 153]. While e-business technologies, applications, business models, and practices can enable collaborative processes that are efficient and agile, these resources are architected on assumptions of information sharing. The

level of utilization of such technologies and the extent to which they generate value is shaped, in part, by the actual extent to which information is shared between partners. Therefore, our theoretical understanding and empirical investigation of the value of e-business investments and solutions must be based on an understanding of information flow integration between a firm and its partners. Toward this end, measures and models of constructs related to information flow integration in supply chains, and its antecedents and consequences, will enhance our understanding of the value created by e-business innovations. Our research focus is to (1) isolate a parsimonious set of relational preconditions, (2) investigate the interrelationships among them, and (3) examine how they shape information flow integration[2] in a focal firm's supply chains. Given our intent to isolate the relational preconditions that shape information flow integration, we draw upon the relational perspective of interorganizational partnerships [53], theoretical and empirical studies of supply chain relationships [26, 33, 34, 54, 74, 78, 106, 113, 134, 137], and the marketing literature on communication in channel relationships [7, 49, 55, 69, 112] to inform our investigation.

We identify partner-specific investments in dedicated assets, interfirm interaction routines, and long-term relational orientation as relational antecedents. We focus our theory building and theory testing with the focal firm in a supply chain as our unit of analysis. We theoretically develop and propose a nomology that suggests that long-term relational orientation between a focal firm and its supply chain partners supports the creation of partner-specific assets and interfirm interaction routines. Partner-specific assets provide the impetus for developing effective know-how to leverage resource complementarities across firms by establishing interfirm interaction routines. These interaction routines then represent network-wide coordination structures that shape information flow integration between a focal firm and its network partners.

Information Flow Integration for Supply Chain Coordination

COORDINATION AND INTEGRATION OF RESOURCE FLOWS in supply chains is now considered a critical factor for firm success [137]. It has become imperative for firms to effectively communicate with customers and suppliers to responsively align supply and demand. Traditionally, firms have operated in supply chain environments characterized by sparse information [140], imperfect information (e.g., lack of timely information about discounts and promotions), excluded classes of information (e.g., information about substitute products), or absence of compatible infrastructure such as compatible software and hardware for communication [137]. This lack of information sharing and information asymmetries lead to greater operational inefficiencies, transaction risks, and coordination costs [36]. As such, these information asymmetries can be reduced by sharing inventory, production, and sales data, along with planning and forecasting information. Transaction risks can also be reduced by sharing monitoring and control information, such as performance metrics, and production and delivery schedules [94]. Benefits of such coordination through information flow integration are expected to result in reduced operating costs and improved

productivity, asset efficiency, higher revenues, and improved customer relationships [97, 154].

The Strategy Perspective

Until the mid-1980s, based on principles of transaction cost economics (TCE), the emphasis in governing supply chain relationships was to safeguard against opportunism through arm's-length relationships and to achieve performance gains through market prices. By the late 1990s, supply chain relationships were marked by increased cooperation among partners, consistent with the relational view of the firm. Wal-Mart, Procter and Gamble, Lucent Technologies, Dell, Cisco, and Sara Lee became leading exemplars of collaborative practices with supply chain partners in areas of planning, forecasting, and replenishment [83]. Concepts of trust and collaboration challenged the assertions of transaction cost theory [29, 65], notably, from resource- and competency-based theorists [65, 96, 104].

The resource-based theory of firms [17, 42, 121] argues that firms derive sustainable competitive advantage from scarce, valuable, and inimitable firm-specific resources. Drawing upon this theory, researchers [47, 66, 114, 146] have proposed that the deployment of tangible assets and resources depends on how they are combined and applied by the firm. It is argued that heterogeneous stocks and flows of information and knowledge provide firms with unique resources for competitive advantage. These unique resource combinations are considered to be embedded in the firm's culture and identity, routines, policies, systems, repositories, and individual employees [2, 66, 68, 146].

Given that the value-creation potential of unique resources may be with partners, firms can develop inimitable capabilities by establishing information sharing routines [53]. This view is consistent with the noted importance of network membership, where researchers suggest that the content and process of information and knowledge sharing in networks are key sources of firm value [70, 72, 95, 105]. Collaboration between network members requires significant information exchange and is promoted by the nature of the relational ties between firms that interact directly and indirectly with each other [70]. Furthermore, knowledge and information, especially in the supply chain, are physically and temporally distributed, making information sharing an important aspect of managing the extended enterprise. Integrated information flows across the supply chain then represent information about events, stocks, flows, and outcomes that can be accessed to establish coordination patterns and achieve performance improvements. Researchers argue that when firms collaborate to share information, knowledge, and resources, they are often in a position to generate relational rents [53]. Successful firms are more likely to take a systematic and dynamic view of their supply chain and develop efficient information transfer systems [18]. Thus, from the resource-based, relational, and network perspectives, the information flow capabilities between a firm and its partners supports the development of sustainable competitive advantage [83].

The Marketing Perspective

Channel communication is identified as key to effective functioning of channel networks [111]. It is viewed as the "glue that holds together a channel of distribution" [110, p. 36] and an important factor in developing and assessing the quality of channel relationships [111]. According to Mohr and Nevin [110], most research on channel communication in marketing takes one of two approaches: focusing either on executive/summary evaluative judgments about satisfaction and value derived from the communication itself [7] or on the nature of communication flows [110]. Research on communication flows has examined interactions between channel members [25], two-way feedback and participation [8], and the degree to which detailed expectations are communicated [5]. In summarizing research on communication in marketing channels, Mohr and Sohi [111] suggest that multiple measures of communication be evaluated to have a more precise understanding of patterns and their effects. In other research, communication between channel members has been linked to trust [4, 5, 55], channel structure [25], and coordination and cooperation [4, 8, 55, 112].

In studying communication flows in marketing channels, the focus has been on their positive and beneficial effects, often overlooking distortion, selective disclosure, and opportunistic withholding of information that can have negative consequences for the entire channel [111]. In collaborative relational structures, parties may be able to influence each other merely by providing information without resorting to distributive bargaining tactics [83, 137, 148]. For instance, collaborative communication strategies may serve as informal governance without requiring formal governance or sole reliance on complete contracts [112]. Mohr and Nevin [110] suggest that the effectiveness of different communication strategies depends on channel conditions, such as channel structure, climate, and distribution of power relationships. They argue that the drivers of collaborative communication include shared norms about the value of information sharing and relational embedding. Joint planning, collaborative execution, and a high amount of interdependence are considered to be characteristics of a relational structure. Coordination of such joint activities across the supply chain requires information sharing, and the information exchanged can be categorized as related to pricing, location, inventory, product characteristics, performance metrics, and demand information. It has been suggested that future research should examine information sharing behavior [79] and specific communication flows [111] between supply chain partners for purposes of supply chain coordination.

The Operations Perspective

Anand and Mendelson [3] point out that supply chain coordination capability is affected by two main issues—that is, information sharing and the allocation of decision rights across channel members. In traditional supply chain environments, characterized by arm's-length relations and market-based transactions, periodic orders are the primary coordination information exchanged. Accordingly, much of the operations management literature has focused on improving material flow (for example,

determining optimal inventory levels and their staging) in the supply chain given this level of information sharing. Moreover, while information and physical flows have historically been tightly coupled, advances in information technology (IT) have enabled their decoupling. Consequently, it has been noted that focusing on material flows and ignoring information flows across a supply chain results in suboptimal performance [24], resulting in an increasing interest in information sharing in supply chains [13, 26, 27, 63, 100].

