B2B seller competence: Construct development and measurement using a supply chain strategy lens

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Abstract

In less than a decade, Internet-enabled business-to-business (B2B) commerce has become central to supply chain management. But little is known about the infrastructural competencies required for manufacturers engaged in Internet-enabled activities with downstream business customers. This paper aims to take a first step in operationalizing a set of new, multi-item measures that tap into infrastructural (or “soft”) competencies required for leveraging B2B commerce.

We use a structured, two-stage approach to develop and refine a set of constructs, items, and new multi-item measurement scales in order to rigorously evaluate their measurement properties. By drawing upon the literature as well as extensive interviews with expert practitioners, we define and measure the salient infrastructural competencies – termed B2B seller competence (B2B-SC) – associated with the seller-side of Internet-enabled commerce. We find that the conceptual domain of B2B-SC comprises seven theoretically important dimensions: (1) technical skills, (2) change disposition, (3) conflict management, (4) market acuity, (5) coordinated logistics, (6) knowledge channels, and (7) fluid partnering. Operational indicators that tap into constructs pertaining to each B2B-SC dimension are developed through an iterative process.

In the second stage, we conduct a field study to more fully assess the measurement properties of item and scale reliability and validity using a covariance structure framework. The results indicate that our new scales exhibit sufficient psychometric properties, which make them useful for theory building, testing, and the refinement of supply chain strategy paradigms in the emerging area of B2B commerce.

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1. Introduction

This paper seeks to contribute to the development of business-to-business (B2B) supply chain strategy content and measures. Our basic premise is this: there exists a set of generic infrastructural (or “soft”) competencies that enable manufacturers to leverage their eBusiness technologies. eBusiness technologies are characterized by “the use of the Internet or any digitally enabled intra-organizational information technology to accomplish business processes” (Boone and Ganesan, 2004, p. 709). We specifically focus on infrastructural competencies associated with eBusiness technologies that facilitate B2B commerce over the Internet (hereafter, Internet-enabled commerce) and that are applicable during the post-installation, infusion (systems-in-use)
stage of the technology implementation process (Cooper and Zmud, 1990).

The term “competency” has taken on a number of disparate meanings in the operations management (OM) literature (Leonard-Barton, 1992; Prahalad and Hamel, 1990; Roth and Jackson, 1995; Vickery et al., 1993). The present research draws on Roth and Jackson’s (1995, p. 1722) definition of competencies:

... [C]ompetencies refer to more localized production expertise, such as the bundle of people skills, system integration, or specific production technologies, that can be linked to a specific point in the value chain or to specific strategic design choices that create competitive capabilities... [C]ompetencies designate how specific competitive capabilities are acquired and leveraged; they constitute the realization of a complex pattern of strategic choices (e.g., realized supply chain strategy).

Synthesizing insights from existing theory, literature, and practice, we introduce the term **B2B seller competence** (B2B-SC). B2B-SC represents a bundle of tangible and intangible assets and resources that work together to create competitive capabilities (Barua et al., 2004; Leonard-Barton, 1992). It is a multidimensional construct composed of theoretically important dimensions that capture key infrastructure elements involving the relative skills, operational practices, and integrating mechanisms by which manufacturers can capitalize on Internet-enabled activities with downstream business customers (Boyer et al., 2002; Giffi et al., 1990; Law et al., 1998; Menor and Roth, in press; Roth, 1996; Teece et al., 1997). We identify seven dimensions that comprise B2B-SC: technical skills, change disposition, conflict management, market acuity, coordinated logistics, knowledge channels, and fluid partnering (Fig. 1). These seven dimensions reflect constructs corresponding to people B2B skills and intangible B2B-enabled resources (Bharadwaj, 2000).²

The intended contribution of this research to practice and theory are threefold. First, our conceptual model of B2B-SC offers practical guidance to manufacturers, as many have failed to successfully transition to the emerging Internet-enabled commerce paradigm (Boone and Ganesan, 2004; Geoffrion and Krishnan, 2003; Mullaney et al., 2003). According to Colony (2002), “...Deploying [eBusiness] technology without changing process and organization will create little impact... and it often brings negative consequences.” The results provide tangible evidence of important infrastructural areas that managers should benchmark internally and externally for leveraging their Internet-enabled commerce.

Second, we address a gap in the operations and supply chain strategy literature concerning the salient infrastructural dimensions for manufacturers engaged in demand-side, Internet-enabled commerce. Much of the existing literature in this area takes an information systems (IS) perspective that emphasizes the “hard” technical aspects of B2B commerce and/or the technology functionality, such as website design and functionality, systems integration, and structured data connectivity (see, e.g., Angeles et al., 2001; Barua et al., 2004; Chatterjee et al., 2002; Chow, 2004; Gosain et al., 2004–2005; Straub et al., 2002a,b; Zhu and Kraemer, 2002, 2005). Furthermore, the majority of papers in the B2B commerce domain focus on antecedents or barriers to implementation, or on critical success factors associated with the adoption process itself (see, e.g., Angeles et al., 2001; Chatterjee et al., 2002; Chow, 2004; Daniel and Wilson, 2003; Frohlich, 2002; Frohlich and Westbrook, 2002; Wheeler, 2002). In contrast, this research provides theoretically important, generic competencies relevant for the post-installation, infusion stage of Internet-enabled commerce. Our research thus fills an important gap and is a reasonable starting point for further theory development in the area of B2B commerce (Sethi and King, 1994).

Third, the paper adds to the measurement stream of supply chain strategy content by deriving a set of operational definitions and indicators for each B2B-SC dimension. Good empirical science starts with the identification and explicit definition of key constructs within a theoretically important domain. Along these lines, axiomatic to good theory building and testing are metrics with sufficient psychometric properties (Ahire et al., 1996; Bollen, 1989; Churchill, 1979; Gatignon et al., 2002; Roth et al., 2007; Sethi and King, 1994; Sethi and Variyam, 1994).

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Fig. 1. Conceptual domain of B2B seller competence.

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² Constructs are latent, nonobserved variables that are typically operationalized by two or more indicators, or observed variables (Bollen, 1989; Churchill, 1979; Pedhazur and Schmelkin, 1991).
Straub et al., 2002a,b). In a recent study, Zhu and Kraemer (2005, p. 62) noted that “...although showing recent signs of advancement, the linkage between theory and measures is still weak in the e-business literature.” To address this weakness, we use Menor and Roth’s (2007) two-stage approach to develop and then evaluate the measurement properties of a new set of B2B-SC scales reflecting the seven dimensions of B2B-SC identified in our research (Menor and Roth, in press; Stratman and Roth, 2002). Grounded in the literature and in practice, the resulting multi-item measurement scales – which tests show to be both reliable and valid – constitute a significant contribution to this emerging area of study.

The remainder of this paper is divided into three sections. In section two, we provide the background, theoretical foundation, and literature review for the seven proposed underlying dimensions of B2B-SC. Section three reviews the results from the structured, two-stage scale development process described above. We offer conclusions in section four.

2. Conceptual development

B2B-SC comprises the portfolio of infrastructural competencies that, taken together, enhances the manufacturer’s ability to leverage its technology investments associated with demand-side, Internet-enabled commerce. To begin, we draw upon literature that distinguishes Internet-enabled commerce (e.g., marketspace-based) from traditional B2B commerce (e.g., marketplace-based). According to Rayport and Sviokla (1994, pp. 141–142):

... When buyer-seller transactions occur in an information-defined arena, information is accessed and absorbed more easily, and arranged and priced in different ways. Most important, the information about a product or service can be separated from the product or service itself... The traditional marketplace interaction between physical seller and physical buyer has been eliminated. In fact, everything about this new kind of transaction—what we call a marketspace transaction—is different than what happens in the marketplace... in an information-defined transaction space, customers learn about their products differently, buy them differently, and have them delivered differently.