Based on this growing attention to information sharing, it has been found that shared information can improve supplier's order quantity decisions and supplier's allocation of inventory among the retailers [100]. In addition to studying the sharing of demand and inventory data, researchers have examined the benefits of sharing ordering policy and forecasts of future demand [12, 63]. Lee et al. [99] find that sharing information reduces the supplier's demand variance with the potential benefit of reducing costs. Reported benefits of information sharing in this stream of research vary considerably depending on the model assumptions and its parameters [26]. For example, Chen [27] found that supply chain costs could be lowered by as much as 9 percent, and on an average by 1.8 percent, and Gavirneni et al. [63] found that supplier's costs were reduced by 1–35 percent when retailer's demand data was available to the supplier. Lee et al. [100], on the other hand, report that information sharing lowered supply chain costs by about 23 percent. In examining all feasible information sharing policies, it has been suggested that full information sharing policy is considered close to optimal [26, 28, 67, 100], though the benefits of information sharing need to be examined if the demand is predictable based on previously available information [126].

IT has played a significant role in enabling information sharing in supply chains. Automated collection of data from scanners at points of sale and technologies such as electronic data interchange (EDI) allow data to be shared in real time among supply chain participants. Wal-Mart is widely used as a textbook example of an organization that carefully manages information flows across the retail supply chain. Scanner data from checkout counters and inventory information are transferred in near real time to suppliers via satellite and used not only for inventory replenishment but also to enable pricing and stocking decisions. Similarly, Cisco's customers place a majority of their orders online, which are then digitally transmitted to contract manufacturers and logistics partners. More than 60 percent of the orders placed by Cisco's customers are directly shipped by Cisco's contract manufacturers [22]. Organizations such as Wal-Mart, Dell, and Honda substitute information for inventory in order to cut their inventory holdings and improve supply chain performance. Looking at their successes, there is now a general belief that capturing and sharing real-time demand information is likely to play a key role in improving the performance of the supply chain.

Operations management scholars note that information can be shared with supply chain partners to reduce inventory, minimize physical flow delays, and better match supply and demand [108]. Downstream information flows in supply chains focus on coordinating capacity, delivery schedules, and product information, whereas upstream information flows focus on orders, demand forecasts, point-of-sales information, and performance metrics. The pooling of complementary demand-related information

enables collaborative forecasting and planning, and the sharing of performance metrics can be used to identify bottlenecks in supply chain operations and orchestrate joint action for correction and avoidance [98].

Summary

The three perspectives recognize that the structure of the supply network influences cooperative behavior and that value from network membership can be realized through cooperative behavior. It is increasingly apparent that in order to function as networks, firms have to move from adversarial relationships to collaborative ones. Not only do network partners need to share transactional data but they stand to derive value from sharing operational and performance outcome information for supply chain coordination. The visibility of information across the supply chain provides the platform for improved resource allocation decisions, process integration, risk management, and responsiveness to changing demand. Finally, all three perspectives reviewed here recognize that cooperative behaviors, such as information flows, are shaped not only by network structure, such as number of nodes, density of weak and strong ties, and number of layers [150], but also by relational properties. We focus on these relational properties that define the qualitative association between a focal firm and its supply chain partners and how this association influences information flow integration for coordination.

Relational Orientation of a Firm

SUPPLY CHAIN PARTNERSHIPS HAVE BEEN INVESTIGATED from a variety of theoretical perspectives ranging from transaction cost theory [156] to social theories, such as relational exchange theory [49] and network theory [76]. Moreover, empirical studies have applied diverse perspectives, such as game theory [155], transaction cost theory, and coordination theory, to examine the effects of specific technologies, such as EDI [78], on governance choices and processes. Coordination theory [37, 44] suggests that coordination costs are an important determinant of market structure, and, even though IT lowers coordination costs, there appears to have been a trend toward fewer suppliers [15]. This move toward partnerships put forth in the "move to the middle" hypothesis by Clemons et al. [38] suggests that intangibles such as trust and quality create the conditions that favor long-term contracts with fewer suppliers. Given the central role of transaction costs and relational considerations in decisions related to supply chain information flows, we focus on these perspectives.

The Transaction Cost Perspective

TCE focuses on the trade-off between transaction costs and alternative governance structures [156, 157]. By selecting appropriate governance mechanisms, firms can minimize their transactions costs [130]. Specifically, firms can choose between markets or

hierarchies and should base this choice on transaction characteristics [119]. A key behavioral assumption of TCE is opportunism [159], which suggests that under conditions of information asymmetry, agents in a relationship are likely to take unfair advantage of a bargaining situation. Firms can counter opportunistic behavior by developing safeguards [29] or investing in assets, such as machinery, training, and procedures, that are specific to the relationship and bind partners together [21].

In terms of advocated approaches for governance, TCE suggests that market-based transactions are preferred under conditions of low asset specificity, low uncertainty, and infrequent transactions, as the risk of opportunism is expected to be lower and complete contracts can be specified. When asset specificity, environmental uncertainty, and transaction frequency are high, the risk of opportunism is high and hierarchies are favored over markets [157]. However, hierarchies are not always the mechanism of choice, because of concerns about economies of scale and scope, lack of entrepreneurial spirit, and bureaucratic costs [158]. In such situations, complete contracts become cognitively difficult to write and execute due to bounded rationality constraints and organizations may favor incomplete contracts in the form of partnerships and alliances [21]. Thus, organizations may not necessarily choose market-based relations over vertical integration but voluntarily establish and maintain long-term, cooperative supply or distribution relationships as a way of competing with organizations outside the network [125]. Similarly, interorganizational information sharing and level of trust in buyer–supplier relationships are expected to reduce transactions costs [52] as well as coordination costs [35]. For instance, the availability of pricing and supply information reduces ex ante and ex post information asymmetries [1], and trust and long-term relationships can mitigate transaction costs by reducing the risk of opportunism [19, 156]. Analyzed from a transaction cost perspective, such partnerships can mitigate the effects of pure markets and hierarchies by (1) having a long-term orientation, (2) creating relationship-specific assets, and (3) developing mechanisms for interacting with supply chain partners to mitigate information asymmetries.

Relational View of Partnerships

In addition to TCE, the marketing and strategic management literature has applied many theories to understand the resource dependence [122], relational exchange [49, 79, 89], communications [112], network structure [8], and social adaptation [77] in interorganizational relationships. We draw upon this rich base of literature to delineate key dimensions of supply chain partnerships that should relate to information sharing.

Relational exchange theory argues that besides economic factors identified in TCE, relationships are influenced by their sociological elements [160]. Relational exchange is considered an ongoing process where interactions and adaptations result in the development of shared knowledge over time [14, 79] and where cooperation takes the place of opportunism [49]. In such contexts, relationships do not have to be gov-

erned by formal contracts [103]. Instead, relational exchange theory argues that relational norms govern interorganizational relationships and that these norms are not exogenous but, rather, are based on internalization and mutual influence [90].

Participation, communication, and trust are key "relational" norms [49], and the incidence of communication and information sharing is higher in supply chain partnerships that operate in a climate of trust [49]. In fact, trust has been identified as a significant relational norm for not only supply chain partnerships but also for business-to-consumer transactions on the Internet [64, 120]. It is also considered to be an effective governance mechanism in interorganizational relationships [53, 80], one that is based on informal arrangements and self-reinforcement rather than strict formal contract and third-party control. The long-term orientation fostered by trust forms the basis for making investments specific to the relationship and developing rich interaction routines.

Long-term orientation is defined as perception that outcomes in a relationship are based on interdependence [92]. Long-term orientation comprises relational symmetry that includes belief in motives and intentions as well as the reliability and credibility of partners [129]. Symmetric dependence structures have been investigated in the context of relational exchange among partners in supply channels [73, 131]. Where relationships are not symmetric, there is a lack of bidirectional communication, and a lack of trust in the relationship [5]. Long-term orientation reduces the risk of opportunistic behavior and transaction costs in the relationship, and increases the confidence that problems in the relationship will be resolved to the benefit of all partners in the relationship [62].

Resource dependency theory suggests that interorganizational partnerships can help manage the uncertainty and distribution of resources in the relationship. For instance, asset-specific investments by suppliers reduce relationship uncertainty by increasing switching costs of the buyer and engender their commitment and cooperation to the relationship, especially in situations where these investments constitute critical tangible and intangible resources for the buyer [6, 20]. According to the resource dependence perspective [122], the availability of critical resources affects cooperation and conflict in distribution channels and determines the governance of these relationships [48]. When channel partners share control of resources, relationships are based less on formalization, centralization, or opportunism, but, rather, are based more on routines that engender greater participation through shared decision making, collaborative practices, and know-how exchange, which leads to greater satisfaction [49]. Specifically, know-how exchange plays a key role in the creation of knowledge [96] and, in contrast to information or codified knowledge, it is "sticky" and difficult to exchange. The ability of an organization to absorb know-how from its partners is thus likely to be influenced by the nature of the interorganizational interaction routines.

Based on the recurrent themes highlighted in the literature, we focus on how a focal firm's information flow integration for supply chain coordination is affected by three relational properties—specifically, established interaction routines, investments by suppliers in relationship-specific assets, and long-term orientation between a focal firm and its supply chain partners. Relational capabilities are characterized by the

extent to which these three properties are developed by a focal firm in the context of its supply chain relationships.

Research Model

WE FOCUS OUR RESEARCH MODEL ON relational antecedents of information flow integration between a focal firm and its partners for supply chain coordination. We propose (Figure 1) that relational interaction routines are proximate to information sharing behavior as it captures the processes that are established to integrate complementary resources between a focal firm and members of its supply chain. Relationship-specific assets and long-term orientation enable the development and deployment of these interaction routines between an organization and its supply chain partners. The model proposes that long-term orientation of relationships provides the foundation for investment in relationship-specific assets and information flow integration behaviors.

Information Flow Integration for Supply Chain Coordination

Visibility of operational information across supply chain partners is one indicator of information flow integration. Seidmann and Sundarajan [135] note that availability of operational information enables partners to leverage operational economies of scale and expertise of an organization. Inventory-holding information, an important operational information item, when shared, can lead to reduction of total inventory in the supply chain [99]. Similarly, production and delivery schedules can be shared to enhance operational efficiencies through improved coordination of allocated resources, activities, and roles across the supply chain [100]. With the substitution of information for inventory holdings [108], information flow integration can improve operational performance by reducing inventory costs, enhancing asset utilization, and improving cash flow and cycle times.

In addition to operational information, information flow integration for coordination includes the sharing of tactical information, such as performance metrics associated with task execution and outcomes. Such information, when shared, allows manufacturers and suppliers to develop common forecasts, synchronize production and delivery, coordinate inventory stocking, and develop an accurate assessment of performance bottlenecks across the supply chain [138]. Finally, strategic information sharing for supply chain coordination occurs when the information possessed by a firm generates little value by itself, but creates strategic value by sharing [135]; for instance, sharing of sales data by buyers with their sellers creates value through improved forecasting and replenishment planning. In fact, it has been shown that lack of actual sales information distorts demand information as it travels upstream across the supply chain [99]. The problems caused by such distortions include excess or inadequate inventory, poor production and capacity planning, poor cash flow utilization, and inadequate customer service.

In summary, we define information flow integration for supply chain coordination as the extent to which operational, tactical, and strategic information is shared be-

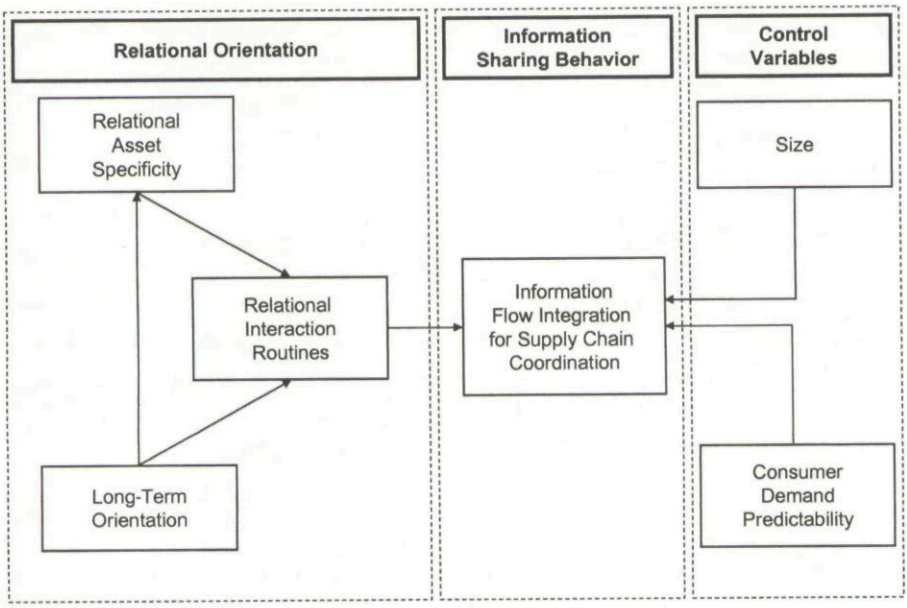


Figure 1. Research Model

tween a firm and its supply chain partners for supply chain coordination. Firms can share information with their supply chain partners about (1) events, such as order receipt and production; (2) stocks, such as work-in-process and finished goods inventory; (3) flows, such as shipment and delivery; and (4) outcomes, such as operational performance, profit margins, revenues, and sales. Specifically, we consider the sharing of demand-related information, inventory and sales positions, production and delivery schedules, and performance metrics as indicators of information flow integration for supply chain coordination.

Relational Interaction Routines

Relational interaction routines are defined as the degree to which informal and formal mechanisms are established for the exchange of information and knowledge between the focal firm and its supply chain partners. An important mechanism for organizations to create capabilities is by way of organizational routines [66]. Most organizational routines are a formalized set of procedures that have been constructed from learning and prior organizational experience [45]. Other organizational routines may be habitual and predictable task performance and coordination patterns, process configurations, and communication procedures that allow employees to exchange information and knowledge.

In general, interaction routines between supply chain partners exploit the notion that integration of information and knowledge typically takes place in groups [117]. The ability to coordinate among supply chain partners is both a collective and distributed capability based on organizational practices [118]. Well-developed interaction

routines structure the coordination and communication between a focal firm and its supply chain partners so that more information and knowledge is revealed and combined. They also channel information and knowledge flows among individuals to provide a platform for coordinating interfirm supply chain activities.

Relational interaction routines represent formal mechanisms where supply chain partners investigate and create opportunities for improvement [117]. These improvements are often focused on planning and coordinating supply chain activities through information flows. It has been suggested that the ability to interpret and utilize shared information and knowledge depends on the absorptive capacity [39] of partners. Dyer and Singh [53] note that partner-specific absorptive capacity, through overlapped knowledge bases, is established through frequent and intense interactions between partners. Siemieniuch [137] found that formal interaction practices between supply chain partners that focused on know-how related to collaborative planning resulted in integration of their information flows. This leads to our hypothesis that interaction routines promote the sharing of information between a focal firm and its supply chain partners:

> *Hypothesis 1: Relational interaction routines positively affect information flow integration for coordination between a focal firm and its supply chain partners.*

Asset Specificity

Asset specificity is defined as the degree to which a firm makes partner-specific investments in tangible physical resources, developing knowledge of partner procedures, culture, and technological know-how [158]. Williamson [158] identifies four kinds of specificity—location specificity, specific assets, dedicated assets, and human capital. Relationship-specific assets can consist of site-specific investments in production facilities and customized tools and machinery that the partners develop over a period of time [158]. Examining the success of Japanese automakers, Dyer [50] argues that the key to success of Japanese network relationships is the practice of dedicating supplier assets to the customer. In fact, it was found that as the distance between suppliers and the automakers' plant decreases, inventories as a percentage of sales decrease for the automaker. Comparing Toyota and GM, Dyer [50] suggested that if GM and Toyota had comparable inventory-to-sales ratios in 1992, then GM's inventory holdings would have been $6 billion less.