The term B2B marketspace embodies a different business model than traditional marketplaces. In this research, B2B marketspaces can range from transaction-oriented Internet sites (e.g., PlasticsNet) to more collaboratively oriented private trading networks (e.g., Cisco), all of which facilitate B2B commerce over the Internet (Jap and Mohr, 2002; Zhu, 2004). The concept goes beyond more traditional interorganizational information systems such as electronic data interchange (traditional EDI),3 which essentially automates current information flows and reinforces existing decision structures and roles (Rai, 2001; see also Angeles et al., 2001; Bandyopadhyay et al., 2005; Frohlich, 2002; Gosain et al., 2004–2005; Zhu and Kraemer, 2002, 2005). The open standards and broad connectivitiy of the Internet foster new ways of doing business and new business models—and as a result, there is a need for new operational competencies (Barua et al., 2004; Chatterjee et al., 2002; Day et al., 2003; Frohlich and Westbrook, 2002; Geoffrion and Krishnan, 2003; Peleg, 2003; Rayport and Sviokla, 1994; Vakharia, 2002).

Three types of eBusiness forms typically occur within marketspaces: e-procurement, e-transactions, and e-collaboration (see Fig. 2). e-Procurement activities with upstream sellers are fairly well elucidated in the OM literature (see, e.g., Boyer and Olson, 2002; Kleindorfer and Wu, 2003; Mukhopadhyay and Kekre, 2002; Peleg et al., 2002; Pinker et al., 2003). In this research, we specifically focus on generic competencies that facilitate e-transactions and e-collaboration spanning multiple industrial settings, as these activities are currently not well understood in the OM literature. Johnson and Whang’s (2002, p. 413) related eBusiness forms serve as a conceptually useful summary of B2B-SC outcomes. They note, “...e-Commerce [e-transactions] helps a network of supply chain partners identify and respond quickly to changing customer demand captured over the Internet... e-Collaboration facilitates coordination of various decisions and activities beyond transactions among the supply chain partners, both suppliers and customers, over the Internet.”

The theoretical foundation for the concept of competence is rooted in the resource-based view of the firm (RBV), which links organizational resources and capabilities to performance (Barney, 1991; Bharadwaj, 2000; Collis and Montgomery, 1995; Mata et al., 1995; Peteraf, 1993; Teece et al., 1997). The RBV has also been applied to marketspaces (Barua et al., 2004; Daniel and Wilson, 2003; Subramani and Walden, 2003; Whang, 2004).

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3 Traditional EDI is characterized by the proprietary, computer-to-computer transmission of standard business documents (e.g., routine invoices, purchase orders, etc.).

The resource-based view provides a solid theoretical foundation for studying the contexts and conditions under which EC [e-commerce] may produce performance gains... [it] acknowledges the commodity view of the technology per se, while allowing the possibility of performance associations arising from combining EC capabilities with IT infrastructure and other complementary resources. Recent OM research advocates the application of the RBV to enrich understanding of the role of operations strategy in creating and sustaining competitive advantage as well (Coates and McDermott, 2002; Roth and Jackson, 1995; St. John et al., 2001; Schroeder et al., 2002).

In conceptualizing B2B-SC, we draw upon the RBV to explain the performance potential associated with building the requisite supply chain infrastructure. The dominant logic of the operations strategy literature is that strategic choices can be considered either structural or infrastructural (Giffi et al., 1990; Hayes and Wheelwright, 1984). Structural or “bricks-and-mortar” choices typically include assets like plants and equipment, while infrastructural choices capture the relative skills, policies, and systems for managing these structural assets. This categorization is consistent with Bharadwaj’s (2000) framework of IT capability and business performance, which includes the structural physical IT assets (e.g., an organization’s hardware and software) and the infrastructural components of human IT resources (e.g., technical and managerial skills) and intangible IT-enabled resources of customer orientation, knowledge assets, and synergy.

In contrast to Bharadwaj’s (2000) information systems focus, this research further considers the mobilization and deployment of operational resources that facilitate the seller’s usage of B2B marketspaces in downstream supply chain operations. Because we are concerned with an up-and-running system, our focus is on the infrastructural elements of supply chain strategy rather than on the physical or structural elements of IT per se. Despite anecdotal evidence emphasizing the infrastructure of supply chain strategy in the B2B arena, little empirical research exists in this area (Hayes et al., 2004). Consistent with Bharadwaj’s (2000) categorization, however, we classify the seven dimensions of B2B-SC into two infrastructural elements: people B2B skills and intangible B2B-enabled resources. Next, the operational definitions and related literature for each dimension are given.

2.1. People B2B Skills

As the primary role of operations evolves from the production of goods to the creation and dissemination of knowledge across the supply chain, the development of people becomes a fundamental strategic issue (Brews and Tucci, 2004; Hall, 1992; Hayes et al., 2004; Roth, 1996; Roth and Jackson, 1995; St. John et al., 2001; Teece et al., 1997). According to Bharadwaj (2000), organizational human resources typically include the
skills, experiences, and relationships of its employees. In the context of the post-installation, infusion stage of Internet-enabled B2B commerce, important related skills are posited to include technical skills as well as managerial skills, such as the organization’s abilities to adapt to organizational change and to manage conflict.

2.1.1. Technical skills

Technical skills (TS) competence refers to the general abilities of the seller’s employees to use advanced information and communication technologies (ICT) – such as the Internet, product development software, Internet-enabled EDI, and supply chain software – in their daily work to support business objectives (Angeles et al., 2001; Powell and Dent-Micallef, 1997; Stratman and Roth, 2002; Tippins and Sohi, 2003). Our definition differs from that found in the IS literature, where technical skills typically refer to the technical knowledge of and experience with IT applications (Bharadwaj, 2000; Mata et al., 1995). While technical IT skills facilitate supply chain coordination and information processing, we posit that a broader operational perspective is required for leveraging the technology (Boyer and Olson, 2002; Fine, 1998; Parker and Anderson, 2002; Roth, 1996; Stratman and Roth, 2002). Consider Covisint, the much-hyped, industry-backed automotive consortium established in 2001. Its long-term success was questioned as late as winter 2001, given the inability to train both buyers and suppliers in the usage of various technical products of the marketplace (Bryce, 2001).

2.1.2. Change disposition

Change disposition (CD) competence is defined as a general readiness for organizational change, or the willingness of the seller’s employees to alter operations in support of the business (Armenakis et al., 1993; Clark et al., 1997; Hall, 1992; Stratman and Roth, 2002; Teece et al., 1997). We posit that CD is critical in the B2B arena as organizations face transformational pressures involving strategy, structure, process, and culture (Clark et al., 1997; Day et al., 2003; Daniel and Wilson, 2003; Subramani and Walden, 2001). Kanter (2001, p. 99) concludes that successful organizations:

...embrace the Internet as an opportunity for questioning their existing models and experimenting with new ways technology can improve their businesses.

They are more likely to consider the systematic consequences of their Internet propositions... they improvise through multiple experiments until they find the approach that seems right.

The importance of the user community’s openness to technological change is well established in the IS literature (see Angeles et al., 2001; Bharadwaj, 2000; Powell and Dent-Micallef, 1997; Venkatraman and Henderson, 1998; Zhu and Kraemer, 2002). The application of new technology in B2B marketspaces can be met with a chilly reception if users are not willing to change the way they work (Daniel and Wilson, 2003; Day et al., 2003; Frohlich, 2002). Armenakis et al. (1993, 682) conclude, “In essence, readiness for change may act to preempt the likelihood of resistance to change, increasing the potential for change efforts to be more effective.”

2.1.3. Conflict management

Conflict management (CM) is defined as a competence in which the selling firm has a systematic approach to the handling of disagreements with supply chain partners that consists of resolution strategies used to foster a mutually acceptable relationship (Anderson and Narus, 1990; Konsynski and McFarlan, 1990). Conflict typically results from interpersonal incompatibilities, differences in viewpoints and opinions pertaining to role expectations and job descriptions, controversies regarding how task accomplishment will proceed, and/or dissimilar views on how to solve problems (Bharadwaj, 2000; Daft and Lengel, 1986; Goodhue et al., 1992; Mata et al., 1995; Powell and Dent-Micallef, 1997).

The importance of CM as a component of supply chain strategy implementation is apparent when sellers must be able to work in concert with supply chain partners from a wide variety of cultures via the B2B marketplace (Fine, 1998; Hausman et al., 2002; Kogut and Zander, 1992). Even when supply chain partners share a common business and social culture, as is typically the case for members of collaboratively oriented marketspaces, disputes periodically occur (Konsynski and McFarlan, 1990; Kumar and van Dissel, 1996; Parker and Anderson, 2002).