In addition to physical and human capital, investments in social capital can also be asset-specific [40]. The training of one's employees in partner-specific business processes is one such example. Building up a good understanding of partners requires investments in social capital through frequent business visits and invitations. It has been suggested that invisible assets, such as tacit knowledge, are inimitable and hence invaluable resources for organizations. Subramani [151] discusses the role of domain-specific knowledge and business process–specific knowledge as two types of "relation-specific intangible assets." Business process knowledge that is particular to the focal firm is more likely to be inimitable than physical assets, because of their greater causal ambiguity [152]. Moreover, domain knowledge specificity, which consists of

a unique understanding of context-sensitive procedures, culture, and technology, facilitates effective interactions in and coordination of the relationship.

When asset specificity is high, the possibility of opportunistic behavior is high and, hence, there is a greater need for safeguards [21, 141]. Creation of specialized assets such as centralized warehousing and distribution systems is accompanied by changes in procedures and roles in different administrative functions of supply chain partners [137]. The establishment of closer relationships accompanied by specialized assets leads to a shift toward a more bilateral governance requiring frequent interactions between supply chain partners. Integration across supply chain organizations for closer meshing of interorganizational processes can be achieved by means of buyer–supplier teams working together. So as to leverage dedicated assets, suppliers to Japanese automakers send their engineers to work at the automaker manufacturing facility (an added advantage of plant proximity) [50]. Frequent and formal interactions among supply chain partners have enabled Japanese automakers to achieve transparency in costs and produce high-quality vehicles quickly and inexpensively, while keeping transportation and inventory costs low [50, 101].

Based on the above discussion, we posit that the level of asset specificity is associated with the extent of interaction arrangements that are in place between a focal firm and its supply chain partners:

> *Hypothesis 2: Relationship-specific assets positively affect the development of relational interaction routines between a focal firm and its supply chain partners.*

Long-Term Orientation

Long-term orientation is defined as the degree to which long-term considerations, mutual gains, and informal governance characterize a firm's relationships with its partners. When parties have a long-term relationship, they believe that positive outcomes for relational partners will also benefit the focal firm [62, 92]. Since there is an expectation of continuity in the relationship [115], the focus is on mutual benefit and expectations that no party will let short-term expediencies come in the way of the relationship. Firms with a short-term orientation are more likely to rely on market exchange mechanisms, whereas firms with a long-term orientation rely more on relational exchange [62].

Interorganizational relationships governed by self-reinforcing mechanisms are usually not bound by time limitations as compared to formal contracts. They could be either formal, such as joint investments, or informal, based on trust and goodwill. Informal reinforcement mechanisms are considered to be more effective and less costly than formal reinforcement mechanisms [80], as they do not require detailed monitoring and enforcement and increase the confidence of partners in making relationship-specific investments. They also enable sharing of tacit knowledge and are more likely to create idiosyncratic routines that are the source of sustainable value. Among self-reinforcing mechanisms, informal mechanisms reflected by the long-term orientation of partners are also more difficult to imitate [53].

Accordingly, we suggest that long-term relationship orientation will promote partner investment in assets that have a greater degree of specificity to the relationship. Implicit in long-term orientation is an expectation of continuity in the relationship that leads to mutual give-and-take over a period of time and provides for development of patterns of interaction specific to the relationship [62]. Finally, long-term orientation supports the creation and sustenance of relational interaction routines.

Arguably, relationship-specific assets can also exist in dependence relationships where suppliers have limited options available, except for meeting the demands of a powerful channel member [109]. Based on this premise, asset specificity can create long-term dependence relationships in the supply chain [62]. However, investments in relationship-specific assets and development of collaborative interaction routines are likely to be enabled by a long-term view of the relationship that is characterized by trust, goodwill, and a focus on mutual gain. Therefore, we propose that

Hypothesis 3: Long-term orientation positively affects investments in relationship-specific assets between a focal firm and its supply chain partners.

Hypotheses 4: Long-term orientation positively affects the development of relational interaction routines between a focal firm and its supply chain partners.

Control Variables

Fisher [58] makes a distinction between functional and innovative products based on differences in consumer demand predictability for these products. A key differentiation between them is that functional products have long product life cycles, which makes their demand predictable and lowers forecasting errors, whereas innovative products have short product life cycles, which makes their demand less predictable and increases the likelihood of forecasting errors. Organization information processing theory suggests that innovative product environments are rich in information [57, 60, 107] and, therefore, firms operating in such uncertain demand environments may be propelled to integrate information flows and develop joint strategies with their partners [107]. Accordingly, we specify consumer demand predictability as a control variable. In addition, since larger firms have greater available resources and power to influence the level of coordination among supply chain partners, we specify firm size as a control variable [81]. The research model is shown in Figure 1, and Table 1 provides a list of constructs and their definitions.

The Empirical Study

Instrument Development

WE DEVELOPED AND VALIDATED MEASURES for this study using guidelines and exemplars in the information systems (IS) literature, for example, Straub [149] and Sethi and King [136]. Past literature was reviewed to develop measures that adequately tapped the underlying construct, had face validity, and had a minimal overlap between

Table 1. Construct Definitions

Construct	Definition
Information flow integration for supply chain coordination	The extent of operational, tactical, and strategic information sharing that occurs between a focal firm and its supply chain partners for coordination.
Relational orientation	The degree to which a focal firm's relationship with its supply chain partners is based on long-term contracts, information sharing routines, trust, and asset-specific investments.
Relational asset specificity	The degree to which a focal firm's suppliers make partner-specific investments in tangible physical resources and intangible know-how.
Long-term orientation	The degree to which long-term considerations, mutual gains, and informal governance characterize a focal firm's relationships with its partners.
Relational interaction routines	The degree to which informal and formal mechanisms are established for the exchange of information and knowledge between a focal firm and its supply chain partners.
Consumer demand predictability	The length of the product life cycle and likelihood of forecasting errors.
Organization size	The total number of full-time or equivalent organizational employees.

constructs [43, 93]. As measures were developed for the first time, steps were taken to assess content validity. In the first instance, items were independently evaluated by each of the researchers and then subsequently in joint meetings where each construct and its items were discussed until there was unanimous agreement on content validity of the construct. Following the recommendation that having experts in the field evaluate several versions of the instrument contributes to content validity [43], we had a total of 21 different individuals evaluate the instrument at various stages of development. Two well-established IS researchers with significant experience in survey-based empirical research and with relevant domain expertise evaluated the draft instrument. After incorporating suggested changes, the first phase of the pilot test was conducted with nine faculty members in the IS area who are actively researching the strategic use of IT with a focus on interorganizational systems and e-commerce. In addition to asking them to make any comments on items and instructions, they were also requested to respond to semistructured questions designed to obtain their assessment of the content validity of each measure. Based on their feedback, the instrument was modified. The instrument was then tested using a similar approach with ten supply chain and logistics managers in the greater Philadelphia region. Telephone and e-mail discussions were conducted with respondents to obtain clarifications and to ensure that adjustments made to the instrument addressed their concerns. The process resulted in refinements such as modifying or deleting items and clarifying instructions.

Items associated with these constructs used a seven-item Likert-type scale where respondents were asked to state their agreement with a given statement on a scale that ranged from "strongly agree" to "strongly disagree," with its midpoint anchored as "neither agree nor disagree." Survey items associated with each construct are listed in Table 2.

Data Collection

A mailing list of supply chain and logistics managers was compiled from a list of attendees of the annual meeting of the Council of Logistics Management.[3] Target respondents for the survey were considered to be senior or middle managers with direct responsibility for supply chain management or logistics function in the organization. Published attendee information included name, title, affiliation, and contact information; most of them included an e-mail address in the contact information. Approximately 1,800 names were randomly selected from the list. All organizations that did not belong to manufacturing or retail industries (the first two digits of SIC [Standard Industrial Classification] codes 20 to 39 and 52 to 59) were removed from our sample. Because some of the conference participants were from the same organization, we selected one person from each organization based on the professional title that most closely matched the target respondent. The final list consisted of 432 manufacturing and retail organizations.

The survey was first mailed out and then subsequently made available on a Web site; the address of the Web site was sent only to people on the targeted mailing list. After the first conventional mailing, we sent e-mail reminders, providing respondents the option of receiving another copy of the survey by regular mail or completing the survey online. Our e-mail reminder provided an incentive of a $10 gift certificate for each completed survey. After accounting for undelivered and invalid mailing and incorrect e-mail addresses, the effective mailing was 360 surveys. We received a total of 110 combined responses via return mail, Web, and e-mail. The effective response rate was 30.55 percent, which is considered acceptable for such survey-based research.

The sample was comprised of organizations that had an average revenue of $6.43 billion (standard deviation [sd] 11.23, $n = 103$) and an average of 19,930 employees (sd 40,540, $n = 97$). The median organization size was 4,000 employees and the median organization revenue was $1.5 billion. Forty-five percent of the respondents were from the logistics function, 17 percent each from the supply chain and distribution functions, 13 percent had responsibility for IT pertaining to the supply chain, 6 percent specified that their direct responsibility focused on e-commerce and digitization to support the supply chain, and 3 percent belonged to the purchasing function. Collectively, our respondents appear to hold positions that are well aligned to the subject matter of our investigation and are likely to be well informed of relevant initiatives within their firms.

We tested for nonresponse bias using analysis of variance techniques. Considering the last group of respondents as most likely to be similar to nonrespondents, a com-

Table 2. Measurement Items

Information flow integration for supply chain coordination
• Production and delivery schedules are shared across the supply chain.
• Performance metrics are shared across the supply chain.
• Supply chain members collaborate in arriving at demand forecasts.
• Our downstream partners (e.g., distributors, wholesalers, retailers) share their actual sales data with us.
• Inventory data are visible at all steps across the supply chain.
Relational interaction routines
• We have created formal and informal arrangements for information exchange with our partners.
• Partners are involved in quality and improvement initiatives.
• We share best practices with our partners.
• We learn about new technologies and markets from our partners.
Relational asset specificity
• Partner tools and machinery are customized to our needs.
• Partners have dedicated significant investment and capacity to our relationship.
• Partner knowledge of our procedures, culture, and technological know-how is difficult to replace.
Long-term orientation
• We have long-term relationships with our strategic partners.
• In key partner relationships, trust and goodwill have the same or greater significance than formal contracts.
• Both sides in the relationship do not make any demands that can hurt the relationship.
Consumer demand predictability
• There is a high margin of error in product forecasts.
• Products have a short life cycle (< 1 year).

parison of the first and last quartile of respondents provides a test of response bias in the sample [9]. The first and last 25 percent of respondents were compared on revenue, organization size, and other key study variables. The tests did not indicate any response bias across these variables. Similar comparisons were made across participants who responded by regular mail and those who completed the survey online. The analysis indicated that the two groups were statistically similar on all demographic and key study variables.

Measurement Validation

Constructs in theoretical networks gain meaning from their definition and measures and the theoretical context in which they are embedded [16]. Second-generation statistical methodologies provide researchers with the ability to incorporate multiple dependent constructs, explicitly recognize error terms, and integrate theory with data. They also enable researchers to evaluate the measurement model along with the structural model between latent constructs proposed by the theoretical model. Partial least squares (PLS),[4] a second-generation statistical technique, was used for analyzing study data. We chose PLS for data analysis because of our emphasis on

theory development in this study. PLS is generally recommended for predictive research models where the emphasis is on theory development, whereas LISREL is recommended for confirmatory analysis and requires adherence to a stringent set of distributional assumptions [88].

Constructs in structural equation models may be modeled as either reflective or formative [30]. Jarvis et al. [86] note that the decision to model a construct as formative or reflective should be based on four major criteria: (1) direction of causality from construct to indicators, (2) interchangeability of indicators, (3) covariation among indicators, and (4) nomological net of construct indicators. In the case of formative constructs, indicators are considered to "form" as opposed to "reflect" constructs. They are not necessarily interchangeable, need not covary, and can be drawn from different nomological networks. The opposite conditions would apply in the case of reflective constructs. Subjected to the criteria, we consider information flow integration, relational interaction routines, and relational asset specificity as formative constructs, whereas long-term orientation was modeled as a reflective construct.

Since long-term orientation was modeled as a reflective construct, we evaluated the measurement properties of the construct by applying the following criteria. Item-to-construct loadings of 0.707 and above are considered to be desirable, as it indicates that 50 percent or more of the variance in the item is shared with the latent construct. Internal consistency was assessed using a measure of composite consistency[5] proposed for use in assessing the measurement properties of constructs in structural models by Fornell and Larcker [59]. We also report Cronbach's alpha for the construct in Table 3. While Cronbach's alpha is a measure of homogeneity of items in a construct based on the assumption that each item in the scale contributes equally to the latent construct, the measure for composite consistency uses item loadings estimated in the causal model to compute the measure of internal consistency. The interpretation of both measures is similar. Based on Nunnally's [116] guidelines, a score of 0.70 or above is acceptable for exploratory research, which is met here.

Formative constructs are not subject to the same criteria. Table 4 provides the mean values and standard deviation of all constructs. We also performed analysis to assess the factor structure of constructs in our study. As noted by Karahanna et al. [91], PLS does not directly support confirmatory factor analysis. Since PLS does not provide cross-loading information on other constructs, we used the procedure similar to the one described in Karahanna et al. [91] and Smith et al. [144] to evaluate the factor structure. First, a mean score for each construct was computed from the items that belonged to the construct. Factor scores or multivariate means can also be used to compute linear composite scores. Using summated mean values of items offers the advantage of being replicable across samples. It is the recommended approach when new measures are developed and transferability is desired [75]. Rozeboom [132] also notes that linear composite scores based on different weighting schemes are highly correlated when the items are internally consistent, which is true in our case. Subsequently, each item was then correlated against the mean score for each construct. For an indicator's intended construct, this correlation represents its "loading," whereas its correlations with other constructs represent the "cross-loadings." Table 5 shows each

Table 3. Measurement Properties of Long-Term Orientation (Reflective Construct)

Item	Loading	Composite reliability	Average variance extracted (percent)
Long-term orientation			
We have long-term relationships with our strategic partners	0.80	0.83 ($\alpha = 0.72$)	61.6
In key partner relationships, trust and goodwill have the same or greater significance than formal contracts	0.78		
Both sides in the relationship do not make any demands that can hurt the relationship	0.77		

Table 4. Descriptive Statistics for Formative Constructs

Construct	Mean	Standard deviation
Relational asset specificity	3.40	1.17
Relational interaction routines	3.06	1.15
Information flow integration	3.92	1.23
Consumer demand predictability	3.67	1.02

item's correlation with its own construct and its correlation with other constructs. Each item's correlation with its own construct should be greater than its cross-correlation with other constructs. Based on this analysis, we find that indicator loadings on their respective constructs are higher than their cross-loadings on other constructs, providing evidence of discriminant validity. Although the formative constructs also met tests of convergent validity, it should be emphasized that these are *not necessary* requirements for formative constructs [86]. The collective evidence suggests that the constructs demonstrate good measurement properties. In the subsequent structural analysis, the linear composite scores were used for formative constructs.