The increased connectivity afforded by B2B marketspaces can also create conflict between supply chain partners because tasks may no longer be performed in the same manner (Fine, 1998). The change from marketplace to marketspace transactions can have this effect, as one manager remarked:

[The buyer] talks about the relationship being a partnership and this [reverse auction] really takes
that away… What they do is take your existing business that you have worked very hard to achieve and maintain. You work with them to give them cost reductions over the years and they send it out across the board for a competitive bid. I just do not think that is fair” (Jap and Mohr, 2002, p. 33).

We posit that a systematic approach to handling disagreements is a necessary managerial competence for B2B marketspace participation. Without rapid conflict resolution, partnership-related control costs can become excessive for all parties involved (Quinn, 1999). Since conflict management competence is critically dependent upon interpersonal relationships, it takes considerable time and effort to develop, and is therefore difficult to imitate, as posited by the RBV.

2.2. Intangible B2B-enabled resources

Bharadwaj (2000) stresses the importance of three key intangible resources in attaining and sustaining IT-enabled competitive advantage: customer orientation, knowledge assets, and synergy. The customer orientation resource represents IT’s facilitating role in rapidly tracking and predicting changes in customer preferences. We operationalize customer orientation by means of the market acuity metric used in the OM literature (Roth and Jackson, 1995). The knowledge assets resources in Bharadwaj’s classification scheme, which comprise the stock of knowledge embedded in systems, employees, and processes, are similar to the supply chain competencies we call coordinated logistics and knowledge channels. Finally, parallel to Bharadwaj’s synergy resource for multiple organizational divisions, our notion of fluid partnering pertains to the synergistic sharing of resources and capabilities across the supply chain.

2.2.1. Market acuity

Market acuity (MA) denotes the ability of the seller to see the competitive environment clearly and to anticipate customers’ needs and wants (Roth and Jackson, 1995; Teece et al., 1997). MA associated with supply chain operations includes the understanding of frequently changing customer needs and expectations (Frohlich and Westbrook, 2002) as well as the awareness of exogenous market factors such as competitors, the general business environment, and regulation (Kohli and Jaworski, 1990; Roth and Jackson, 1995; Sambamurthy et al., 2003).

Developing the competencies to systematically learn about and interpret external events and shifts in what drives customer value is an ongoing organizational challenge. This is particularly acute in B2B marketspaces due to the rapid pace at which manufacturers execute transactions, exchange information, and innovate through revamped business processes (Coates and McDermott, 2002; Daft and Lengel, 1986; Roth, 1996; Teece et al., 1997; Venkatraman and Henderson, 1998; Wheeler, 2002; Zahra and George, 2002; Zhu and Kraemer, 2002). We hypothesize that heightened MA enables sellers to successfully monitor the competitive business terrain and their relationship to, and position on, that terrain.

2.2.2. Coordinated logistics

Coordinated logistics (CL) competence represents the seller’s ability to effectively track and manage the flow of materials and information through a network of organizations that deliver products to customers (Barua et al., 2004; Boone et al., 1996; Cannon and Perreault, 1999; Fuller et al., 1993). Through the use of sophisticated IT, organizations can develop tacit, complex coordination mechanisms and corresponding skills that enhance communication and visibility across the supply chain (Bharadwaj, 2000; Porter and Millar, 1985; Powell and Dent-Micalef, 1997).

CL is posited to be a critical competence for supply chain operations (Chen and Paulraj, 2004; Fine, 1998; Frohlich and Westbrook, 2002). Current OM research highlights the need for the near real-time exchange of logistics information (e.g., inventory and shipping data) across enterprise boundaries in order to attain efficient and rapid delivery of materials without relying on costly inventory. The importance of coordinated logistics is apparent when sellers are faced with nonrepeating logistics patterns due to the dynamic portfolio of supply chain relationships they maintain. This is often the case in transaction-oriented marketspaces (e.g. PlasticsNet) and in industry-backed marketspace consortiums [e.g., World Wide Retail Exchange (WWRE)]. Rapidly changing market demand may require sellers to reconfigure their supply network frequently. To complicate matters further, sellers participating within these types of marketspaces or within private trading networks typically work in concert with multiple supply chain partners positioned around the globe. Because coordinating global logistics across multiple factories, component suppliers, warehouses, and customers can become quite complex, the timely exchange and coordination of logistics information is critical (Porter and Millar, 1985).

2.2.3. Knowledge channels

Knowledge channels (KC) competence refers to the boundary-spanning strategies used by sellers that
permit the transfer, recombination, and/or creation of knowledge among supply chain partners (Darr et al., 1995; Dyer and Singh, 1998; Gosain et al., 2004–2005; Sambamurthy et al., 2003; Teigland and Wasko, 2003; Tippins and Sohi, 2003). From a supply chain perspective, we posit that KC enable both the cross-organizational integration required for creating informal and formal connections and also the potential for deep integration among partners. These coordinating mechanisms facilitate the leveraging of shared expertise, spontaneity, and better judgment that often result from skilled personnel interactions (Chatterjee et al., 2002; Coates and McDermott, 2002; Inkpen and Dinur, 1998; Porter, 2001; Rosenzweig and Roth, 2004; St. John et al., 2001; Uzzi and Lancaster, 2003; Venkatraman and Henderson, 1998). Because KC competence is developed through an accumulation of shared cross-organizational experiences, it is both difficult to acquire and complex to imitate (Kogut and Zander, 1992; Grant, 1996; Rosenzweig and Roth, 2004).

In transaction-oriented marketspaces, such as the Global Healthcare Exchange (GHX), knowledge channels may help sellers gain a deeper understanding of how to service customers better and how to further reduce transaction costs and operational inefficiencies (Daniel and Wilson, 2003; Uzzi and Lancaster, 2003). Sometimes cross-organizational points of contact extend beyond the sales-to-purchasing interface of the seller and buyer to include a range of processes from product design through manufacturing to distribution— as is often the case for industry-backed consortiums such as the high-tech industry’s e2open. In this situation, KC facilitate debate, clarification, and enactment of information and knowledge among partners (Daft and Lengel, 1986). In collaboratively-oriented marketspaces, KC competence allows different types of knowledge to converge and become accessible, providing a forum for improvisation to occur among members (Dyer and Singh, 1998; Gosain et al., 2004–2005; Inkpen and Dinur, 1998; Powell and Dent-Micalef, 1997; Sambamurthy et al., 2003; Teigland and Wasko, 2003).

2.3. Fluid partnering

Fluid partnering (FP) competence represents the seller’s ability to change supply chain partners quickly (El Sawy et al., 1999; Gosain et al., 2004–2005; Greis and Kasarda, 1997). FP is consistent with the IS notion of partnering flexibility, what Gosain et al. (2004–2005, p. 12) call “...the ease of changing supply chain partners in response to changes in the business environment.” With the availability of real-time information and the promise of achieving ever-cheaper unit costs via coordination through technologies such as B2B marketspaces, organizations increasingly turn to supply chain partners to help design, develop, manufacture, and distribute products (Angeles et al., 2001; Brews and Tucci, 2004; Daniel and Wilson, 2003; Gosain et al., 2004–2005; Hayes et al., 2004; Konsynski and McFarlan, 1990; St. John et al., 2001; Zhu and Kraemer, 2002). By developing multiple partnerships to conduct noncore activities, sellers are able to focus on their core, value-creating activities (Leonard-Barton, 1992; Prahalad and Hamel, 1990). Moreover, partnering may result in a synergistic effect such that the combined resources are more rare and valuable than each resource in isolation (Dyer and Singh, 1998). In the RBV, this synergy makes the source of the competitive advantage difficult to discern and therefore also to imitate (Mata et al., 1995).

FP has the potential to deliver customer value because it enables sellers to hone their ability to identify potential partners quickly, determine the appropriate level of intimacy for the relationship, and secure the corresponding level of commitment rapidly (Downes and Mui, 1998; Dyer and Singh, 1998; Gosain et al., 2004–2005). However, realizing FP – the rapid alignment of assets, capabilities, and knowledge across disparate supply chain entities – is challenging at best (St. John et al., 2001; Fine, 1998; Sambamurthy et al., 2003). Members of industry-backed consortiums, such as e2open, may find it necessary to orchestrate resources and expertise across an increasingly dynamic and culturally diverse pool of supply chain partners (Quinn, 1999; Venkatraman and Henderson, 1998). Learning how to rapidly interface with and leverage global partners and customers is a critical step in the transformation from local to global supply chain management (Boone et al., 1996).