Results

The proposed research model was assessed by examining the significance of paths in the structural model. The PLS method does not directly provide significance tests and confidence interval estimates of path coefficients. In order to estimate the significance of path coefficients, a bootstrapping technique was used. Bootstrap analysis was done with 500 subsamples, and path coefficients were reestimated using each of these samples. The vector of parameter estimates was used to compute parameter

Table 5. Item-to-Construct Correlation Versus Correlations with Other Constructs

Construct/item	Information flow integration	Relational interaction routines	Relational asset specificity	Long-term orientation
Information flow integration (IFI)				
IFI1	**0.735**	0.386	0.220	0.201
IFI2	**0.817**	0.409	0.217	0.178
IFI3	**0.805**	0.416	0.216	0.241
IFI4	**0.694**	0.292	0.257	0.170
IFI5	**0.727**	0.393	0.130	0.280
Relational interaction routines (RIR)				
RIR1	0.323	**0.809**	0.268	0.395
RIR2	0.410	**0.883**	0.376	0.284
RIR3	0.450	**0.898**	0.376	0.390
RIR4	0.511	**0.848**	0.306	0.338
Relational asset specificity (RAS)				
RAS1	0.267	0.204	**0.751**	0.173
RAS3	0.231	0.437	**0.826**	0.297
RAS4	0.129	0.279	**0.761**	0.233
Long-term orientation (LTO)				
LTO1	0.167	0.426	0.330	**0.744**
LTO2	0.157	0.215	0.130	**0.869**
LTO3	0.333	0.377	0.249	**0.765**

means, standard errors, path coefficient significance, indicator loadings, and indicator weights. This approach is consistent with recommended practices for estimating significance of path coefficients and indicator loadings [102] and has been used in prior IS studies [31, 41, 128]. All path coefficients, except for the paths from the control variables to information flow integration, were found to be significant, thus providing support for the four hypotheses proposed by the research model (Figure 2). The model explained about 27.9 percent of the variance in relational interaction routines and 25 percent of the variance in information flow integration for supply chain coordination.

Mediation Analysis

The research model proposes that relational interaction routines mediate the impact of the two other relational characteristics—long-term orientation and relational asset specificity—on information flow integration. In addition to testing the hypotheses proposed by the model, we tested the mediation effect in two ways. First, we compared the research model that proposes full mediation against competing models that propose both direct and mediated effects—that is, a partially mediated model of the impact of relational antecedents on information flow integration. The two alternative partially mediated models have one additional path compared to the fully mediated

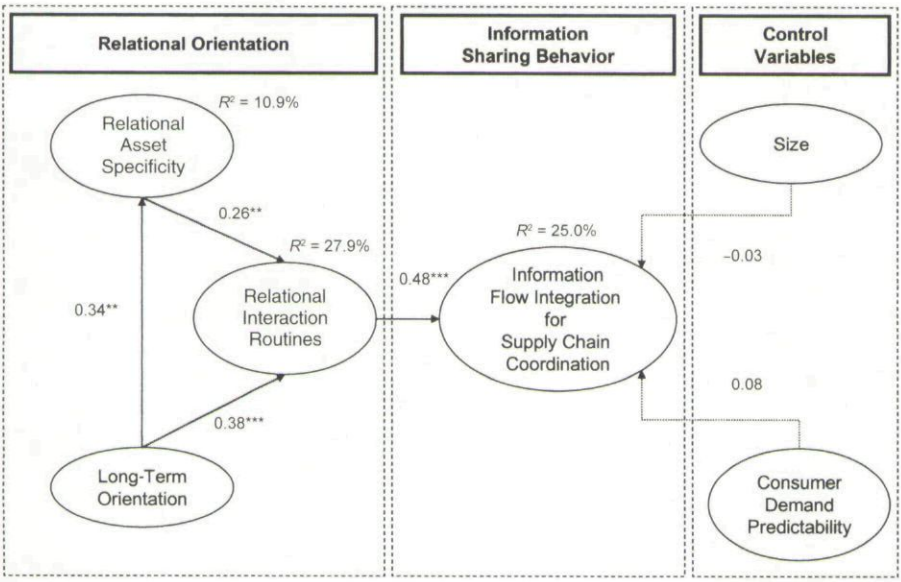
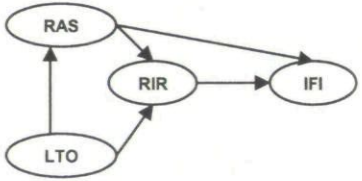
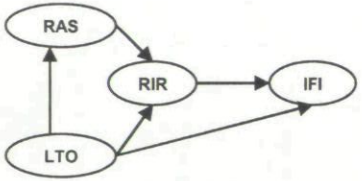


Figure 2. Results of PLS Analysis
** significant at the $p < 0.005$ level (one-tailed); *** significant at the $p < 0.001$ level (two-tailed).

model. In one of the alternative models, the path from long-term orientation to information flow integration is introduced, and in the other, a path from relational asset specificity to information flow integration is introduced (see Table 6). The fully mediated model is nested within each of the partially mediated models and can be compared statistically using PLS results [32, 151]. The R^2 for firm performance in the partially mediated model was 25.7 percent and 25.6 percent for each of the two alternative partially mediated models, as compared to 25 percent in the fully mediated research model. The effect of the extra path in the partially mediated models is assessed using a procedure similar to the one used to test competing models in stepwise linear regression. Accordingly, the f^2 statistic, which is based on the difference in R^2 between two models, is first computed and then used to compute a pseudo F-statistic.[6] Based on this procedure, the f^2 was 0.009 and 0.008 for the two partially mediated models, resulting in insignificant pseudo $F(1,106)$-statistics of 1.083 and 0.927. These results suggest that the additional variance explained by introducing the direct paths from either long-term orientation or relational asset specificity to information flow integration does not significantly add to the explanatory power of the model.

In addition to comparing nested models, we used mediation analysis techniques [82, 151] to assess the significance of the mediation effect of interaction routines on the relationship between the two relational antecedents—long-term orientation and relational asset specificity—and information flow integration. The analysis is based on the path coefficients and the standard errors of the direct paths between long-term orientation and relational asset specificity (independent variable, *iv*), relational interaction routines (mediating variable, *m*), and information flow integration (dependent

Table 6. Tests of Mediation—Nested Model Analysis

Direct path	Graphical model	R^2 full model	R^2 nested model	f^2-value	Pseudo $F(1,106)$
RAS–IFI (0.105,[1] $t = 1.00$*)		0.257	0.250	0.009	1.083*
LTO–IFI (0.094,[1] $t = 0.854$*)		0.256	0.250	0.008	0.927*

Notes: [1] path coefficient of direct path; * *not* significant at $p = 0.05$.

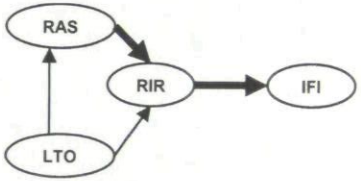
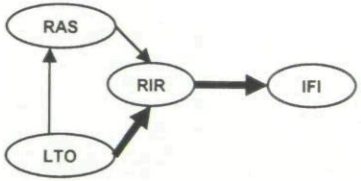
variable, *dv*) (see Table 7). The magnitude of mediation is computed as the product of the standardized path coefficients between long-term orientation and relational interaction routines (*iv* → *m*) and between relational interaction routines and information flow integration (*m* → *dv*). A similar computation is done for the mediated path between relational asset specificity (*iv*) and information flow integration (*dv*). The magnitude of mediation effect was 0.12 and 0.18 for each of the two relational antecedent constructs. The standard error of the mediated path is computed based on the standardized path coefficients and standard deviations of the direct paths among the independent, mediating, and dependent variables.[7] The computations yield a *z*-statistic of 2.11 and 3.23, which are significant at $p < 0.05$. The two tests of mediation illustrated here are considered to be complementary [151], as the nested model analysis assesses the additional explanatory power of competing models, whereas the mediation analysis provides information on the significance of mediation effects. The two tests provide further support for our research model.

Common Method Bias Assessment

The use of a single respondent to provide perceptual survey data raises concerns of common method bias. In order to assess the extent of this problem in our data, Harmon's one-factor test was conducted [123]. In accordance with the suggested procedure, all items used to measure the dependent and independent variables were entered into a single exploratory factor analysis. This analysis produced five factors, each of which has an eigenvalue greater than 1.0, and collectively accounted for 64 percent of the variance in the data. The first factor explained about 29 percent of the total variance. Since a single factor did not account for most of the variance, these results suggest that common method bias is unlikely to be a significant issue in the collected data.