3. Multi-item measurement scale development and validation

Empirical OM researchers recognize that multi-item measurement scales are necessary to operationalize inherently complex business concepts, such as B2B-SC (Ahire et al., 1996; Hensley, 1999; O’Leary-Kelly and Vokurka, 1998; Roth et al., 2007), and to potentially address measurement error (Bollen, 1989; Churchill, 1979; Stratman and Roth, 2002). We followed Menor and Roth’s (2007) structured, two-stage multi-item scale-development approach for this study.
3.1. Stage 1: item and scale construction

In stage 1, we first determined the conceptual domain of the B2B-SC dimensions and their construct definitions. We then demonstrated the content validity of each of the seven proposed B2B-SC dimensions according to the established approaches (Churchill, 1979; Pedhazur and Schmelkin, 1991; Roth et al., 2007). For completeness in assuring domain and content validity, knowledgeable practitioners were asked to comment on, refine, and add to the constructs and their associated indicator variables, first by way of interviews and then by three independent rounds of Q-sorting. The details of stage 1 are presented in the following sections.

3.1.1. Specification of domain of constructs and generation of item pool

In order to theoretically ground the conceptual domain of B2B-SC, we conducted a full literature review and search for existing scales. Eight constructs were initially identified and operationally defined. Next, where possible, we selected items from existing scales used in other related contexts, and created additional items that appeared to fit the construct definitions. In this case, items are said to “reflect,” or to be caused by, the construct of interest (Edwards and Bagozzi, 2000).

To ensure the content validity of the B2B-SC constructs and the adequacy of the sample items pertaining to each construct, we reviewed them with seven consultants and senior managers (with titles including Director-Integrated Supply Chain Program, President, and CEO) from companies such as KPMG Consulting (now BearingPoint, Inc.), IBM, Longistics, BuildNet, and Businessmodel.com. Each interviewee had extensive knowledge of state-of-the-art B2B commerce practices and significant experience with systems-in-use. Separate interviews were conducted by means of the telephone, face-to-face meetings at the business school, or on-site company visits. Each interview lasted one to two hours, on average, during which time both authors covered a set of open-ended questions. From the interviews, construct definitions and items were refined and gaps were filled.

3.1.2. Purification and pretesting of measures

Next, we applied a type of Q-sort methodology (Churchill, 1979; Menor and Roth, in press; Moore and Benbasat, 1991; Roth et al., 2007; Stratman and Roth, 2002) to systematically refine the construct definitions and item wording. For this analysis, we used data from fourteen senior managers involved with supply chain and/or Internet-enabled commerce initiatives and B2B commerce consultants to obtain formal statistics of expert interjudge agreement. The expert judges held job titles such as Senior Manager–Integrated Value Chain Strategy Team and Chief Technology Officer, and were from various companies including Dell, SupplySolutions, Dupont, Accenture, and Ernst & Young. Each was knowledgeable about the research topic and was characteristic of the sample of respondents who would be ultimately targeted to complete the final survey.

The items and associated constructs were subjected iteratively to three rounds of independent sorting, each with a different panel of expert practitioners who served as judges \( n = 14; 4 \text{ judges in round 1}; 4 \text{ in round 2}; 6 \text{ in round 3} \). For each round, the judges provided structured survey and qualitative feedback on the conceptual definition and wording of each construct as well as on the fit of each item with its intended construct and the precision in wording. Judges also noted if there were omitted constructs or items that should be included for the coverage and representativeness of the conceptual domain. See Appendix A for the pool of items associated with each dimension of B2B-SC that resulted from the final round of the Q-sort exercise.

The degree of agreement between judges within each round of the Q-sorting exercise formed the basis for the statistical assessment of tentative reliability and construct validity. For example, if an item was consistently placed by the judges within its intended construct, it was considered to demonstrate convergent validity with that construct and discriminant validity with the others (Moore and Benbasat, 1991). Perreault and Leigh’s (1989) interjudge agreement statistic \( I_p \) captured the observed proportion of agreement between all possible pairs of judges for each round of Q-sorts, taking into account the number of construct categories. Another statistic gathered was Moore and Benbasat’s (1991) item placement ratio, which involves a comparison of the number of items placed correctly by the panel of judges within the target construct, termed “hits,” and the potential number of hits or “item placements.”

In addition to items for the seven B2B-SC constructs listed earlier, the final, round three Q-sort questionnaire also contained items pertaining to a potential construct called technical disposition (TD), which tapped into the willingness of the seller’s employees to embrace new and existing ICT in support of the business (Powell and Dent-Micaleff, 1997). Follow-up phone calls and substantive interviews with several of the expert judges indicated that a TD competence is more appropriate for the adoption stage of technology implementation. In addition, the preliminary data analysis results indicated
that this construct could not be clearly distinguished from technical skills for systems-in-use. Therefore, TD was dropped from subsequent analysis.

The Perreault and Leigh (1989) interjudge agreement statistics from the final round of Q-sorting easily exceed the 65% rule-of-thumb cut-off value for all possible pairs of the six judges (Table 1a). Item-placement ratio results (Moore and Benbasat, 1991) show that out of a maximum of 414 possible item placements (69 measurement items \( \times 6 \) respondents), a total of 394 correct placements (or “hits”) were achieved, for an overall hit ratio of 95.2% (Table 1b). In this final round of Q-sorting, no individual hit ratio fell below the 75% rule-of-thumb cut-off value (Menor and Roth, 2007, in press; Stratman and Roth, 2002). Moreover, the off-diagonal data do not show any systematic pattern of misclassification.

Taken together, the results of the literature review, interviews \((n = 7)\), and Q-sorting \((n = 14)\) provided tentative evidence of the reliability and validity of the B2B-SC constructs and items. These results laid the foundation for the preparation of a survey instrument and measurement scales for the subsequent confirmatory analyses of stage 2, to which we now turn.

### 3.2. Stage 2: confirmatory analyses

The set of constructs and items resulting from the final round of the Q-sorting process was used to create a web-based survey that would allow us to further refine and validate or “confirm” the measurement models. The Menor and Roth (2007) second stage involves the confirmation of the measurement models associated with each of the seven dimensions of B2B-SC. We propose seven identical hypotheses regarding data fit.

**Hypotheses 1–7.** The items \(1, \ldots, n_i\) reflecting the intended construct \(i\) fit the data, where \(i = \text{B2B-SC dimensions } 1–7\) (e.g., \(i = 1\) corresponds to TS, \(i = 2\) CD, \(i = 3\) CM, \(i = 4\) MA, \(i = 5\) CL, \(i = 6\) KC, and \(i = 7\) FP).

Primary data was collected to test the seven measurement models (see Section 3.2.1). Prior to implementing the field study, however, a small pretest \((n = 11)\) helped us gauge factors, such as the readability of the questionnaire and the estimated completion times. Pretest respondents were drawn from the field study sample frame. They were asked to indicate their level of agreement with statements regarding their current integrating mechanisms, practices, and skills (related to each dimension of B2B-SC) on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.”

Several of the pretest respondents reported that the survey was much too long. Therefore, to improve the overall survey design and ultimately the field study response rate, we reduced the number of items per scale by deleting items that the pretest respondents suggested were redundant or less representative of the intended construct. Using the full pretest sample, we then supplemented these suggestions by examining the item correlations with the total scale for each B2B-SC dimension. See Appendix A for a list of items associated with each dimension of B2B-SC included in the field survey.

#### 3.2.1. Field study sample

Data for the field study were collected in the summer of 2002. The research population consisted of all manufacturers currently using a B2B marketspace to interact with customer organizations by supplying direct goods and/or services (e.g., logistics planning). (We exclude indirect goods/maintenance, repair, or operating supplies). We developed the sample frame from several key sources that are representative of the target population. The first component of our sample frame included all manufacturing members of the Supply Chain Council (SCC)\(^5\) whose company point

---

**Table 1a**

<table>
<thead>
<tr>
<th>Judge pairs</th>
<th>( I_i )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–2</td>
<td>0.93</td>
</tr>
<tr>
<td>1–3</td>
<td>0.97</td>
</tr>
<tr>
<td>1–4</td>
<td>0.97</td>
</tr>
<tr>
<td>1–5</td>
<td>0.96</td>
</tr>
<tr>
<td>1–6</td>
<td>0.93</td>
</tr>
<tr>
<td>2–3</td>
<td>0.95</td>
</tr>
<tr>
<td>2–4</td>
<td>0.94</td>
</tr>
<tr>
<td>2–5</td>
<td>0.95</td>
</tr>
<tr>
<td>2–6</td>
<td>0.90</td>
</tr>
<tr>
<td>3–4</td>
<td>0.97</td>
</tr>
<tr>
<td>3–5</td>
<td>0.97</td>
</tr>
<tr>
<td>3–6</td>
<td>0.93</td>
</tr>
<tr>
<td>4–5</td>
<td>0.97</td>
</tr>
<tr>
<td>4–6</td>
<td>0.95</td>
</tr>
<tr>
<td>5–6</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Average 0.95

---

\(^5\) The SCC is an independent, not-for-profit, global corporation with membership open to all organizations interested in applying and advancing state-of-the-art supply chain management systems and practices, using technology as an enabler (http://www.supply-chain.org).
person was located in the U.S. To ensure that our survey solicitation efforts pinpointed sellers involved in downstream B2B activities, we also cross-referenced and supplemented the SCC list with a random sample of companies featured on two additional lists: firms represented in the InternetWeek, 2001 100 E-Business Leaders list, and clients of the companies making up the Forbes’ 2001 B2B: Best of the Web list. The resulting sample frame comprises 170 U.S. manufacturers engaged in demand-side, Internet-enabled activities.

The targeted survey respondents were U.S. senior supply chain or e-business managers working directly with customers of the primary B2B marketspace, particularly in the supplying of products and services. Senior ranking informants, such as the ones targeted in this research, tend to be more reliable sources of information relative to their lower-ranking colleagues on strategic OM issues (Miller and Roth, 1994). Because targeted respondents might consider unsolicited emails intrusive and generally unacceptable, the initial mode of contact was by telephone (Dillman, 2000; Schillewaert et al., 1998). Also, we wanted to ensure that the target respondent was the most knowledgeable regarding his/her firm’s B2B strategy and practices. We reached target respondents from 115 of the 170 companies in the sample frame. Interested respondents were emailed a formal invitation to participate in the study. If we did not receive a completed survey within 1 week of the receipt of the email invitation, we followed up with a reminder email. After an additional week, we followed up with a phone call reminder if necessary. A total of 50 surveys were returned, for a response rate of 29.4% (50/170).

The responding organizations represented a range of industrial sectors, including the chemical (22%), consumer product (20%), and high-tech (16%) sectors. An additional 20% were categorized as general manufacturers. Responding organizations had been participating within their B2B marketspace for on average a little over two years. The majority of respondents indicated that participation was at the enterprise level (42%), followed by the division/group level (30%), and the business-unit level (22%). Respondents averaged 10.9 years with their company and 2 years in their current position; sample respondent job titles included Vice President of Supply Chain, Director of Supply Chain Strategy, and Director of eBusiness.

Not surprisingly, because B2B commerce is an emerging area, the sample was dominated by larger market leaders that could invest in the technology. Almost 46% of the survey respondents reported that their company held the number one or two position in their primary markets served via the B2B marketspace. Median sales volume for the enterprise was $4.8 billion and the median number of enterprise employees was greater than 16,000, indicating that survey participants are members of fairly large organizations. Nonresponse bias was assessed through comparisons of early and late respondents on market position, sales volume, and number of employees (Armstrong and Overton, 1977). No statistically significant differences were detected between early and late respondents with respect to these descriptive characteristics.

### 3.2.2. Reliability analysis

We utilized the Werts–Linn–Joreskog composite reliability technique, which employs confirmatory factor analyses (CFA) to derive a composite reliability index \( P_C \) measuring the reliability of the multi-item
B2B-SC scales (Bollen, 1989; Werts et al., 1974). Using AMOS 4.0, we identified several items for removal from the change disposition and coordinated logistics scales during CFA to increase reliability (see Appendix A), while ensuring continued content validity (Ahire et al., 1996; Bollen, 1989; Churchill, 1979; Pedhazur and Schmelkin, 1991). The resulting composite reliability indices for each of our B2B-SC scales easily exceeded the 0.70 rule-of-thumb cut-off value, as shown in the diagonal of Table 2.

3.2.3. Unidimensionality analysis

To assess the unidimensionality of our B2B-SC scales, we employed CFA on each of the scales separately, as the small sample size limited the testing of a full measurement model (Table 3). The exception was the coordinated logistics scale, which contained only two items. Note also that the CFA fit statistics were only available for the conflict management and market acuity scale, which contained four items each. For scales with three items, the measurement models are just identified and fit statistics cannot be computed (Bollen, 1989; O’Leary-Kelly and Vokurka, 1998). In order to ensure unidimensionality, we supplemented the CFA results in Table 3 with the more conventional principal components analyses (PCA).

In CFA, a goodness-of-fit (GFI) index of 0.90 or higher provides adequate evidence for unidimensionality, in addition to a nonsignificant chi-squared ($\chi^2$) statistic (Bollen, 1989). We also employed the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), and the Bentler–Bonett normed fit index (NNFI) and non-normed fit index (NFI), which, like the GFI index, offer evidence for unidimensionality when scores exceed 0.90. The fit statistics/indices for the conflict management scale ($\chi^2 = 2.49$, 2 d.f., $p = 0.29$; GFI = 0.97; AGFI = 0.87; CFI = 0.99; NFI = 0.96; NNFI = 0.98) and market acuity scale ($\chi^2 = 0.84$, 2 d.f., $p = 0.66$; GFI = 0.99; AGFI = 0.96; CFI = 1.00; NFI = 0.99; NNFI = 1.05) indicated good fit (Bollen, 1989). The root mean square residual (RMR) values for the conflict management scale (RMR = 0.03) and market acuity scale (RMR = 0.02) provide further support for scale unidimensionality, as an RMR of zero indicates perfect model fit (Bollen, 1989).

To establish the unidimensionality of each remaining B2B-SC scale (technical skills, change disposition, coordinated logistics, knowledge channels, and fluid partnering), five separate PCAs with varimax rotation using SAS 8.0 retained only one factor each. Thus, all proposed B2B-SC scales show reasonable evidence of unidimensionality for new scales (Gatignon et al., 2002).

3.2.4. Convergent validity analysis

Using multiple studies in two stages for construct measurement enabled us to overcome potential problems and biases inherent in the use of a single method (O’Leary-Kelly and Vokurka, 1998; Pedhazur and Schmelkin, 1991). Because responses from both the Q-sorts and the web-based survey yielded similar results in terms of scale reliability and unidimensionality, some evidence for the convergent validity of our scales is established.

A second way to demonstrate convergent validity is to examine the magnitude and sign of the path loadings of the measures onto the constructs via CFA (Bollen, 1989; Froehle and Roth, 2004; Menor and Roth, in press; Stratman and Roth, 2002). Each of our standardized path loadings is in the anticipated direction.

Table 2
Pearson correlations and measurement properties for B2B seller competence scales (stage 2) ($n = 50$)

<table>
<thead>
<tr>
<th>Construct scale</th>
<th>Mean</th>
<th>S.D.</th>
<th># Items</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technical skills</td>
<td>3.19</td>
<td>0.98</td>
<td>3</td>
<td>(0.89)$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Change disposition</td>
<td>3.11</td>
<td>0.78</td>
<td>3</td>
<td>0.43$^b$ (0.73)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Conflict management</td>
<td>3.64</td>
<td>0.75</td>
<td>4</td>
<td>0.18 0.48 (0.82)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Market acuity</td>
<td>3.48</td>
<td>0.82</td>
<td>4</td>
<td>0.22 0.48 0.60 (0.83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Coordinated logistics</td>
<td>3.17</td>
<td>1.24</td>
<td>2</td>
<td>0.34 0.20 0.34 0.25$^c$ (0.69)$^d$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Knowledge channels</td>
<td>3.50</td>
<td>0.87</td>
<td>3</td>
<td>0.35 0.47 0.72 0.48 0.23 (0.77)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Fluid partnering</td>
<td>3.22</td>
<td>0.87</td>
<td>3</td>
<td>0.38 0.52 0.47 0.48 0.44 0.37 (0.79)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Overall B2B seller competence$^e$</td>
<td>3.33</td>
<td>0.62</td>
<td>–</td>
<td>0.62 0.71 0.75 0.69 0.64 0.72 0.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$ The Werts–Linn–Joreskog composite reliability indices ($P_C$) for the scales are shown in the diagonal. Values greater than 0.70 indicate strong scale reliability.