In addition to the Harmon one-factor test, we examined the correlation between the data provided by the respondents and objective data reported in Compustat related to firm revenues. We were able to obtain revenue data from Compustat for 57 companies, as this was the subset of companies in our sample that were publicly traded and for which the respondents had provided SIC codes. The revenue data provided by survey respondents had a correlation of 0.92 ($p = 0.00$) with the Compustat data. Finally, the results of the PLS analysis show different levels of significance for path relationships. Two of the paths (long-term orientation → relational interaction routines; interaction routines → information flow integration) are significant at the 0.001 level; two others (long-term relationship → relational asset specificity; relational asset specificity → interaction routines) are significant at the 0.005 level; and the relationships between the two control variables and information flow integration are insignificant. The fact that these different levels of significance are observed further reduces concerns around common method bias. Thus, while the presence of common method bias cannot be ruled out, the results for the Harmon one-factor test, strong correlation between self-reported and objective measures of firm revenue, and the

Table 7. Tests of Mediation—Mediated Path Analysis

Indirect effect	Mediated path	Graphical representation	Mediated path coefficient	*z*-statistic
RAS–IFI	RAS–RIR–IFI		0.12	2.11*
LTO–IFI	LTO–RIR–IFI		0.18	3.23*

* One-tailed test significant at $p < 0.05$.

different levels of path significance suggest that common method bias is not a significant issue in our study.

Discussion

A GROWING NUMBER OF RESEARCHERS and practitioners have underscored the emergence of a new model of competitive strategy where supply chain processes are critical for competitive advantage [10, 18, 23, 33, 34, 53, 56, 71, 83, 133]. One approach to effectively manage the supply chain is through integration of supply chain processes across partner organizations [34, 143]. Toward this end, firms need to integrate operational, tactical, and strategic information with members of their supply chains, and this, in turn, requires cooperation, partnership, and management of collaborative relationships. With this motivation, the study proposes and tests a model on the role of relational antecedents for informational flow integration for supply chain coordination. The empirical analysis supports the proposed model.

Information Flows for Supply Chain Coordination

It is suggested that firms that collaborate by sharing knowledge and resources are more likely to be in a position to generate relational rents [53]. Information flow integration can support the collaborative execution of supply chain processes, including order management, fulfillment, and inventory management, thus affecting the stocks and flows of physical goods in the supply chain. Our results suggest that tangible and intangible resources invested in supply chain partnerships enable information flow integration between a focal firm and its partners for supply chain coordination. Such integration enables the coordination of supply chain–wide resources, activities, and processes in a synergistic manner [34]. With such coordination, waste elimination and efficiency objectives can be identified, measured, and managed across the supply chain; resources critical for efficient supply network operation, such as inventory levels of components and finished goods, can be collaboratively planned, monitored, and managed [100].

Many organizations are likely to perceive IT and e-business technologies as solutions to problems of speed and accuracy in information sharing [124]. A focus on supply chain collaboration and the relational perspective suggests that while IT provides the digital platform to share information, organizations may choose not to share information if relationships are perceived as short term and opportunistic, since information asymmetry can be used as a source of rent in such contexts. Information sharing can also generate network effects in that the value of shared information is higher if more parties agree to and participate in the sharing process. Lack of trust and withholding of information by even a single member of the supply chain can have a deleterious effect on the behavior of the entire supply chain [124]. Thus, while the value creation potential of information flow integration for coordination has been discussed, we provide empirical evidence on the important role of a relational orientation toward supply chain partners for this information flow integration to occur.

Relational Capabilities and Interrelationships

Partnerships require organizations to develop interfirm routines that enable "an iterative process of exchange" [53, p. 666] of know-how, learning, and new ideas through the integration of information flows. Thus, the use of interfirm routines is associated with the sharing of specific types of information to coordinate processes and interactions. In addition, the reenactment of practice in the form of routines creates the platform for required flows of information, including information that must be shared across boundaries of firms, such as supply chains, which, in turn, can be applied to improve practice [118].

Our results suggest that development of interaction routines is triggered by investments in tangible and intangible relationship-specific assets. Past research suggests that the most significant relational norm is the development of trust and, consequently, a long-term orientation of interfirm relationships. In the context of supply chain management, such an orientation can have a number of advantages by enabling cooperative behavior and adaptation [61, 87] through the design of networked organizational forms [145] and reduced transaction costs [52].

We suggest long-term orientation has a significant impact on the development of interaction routines and partnership-specific assets, as it influences investments in dedicated resources and development of dedicated capabilities that can be exploited in the future to create value for supply chain partners. In the presence of such long-term orientation, organizations may not need rigid or sole reliance on formal contracts to establish controls on actions and outcomes, but can develop closer relationships [87] through formal and informal interaction routines. As long-term orientation provides partners with a safeguard against opportunism [158] without sole reliance on formal governance mechanisms, the perceived risks of asset-specific investments are also reduced. This finding of the positive impact of long-term orientation on asset-specific investments is consistent with the view expressed by Dyer [51] that a major contributing factor to the creation of relationship-specific assets is the temporal nature of the relationship. Thus, long-term orientation affects interaction routines both directly and indirectly through its impact on asset-specific investments. Through this process, long-term orientation has a major influence on the information flow integration between a focal firm and its supply chain partners.

Our finding of a positive impact of relational asset specificity on relational interaction routines yields interesting insights. It has been suggested that productivity gains can be attributed to asset-specific investments [11], but these productivity gains must occur through processes of interaction that are established to integrate resources distributed across partner firms. In addition, it has been suggested that the accumulation of transaction-specific know-how and shared knowledge of culture enables organizations to communicate effectively [11] and, consequently, collaborate. We then conclude that to the extent that asset-specific investments are undertaken, they promote the development of interaction routines and, consequently, information flow integration for coordination.

In terms of the two control variables, neither organization size nor predictability of consumer demand was found to be significantly related to information flow integration. While organization information processing theory suggests that firms operating in innovative product environments are information rich [107], our results indicate that operating in these contexts does not necessarily translate to a greater degree of information flow integration between a focal firm and its supply chain partners. This lack of significance underscores the importance of relational antecedents to integration of information across the supply chain. In other words, relational factors, not the firm's demand context, seem to play a dominant role in shaping its information sharing behavior.

Organizations can create appropriate mechanisms to respond to their environment's complexities with capacity-enhancing or information-focus strategies. Capacity-enhancing strategies, such as the use of teams and frequent cross-functional interaction as well as investments in open and integrated e-business systems across the supply chain, increase an organization's capacity to process information in uncertain environments [107]. In contrast, information-focus strategies reduce information overload by reducing the number of activities performed and the number of sources from which information is processed. In the supply chain context, organizations can combat information overload by reducing the number of suppliers and the number of different parts purchased [107]. Reducing the uniqueness in parts and modularizing product designs can also reduce information overload by embedding most of the information in design standards. Innovative products are often associated with modular product designs [147]. To summarize, information flow integration may not be directly affected by consumer demand predictability, but the impact may be mediated by the response structures, such as IT infrastructure, partnership interaction routines, or modular product designs, that organizations use to cope with this uncertainty.

Concluding Remarks

THE MOTIVATION TO FOCUS ON THE RELATIONSHIPS between a focal firm and its network members is based on the increased recognition that network capabilities impact the performance of the business network and its member firms. Search-related efficiencies can be brokered by intermediaries, and the rent accrued from this brokerage activity is referred to as *Burt rent* [95]. To the extent that brokers do not create sustainable advantage for the network, their brokerage rents are not sustainable, raising possibilities for their disintermediation. In contrast, collaboration performance in business networks is contingent on integrated process capabilities and its relational antecedents. In contrast to Burt rents, *Coleman rents* are derived from patterns of close collaboration between network members that represent distinctive process capabilities for the network and its members. The shaping of these network processes that are required to generate Coleman rent is contingent on rich information sharing between a focal firm and its supply chain members. Consequently, long-term orientation, relation-specific assets, and interaction routines are critical when a relational

perspective for value creation is adopted. Firms with a greater development of these relational resources can be considered to have embraced a relational, as opposed to a transactional, perspective toward value creation.