$^b$ Pearson correlations with associated $p$-values $\leq 0.05$ are in bold.

$^c$ Pearson correlations with associated $p$-values $\leq 0.10$.

$^d$ Pearson correlation between the two items comprising the coordinated logistics scale ($p < 0.0001$).

$^e$ The overall B2B seller competence meta-scale was calculated by averaging construct scale scores 1–7.
and is significantly different from zero at $p \leq 0.01$, i.e., the critical ratio is $\geq 2.33$ (see Table 3). The average variance extracted (AVE) for each scale (comprising three or four items) is close to or greater than the 0.50 threshold value. Note that path loadings cannot be calculated for the coordinated logistics scale since its measurement model is unidentified, but the PCA loadings are high. Together these results offer further statistical evidence that the items adequately reflect their corresponding constructs and that our B2B-SC scales exhibit convergent validity.

3.2.5. Discriminant validity analysis

To check for discriminant validity, we employed a $\chi^2$ difference test (Ahire et al., 1996; Froehle and Roth, 2004; Gatignon et al., 2002; Stratman and Roth, 2002).
The discriminant validity procedure entails running two CFAs on each pair of scales (see Table 4 and Appendix B for details). In the first analysis of each pair of scales, the two constructs are allowed to freely correlate. In the second, the correlation between the two constructs is set to 1.

Using the resulting $\chi^2$ statistics from each of these analyses, we conducted a $\chi^2$ difference test for each pair of scales. Because the $p$-values associated with each of the $\chi^2$ statistics are all less than or equal to 0.10 (see Table 4), we conclude that each measurement scale represents a distinct construct. Given the CFA results, the stage 1 Q-sorting routines appear to have been especially valuable in developing reasonably good measurement scales that held up to confirmation in our field study (Menor and Roth, 2007, in press; Moore and Benbasat, 1991).

### Table 4
Pairwise CFA tests of measurement scale discriminant validity (stage 2)

<table>
<thead>
<tr>
<th>Construct scale pairs</th>
<th>Unconstrained</th>
<th>Constrasted</th>
<th>$\chi^2$ diff. test $p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\chi^2$</td>
<td>d.f.</td>
<td>$\chi^2$</td>
</tr>
<tr>
<td>Technical skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change disposition</td>
<td>4.92</td>
<td>8</td>
<td>12.46</td>
</tr>
<tr>
<td>Conflict management</td>
<td>10.49</td>
<td>13</td>
<td>31.67</td>
</tr>
<tr>
<td>Market acuity</td>
<td>16.37</td>
<td>13</td>
<td>30.91</td>
</tr>
<tr>
<td>Coordinated logistics</td>
<td>6.07</td>
<td>4</td>
<td>10.19</td>
</tr>
<tr>
<td>Knowledge channels</td>
<td>10.44</td>
<td>8</td>
<td>21.42</td>
</tr>
<tr>
<td>Fluid partnering</td>
<td>4.90</td>
<td>8</td>
<td>13.40</td>
</tr>
<tr>
<td>Change disposition</td>
<td>14.26</td>
<td>13</td>
<td>27.97</td>
</tr>
<tr>
<td>Conflict management</td>
<td>11.62</td>
<td>13</td>
<td>19.43</td>
</tr>
<tr>
<td>Market acuity</td>
<td>4.09</td>
<td>4</td>
<td>14.05</td>
</tr>
<tr>
<td>Coordinated logistics</td>
<td>10.60</td>
<td>8</td>
<td>19.43</td>
</tr>
<tr>
<td>Knowledge channels</td>
<td>10.09</td>
<td>8</td>
<td>15.86</td>
</tr>
<tr>
<td>Conflict management</td>
<td>20.46</td>
<td>19</td>
<td>32.22</td>
</tr>
<tr>
<td>Market acuity</td>
<td>9.42</td>
<td>8</td>
<td>21.11</td>
</tr>
<tr>
<td>Coordinated logistics</td>
<td>26.00</td>
<td>13</td>
<td>31.43</td>
</tr>
<tr>
<td>Knowledge channels</td>
<td>15.41</td>
<td>13</td>
<td>25.87</td>
</tr>
<tr>
<td>Fluid partnering</td>
<td>2.14</td>
<td>8</td>
<td>12.60</td>
</tr>
<tr>
<td>Coordinated logistics</td>
<td>21.45</td>
<td>13</td>
<td>28.27</td>
</tr>
<tr>
<td>Knowledge channels</td>
<td>5.39</td>
<td>13</td>
<td>11.77</td>
</tr>
<tr>
<td>Fluid partnering</td>
<td>1.09</td>
<td>4</td>
<td>9.56</td>
</tr>
<tr>
<td>Coordinated logistics</td>
<td>8.49</td>
<td>4</td>
<td>11.39</td>
</tr>
<tr>
<td>Knowledge channels</td>
<td>5.55</td>
<td>8</td>
<td>14.28</td>
</tr>
</tbody>
</table>

3.2.6 Predictive validity analysis

According to Stratman and Roth (2002, 620), “Predictive validity... measure[s] how well antecedent constructs predict the hypothesized dependent variable.” Our conceptualization of B2B-SC suggests there may be a positive association between each B2B-SC scale and one or more dimensions of business performance. In an attempt to establish predictive validity for the B2B-SC scales, we asked respondents to provide us with four self-reported, objective measures of their organization’s performance. These four single-item performance measures, drawn from multiple perspectives of the balanced scorecard (Kaplan and Norton, 1996), are inventory turns, ROA, market share for primary products and profitability (see Appendix C for measurement details).

Our results reflect extensive missing data across these measures of performance (Table 5). Follow-up telephone calls to respondents indicated that a number of the targeted firms do not allow employees to disclose financial information in survey research (cf. Vickery et al., 1993). Missing data notwithstanding, all the B2B-SC scales are significantly correlated with at least one of the performance measures, with the exception of...
technical skills. The Spearman correlations in Table 5 indicate that inventory turns is weakly related to the coordinated logistics scale ($p = 0.10$) and the knowledge channels scale ($p = 0.08$). This result provides weak evidence that better information flow across the supply chain can improve physical inventory management. Strength on these two dimensions of B2B-SC may lead to more accurate forecasting and production planning, which in turn would reduce the need for costly inventory (Barua et al., 2004; Konsynski and McFarlan, 1990; Porter and Millar, 1985; Zhu and Kraemer, 2002).

Not surprisingly, market share shows a positive relationship with market acuity ($p = 0.00$). Finally, the ROA measure is associated with change disposition ($p = 0.01$), conflict management ($p = 0.03$), knowledge channels ($p = 0.06$), and fluid partnering ($p = 0.01$), while profitability is weakly related to change disposition ($p = 0.11$). These correlations provide some evidence of the predictive validity for six of the seven B2B-SC dimensions (Narasimhan et al., 2001; Pedhazur and Schmelkin, 1991).

The relationship between technical skills and performance is under debate in the literature. Parker and Anderson (2002) suggest the need for basic IT knowledge in coordinating supply chain operations, but Frohlich (2002) found that supplier and customer technical skills were not a major barrier inhibiting the implementation of Internet-enabled supply chains. Perhaps the lack of relationship between technical skills and performance in our results implies that technical skills are more of a tactical requirement for IT personnel and for technology implementation (see, e.g., Konsynski and McFarlan, 1990; Ross et al., 1996; Zhu and Kraemer, 2005), or are of more importance for the ongoing use of complex technical, proprietary user interfaces such as those found in ERP systems (see, e.g., Stratman and Roth, 2002). Interestingly, technical skills may be less important for operations personnel utilizing more user-friendly, B2B Internet-enabled platforms. The reasons underlying this result remain areas for future research.

4. Conclusions

In this study, we introduce the concept of B2B-SC as a second-order latent construct that captures generic infrastructural elements of a supply chain strategy particularly suited for manufacturers engaged in Internet-enabled commerce. Rooted in the resource-based view of the firm, our preliminary framework of B2B-SC draws from three sources: Bharadwaj’s (2000) framework of IT capability and business performance, the operations and supply chain strategy and cross-functional literature bases, and extensive interviews and structured assessments with experienced senior managers in companies leading Internet-enabled commerce. We find that the conceptual domain of B2B-SC comprises seven generic dimensions that are essential to the post-installation, systems-in-use stage of Internet-enabled commerce with downstream business customers: technical skills, change disposition, conflict management, market acuity, coordinated logistics, knowledge channels, and fluid partnering.

<table>
<thead>
<tr>
<th>Item/construct scale</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective item</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Inventory turns</td>
<td>31</td>
<td>4.42</td>
<td>1.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ROA</td>
<td>15</td>
<td>3.20</td>
<td>2.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Market share</td>
<td>37</td>
<td>3.08</td>
<td>2.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Profitability</td>
<td>25</td>
<td>4.24</td>
<td>2.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construct scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Technical skills</td>
<td>50</td>
<td>3.19</td>
<td></td>
<td>0.98</td>
<td>0.16</td>
<td>0.20</td>
<td>0.00</td>
</tr>
<tr>
<td>6. Change disposition</td>
<td>50</td>
<td>3.11</td>
<td></td>
<td>0.78</td>
<td>0.03</td>
<td>0.64b</td>
<td>0.09</td>
</tr>
<tr>
<td>7. Conflict management</td>
<td>50</td>
<td>3.64</td>
<td></td>
<td>0.75</td>
<td>0.18</td>
<td>0.55b</td>
<td>0.11</td>
</tr>
<tr>
<td>8. Market acuity</td>
<td>50</td>
<td>3.48</td>
<td></td>
<td>0.82</td>
<td>0.18</td>
<td>0.33b</td>
<td>0.48b</td>
</tr>
<tr>
<td>9. Coordinated logistics</td>
<td>50</td>
<td>3.17</td>
<td></td>
<td>1.24</td>
<td>0.30b</td>
<td>0.12b</td>
<td>0.22</td>
</tr>
<tr>
<td>10. Knowledge channels</td>
<td>50</td>
<td>3.50</td>
<td></td>
<td>0.87</td>
<td>0.32b</td>
<td>0.50b</td>
<td>0.09</td>
</tr>
<tr>
<td>11. Fluid partnering</td>
<td>50</td>
<td>3.22</td>
<td></td>
<td>0.87</td>
<td>–0.10</td>
<td>0.62b</td>
<td>0.19</td>
</tr>
<tr>
<td>12. Overall B2B seller competence</td>
<td>50</td>
<td>3.33</td>
<td></td>
<td>0.62</td>
<td>0.20</td>
<td>0.69b</td>
<td>0.20</td>
</tr>
</tbody>
</table>

a Sample size (n) adjusted for missing data.
b Spearman correlations with associated p-values ≤0.05 are in bold.
c Spearman correlations with associated p-values ≤0.10.
We operationally define these seven constructs and then evaluate and confirm their measurement properties using survey data from a sample of companies engaged in Internet-enabled commerce. The empirical results demonstrate that our newly developed, multi-item measurement B2B-SC scales exhibit sufficient psychometric properties for use in theory building, testing, and refinement of supply chain strategy paradigms in the emerging area of B2B commerce. Reliable and valid metrics, such as the ones developed in this study, are a prerequisite for moving a research stream from anecdotes to hypotheses and testable models (Sethi and King, 1994). As articulated by Gatignon et al. (2002, p. 1103), “With greater clarity on... concepts and measures, research... might be more cumulative and impactful.”

Further, the results of a predictive validation process show that six of the seven B2B-SC scales – change disposition, conflict management, market acuity, coordinated logistics, knowledge channels, and fluid partnering – are positively correlated with one or more measures of performance. According to Straub et al. (2002a, pp. 115–116), having good metrics is important for practice.

...Metrics, that is, measures of key attributes that yield information about a phenomenon, lie at the heart of empirical social science and economics research... Clear useful metrics that capture commercial or operational strengths and weaknesses for conducting Internet-enabled commerce should prove to be beneficial, as discussed by numerous executives interviewed throughout the course of this study.

In terms of this research, the scales underlying B2B-SC can be used by firms desiring to leverage Internet-enabled commerce—sellers can benchmark their competencies relative to competitors, while buyers can evaluate and select sellers with which to do business. Practitioner understanding of an organization’s particular operational strengths and weaknesses for conducting Internet-enabled commerce should prove to be beneficial, as discussed by numerous executives interviewed throughout the course of this study.

In order to achieve our research objectives, we made several design choices that are associated with some limitations. First, we conceptualized B2B-SC by drawing on the literature and on in-depth surveys of knowledgeable practitioners to find generic infrastructural competencies that span multiple industrial settings. The resulting competencies do not constitute the full domain of supply chain e-business forms for any particular industry or other business functions.

Second, we utilized single informants in our survey data collection, which creates the potential for common methods variance bias in our data. Use of a single informant was necessitated by concerns that we would be unable to ensure a large enough set of matched pairs of responses, due to the prevailing level of B2B marketspace adoption at the time of data collection (2002). Results from Harman’s one-factor test (Podsakoff and Organ, 1986) indicated that common-methods variance is not present to a significant degree in our data. Our use of multiple, independent sets of judges in the Q-sort exercise also attests to the quality of our items and scales. However, given the potential for common methods variance bias, a logical extension of this research would be to test the model using survey data collected from multiple informants from each firm.

Third, we operationalized the coordinated logistics construct using two items. While Hensley (1999) advocates the use of as few items as possible to measure theoretical constructs, the inclusion of at least three items per scale serves as a typical lower bound. Future research should assess the reliability and validity of the coordinated logistics scales using the full set of items provided in Appendix A, which was limited in the present study due to survey length. Likewise, future research should subject the technical skills, change disposition, conflict management, market acuity, knowledge channels, and fluid partnering scales to careful replication using different datasets, given they represent a first attempt at operationalizing B2B-SC (Sethi and King, 1994).

Fourth, sample-size limitations precluded us from testing a single measurement instrument encompassing the full portfolio of generic infrastructural competencies. However, the paired construct tests for establishing discriminant validity provide reasonable evidence that our constructs are distinct. Further, bootstrapping results associated with each of the identified CFA models (technical skills, change disposition, conflict management, market acuity, knowledge channels, fluid partnering) show path loadings and critical ratios nearly identical to the ones reported in Table 3, indicating the robustness of our parameter estimates (see Yung and Chan, 1999 for details regarding the bootstrapping procedure). We utilized Menor and Roth’s structured, two-stage approach for our new scale development. We applied independent samples and used different means of data collection to achieve highly consistent results. These results add considerably to the confidence of the overall metric quality. Nonetheless, the empirical validation of the usefulness of B2B-SC as a higher-order factor is an area ripe for future research (Law et al., 1998).

The limitations described above offer opportunities for future research on the growing ranks of manufacturers engaged in demand-side, Internet-enabled commerce. According to Gartner Research, most firms will participate in at least one type of B2B marketspace by
2007 (Woods et al., 2003). Our research suggests that the concept of B2B-SC may be an important antecedent of business performance for firms when utilizing B2B marketspaces. Future research should examine how the mix and importance of B2B seller competencies change and interact over time. In addition, future studies should assess whether, and if so, how, the generic infrastructural competencies vary across industries, particularly for service organizations (Cool and Schendel, 1987; Rumelt, 1991). Finally, a study investigating the influence of B2B-SC on multiple measures of operational and business performance would represent a valuable contribution to the emerging literature stream in B2B commerce.