Implications for Managers

An organization's ability to leverage resources and capabilities of supply chain partners has become increasingly important as business networks compete against each other. Interactions that are designed to pressure suppliers to share specific operational data, such as shipment status or order status, for narrowly prescribed interaction routines are unlikely to enhance interorganizational learning and sharing of know-how. Managers must not only appreciate the value of rich information sharing [100, 150] but must focus on the antecedent conditions that must be in place for this sharing to occur and grow. While a typical response to facilitate information sharing is investment in and development of interorganizational systems, the presence of these technological systems in and of itself is insufficient to enable this sharing. Managers should focus on negotiating and establishing interaction routines, as it is these interaction routines that directly affect the information that is exchanged between partners through interorganizational systems.

To establish rich interaction routines, managers need to develop a long-term orientation toward their supply chain partners, as an expectation of relationship continuity creates opportunities for partners to invest in dedicated organizational processes and know-how. These processes and know-how are relation-specific and inimitable, and a potential source of rents. In addition, by promoting such a long-term orientation, managers can enable partner firms to share information without fear that partners will exploit the information for self-interest without regard to collective interest.

By developing a long-term orientation and relationship-specific assets, managers will promote the design and use of interaction routines that permit rich and dynamic collaboration and, consequently, information flow integration for coordination with supply chain partners. The greater the desired information sharing with partners for value creation, the more managers need to focus on and invest in the development of relational orientation and interaction routines. When relationship-specific assets and interaction routines are developed on a foundation of relationship continuity, they are likely to create conditions for collaboration and rich information exchange, which, in turn, can enable learning and value creation.

Implications for Research

We develop and test a model that (1) isolates a parsimonious set of relational preconditions, (2) investigates the interrelationships among them, and (3) examines how they shape information flow integration between a focal firm and its supply chain partners. Given the recognition that coordination and integration of resource flows in supply chains is a critical factor in the success of firms [137] and business networks [85], we focused our research on understanding the enablers of information flow

integration. By drawing on multiple research perspectives, this study identified a parsimonious set of relational antecedents and examined their interrelationships and subsequent impact on information flow integration. Whereas, traditionally, supply chains have operated with sparse information exchange [140], we base our research on findings that underscore the value of information flow integration for coordination of supply chains [100, 150]. Coordination costs are higher in the absence of such information flow integration, and asymmetries in information can lead to greater transaction risks. Information asymmetries are reduced by sharing inventory, production and sales data, and planning and forecasting information among supply chain partners. Benefits of information integration are expected to be seen in the reduction of operating costs and improved productivity, asset efficiency, higher revenues, and improved customer relationships [97, 127, 154]. Based on our examination of complementary literature streams in strategy, marketing, and operations, this study highlights the critical role of information flow integration in supply chains, an approach to its measurement, and, centrally, a nomological network that provides a theoretical explanation of the level of information flow integration between a focal firm and its partners.

The study recognizes that integration of information flows is shaped not only by traditional structural variables, such as number of nodes, density of ties, and layers in a network, but also by its relational properties. Although the role of long-term orientation as an antecedent for collaborative relationships has been discussed in the literature, this study positions it as a precursor to other relational characteristics, in particular, investments in relationship-specific assets and development of interaction routines. It also establishes that interaction routines mediate the impact of both long-term orientation and asset specificity on information flow integration.

Limitations and Future Research

We hope that our study triggers a series of related investigations by the IS research community. As with such exploratory research, there are specific limitations to our work. First, the unit of analysis of this study is not a specific supply chain for a given product line but, rather, is a focal firm. We examine aggregate supply chain capabilities and relational characteristics across the primary products for a firm. This results in aggregation across supply chains for products. On the other hand, this unit of analysis allows us to focus on broader organization-wide patterns of information flow integration and relational characteristics. Second, although there is merit in using information flow integration as a dependent variable, the study does not undertake investigation of its impact on measures of firm performance. Third, the study focused on manufacturing and retail organizations, and data was collected from member firms of the Council for Logistics Management. As such, the model and relationships should be examined in other industrial sectors and from a broader representation of firms in the manufacturing and retail sectors. Fourth, variables such as structure of specific supply chains, number of tiers in the chain, types of supply chain applications, and types of business processes integrated, which have not been examined, should help us develop a better

understanding of capabilities and collaborative behaviors in different contexts. For such investigation, the unit of analysis will need to be a supply network and not a focal firm [150]. Fifth, we recognize that the conceptualization of asset specificity can be expanded to focus on the nature of standards and other digital linking mechanisms that are used to integrate supply chain participants and exchange semantically consistent content across heterogeneous systems and applications. Methodologically, collection of perceptual data from a single source in respondent firms leaves the results susceptible to common method bias. Although our analysis suggests that common method bias should not be a concern for the present study, objective measures should also be used in future studies. Finally, further development of some of the constructs, such as relational interaction routines and information flow integration, appears meaningful. For example, prescribed relational interaction routines for repetitive tasks are fundamentally different from interaction routines that are required to support emergent tasks. The information integration implications of different dimensions of interaction routines and the enabling of long-term orientation and asset-specificity conditions required for such sharing will be a very fruitful line of inquiry that should result in insights for the design of collaborative supply chains.

Future research that further investigates the constructs in this study, along with related concepts pertaining to uncertainties in the demand and supply environment, IT infrastructure, and strategic choices with respect to supplier relationships, will provide greater insight into theoretical linkages between important concepts in IS, strategy, and operations as they relate to digitally enabled supply chains. As IT plays an increasingly important role in architecting and enabling the operations of business networks, developing such theoretical understanding is critical and represents a significant opportunity for IS scholars. In addition, we have limited our focus on information flow integration for coordination and have not considered additional forms of information, such as market intelligence information, that may be exchanged between partners. The extent to which different types of information, coordination, or market intelligence, among others, should be exchanged in different environmental and relational contexts is another interesting avenue for future research.

Notes

1. Managerial practices that promote the bullwhip effect, such as price fluctuations and forward buying, are discussed in Lee et al. [98]. We focus our attention here on information flows and their ability to counter the bullwhip effect.

2. We focus here on information flow integration for supply chain coordination. Other dimensions of information flow integration, such as breadth and quality of information [105], have been identified. Prior research on supply chain performance has focused on information for coordination, which has been found to improve supply chain performance, especially operational efficiency. Therefore, we limit focus on information flow integration for supply chain coordination.

3. The Council of Logistics Management is now known as the Council of Supply Chain Management Professionals.

4. The analysis was done using PLS Graph 3.0 from Soft Modeling Inc.

5. The mathematical formula for computing internal consistency is

$$\text{Internal consistency} = \frac{\left(\Sigma\lambda_{yi}\right)^2}{\left(\Sigma\lambda_{yi}\right)^2 + \Sigma\text{Var}\left(\varepsilon_i\right)},$$

where $\text{Var}(\varepsilon_i) = 1 - \lambda_{yi}^2$, λ is the item loading, and ε is the error.

6. The formula for computing f^2 is (R^2 partial mediation – R^2 full mediation)/(1 – R^2 partial mediation). The pseudo F-statistic is computed using the formula $f^2 * (n - k - 1)$, with 1, $(n - k)$ degrees of freedom where n is the sample size and k is the number of constructs in the model [32].

7. An approximation for the standard error of the mediated path is computed using the formula $\sqrt{(p_1^2 s_2^2 + p_2^2 s_1^2 + s_1^2 s_2^2)}$ where p_1 is the path coefficient of the path from $iv \rightarrow m$, p_2 is the path coefficient from $m \rightarrow dv$, and s_1, s_2 are the corresponding standard deviations [82].

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