In conclusion, this research melds multiple literature streams bridging traditional operations strategy and information systems, to yield a new, technology-enabled, supply chain perspective (Vakharia, 2002). Our study advocates changes to traditional operations strategy when conducting Internet-enabled commerce, particularly regarding integration choices and the way a selling firm interacts with its supply chain partners (Day et al., 2003; Giffi et al., 1990; Kanter, 2001; Konsynski and McFarlan, 1990; Parker and Anderson, 2002; Roth, 1996; St. John et al., 2001; Straub and Watson, 2001; Wheeler, 2002; Zhu and Kraemer, 2002, 2005). The study highlights the increasingly important role of the operations infrastructure in supply chain management, namely, the role of intangible assets such as managerial skills (change disposition, conflict management) and intangible B2B-enabled resources (market acuity, coordinated logistics, knowledge channels, and fluid partnering).

Unlike soft skills, structural elements of supply chain strategy are often codifiable and explicit, and therefore may be more readily transmitted and received among competing firms (Grant, 1996; Hall, 1992; Kogut and Zander, 1992). In keeping with the RBV, competitive advantage is derived and sustained from capabilities based on socially complex organizational routines that are often developed over a long period of time and are not easily observed. Accordingly, we suggest that future supply chain research incorporate a more sociotechnical systems approach, in which the success of the organization depends upon the alignment of the people (social subsystem) using the appropriate tools and techniques (technical subsystem) to produce products and services valued by the customer (environmental subsystem) (Coates and McDermott, 2002; Hayes et al., 2004; Roth and Jackson, 1995; Shani et al., 1992). While no less important than the technical and environmental subsystems, the social subsystem – people’s skills, aptitudes and relationships – has received less attention thus far in the supply chain strategy literature.

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Appendix A. Pool of items associated with each dimension of B2B seller competence

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical skills (TS)</strong></td>
<td>Proficient in using ICT to get work done</td>
</tr>
<tr>
<td></td>
<td>Mastery of workplace ICT features and functions</td>
</tr>
<tr>
<td></td>
<td>Make use of advanced features of ICT</td>
</tr>
<tr>
<td></td>
<td>Overall technological knowledge of employees is very high</td>
</tr>
<tr>
<td></td>
<td>Employees have significant expertise in leveraging ICT</td>
</tr>
<tr>
<td></td>
<td>Employees often apply techniques that allow for the most effective utilization of ICT</td>
</tr>
<tr>
<td></td>
<td>Employees are experienced in using a variety of ICT</td>
</tr>
</tbody>
</table>

| **Change disposition (CD)** | Middle managers thrive in pivotal change roles |
| | Managers are generally supportive of change |
| | It is easy to implement new practices and initiatives |
| | Employees voluntarily experiment with novel solutions to problems |
| | Employees regularly act as agents of change |
| | Managers are open to change |
| | In times of change, employees embrace adjustments to their established routines |
| | Employees are emotionally committed to solving new challenges |
| | Employees are generally receptive to mid-course corrections to solutions as outcomes unfold |
| | Our employees enjoy playing with new ideas and possibilities |

| **Conflict management (CM)** | Systems and procedures in place to resolve disputes with supply chain partners |
| | View differences in opinion with partners as an opportunity to improve relationship effectiveness |
| | Settling of disputes is joint responsibility of us and partners |
| | Regularly discuss with supply chain partners any differences in opinion we have with them |
| | When deliberating differences in opinion, we search for solutions that satisfy each party |
| | Disputes with our partners are openly discussed |
| | In dealing with partners, we have a mutual understanding of how areas of discord will be handled |
| | Give in on some issues to help build trust with partners |
| | Settling disputes with supply chain partners generally increases the strength of our relationships |

| **Market acuity (MA)** | Have a good understanding of competitors’ strengths and strategies |
| | Foresee customers’ product or service needs |
| | Understand target markets better than competitors |
| | Able to sense shifting boundaries of industry |
| | Understand customer requirements better than competitors |
| | Know competitors well |
Appendix A. (Continued)

Have a good sense of how customers value our products and services\textsuperscript{b}
Typically foresee new competitive threats and opportunities\textsuperscript{b}
Know why customers are attracted to our competitors\textsuperscript{b}
Aware of new and emerging markets that we could serve in the future\textsuperscript{b}
Tend to predict fundamental shifts in our industry\textsuperscript{b}

Coordinated logistics (CL)
Routinely provide customers with order status in real-time
Able to account for inbound materials in real-time
Can efficiently deliver varying shipment sizes to customers\textsuperscript{c}
No gap exists between when our customer discovers need for replenishment and when we do\textsuperscript{b}
Capable of making customer-driven changes to our delivery schedules without much disruption\textsuperscript{b}
Generally able to account for product returns in real-time\textsuperscript{b}
Maintain multiple distribution channels in distributing products to target groups of customers\textsuperscript{b}
Able to account for in-transit shipments to customers in real-time\textsuperscript{b}
No gap exists between when we discover need for replenishment and when major suppliers do\textsuperscript{b}
Routinely provide customers with timely updates to delivery schedules\textsuperscript{b}

Knowledge channels (KC)
Managers regularly visit supply chain partners to enable two-way sharing of expertise
Use teams that cross company boundaries
Employees share expertise with supply chain partners via informal gatherings
Regularly practice employee transfer with primary supply chain partners\textsuperscript{b}
Employees regularly visit supply chain partners to enable two-way sharing of expertise\textsuperscript{b}
Capture best practices via an information source that spans company boundaries\textsuperscript{b}
Recommend employees become active members of industry trade groups\textsuperscript{b}
Leverage after-sales service activities as a source of cross-company learning about customers\textsuperscript{b}

Fluid partnering (FP)
Ability to rapidly assemble resources from dynamic pool of supply chain partners
Adept at reconfiguring network of supply chain partners in very short time
Able to work with a dynamic pool of supply chain partners
Able to quickly coordinate activities across a dynamic pool of supply chain partners\textsuperscript{b}
Effectively maintain a shifting network of supply chain partners\textsuperscript{b}
Capable of rapidly altering portfolio of supply chain partners\textsuperscript{b}
Able to dissolve network of supply chain partners at a moment’s notice\textsuperscript{b}
The boundaries of our supply chain network fluctuate frequently\textsuperscript{b}

\textsuperscript{a} These items represent the pool of questions from the final Q-sort exercise.
\textsuperscript{b} Item dropped during the survey construction and pilot phase.
\textsuperscript{c} Item dropped during CFA refinement.

Appendix B. Example of CFA model testing discriminant validity

\[ \Phi_{MA-CD} \]

\begin{align*}
\lambda_{MA1} & \quad 1 & & \lambda_{MA3} & & \lambda_{MA4} \\
\epsilon_{MA1} & & & & & \\
\epsilon_{MA2} & & & & & \\
\epsilon_{MA3} & & & & & \\
\epsilon_{MA4} & & & & & \\
\lambda_{CD1} & & \lambda_{CD2} & 1 \\
\epsilon_{CD1} & & \epsilon_{CD2} & & \epsilon_{CD3} \\
\end{align*}

*The constrained model restricts the latent construct correlation \( \Phi_{MA-CD} \) to 1. The unconstrained model allows the latent constructs to correlate freely.
Appendix C. Predictive validity measures

(A) What is your current inventory turns where the primary B2B marketspace is being used?
(1) Under one time per year, 
(2) one time to 2 times per year, 
(3) over 2 times to 4 times per year, 
(4) over 4 times to 8 times per year, 
(5) over 8 times to 16 times per year, 
(6) over 16 times to 32 times per year, and 
(7) over 32 times per year.

(B) What is your current pre-tax return on assets (ROA) where the primary B2B marketspace is being used?
(1) Under 5%, 
(2) 5–10%, 
(3) over 10% to 15%, 
(4) over 15% to 20%, 
(5) over 20% to 25%, 
(6) over 25% to 30%, and 
(7) over 30%.

(C) For the products you sell via the B2B marketspace, what is your current market share?
(1) Under 8%, 
(2) 8–16%, 
(3) over 16% to 24%, 
(4) over 24% to 32%, 
(5) over 32% to 40%, 
(6) over 40% to 48%, and 
(7) over 48%.

(D) What was your profit level (before taxes) where the primary B2B marketspace is being used for the most recent fiscal year?
(1) Negative, 
(2) break even (no profit/no loss), 
(3) under 5%, 
(4) 5–10%, 
(5) over 10% to 15%, 
(6) over 15% to 20%, and 
(7) over 20%.

References


