SUPPLY CHAIN MANAGEMENT E-COMMERCE: AN EMPIRICAL STUDY OF ORGANIZATIONAL AND CONTEXTUAL ANTECEDENTS AND PERFORMANCE OUTCOMES

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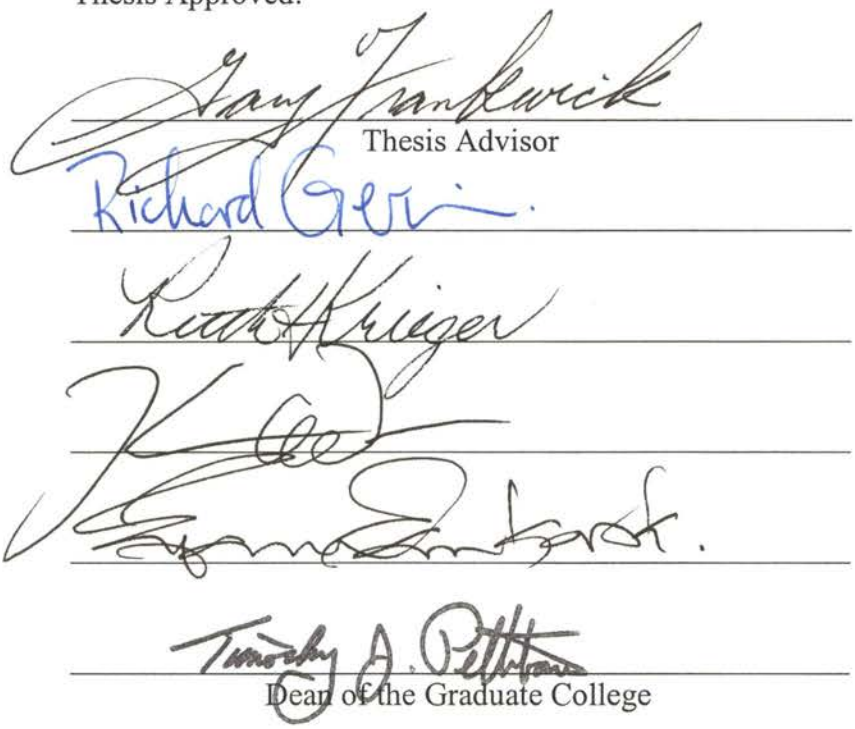

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CHAPTER I

INTRODUCTION

Intense competitive pressure in today's marketplace and the ensuing continuous stream of products vying for market share have driven firms to search for alternative competitive strategies beyond traditional confines. Competitive pressure and customers with ever-increasing demands and preferences are at the heart of the search for sustainable competitive advantage. Customers now look for value offerings beyond costs, seeking innovation and personalization of products, as well as the accompanying delivery and service. This necessarily has increased the velocity and variety of business activities, complicating exponentially the systems that drive buyer-supplier relations. These have given rise to innovative concepts such as supply chain management (SCM): "from virtual anonymity a scant decade ago, supply chain management has soared into prominence today as a core competitive differentiator" (Quinn and Fitzgerald 2000, p. 77). Corroborating the importance of SCM, Lambert, Cooper, and Pagh (1998, p. 1) note that "one of the most significant changes in the paradigm of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains."

An SCM strategy involves integrating and managing the business processes that produce value in the hands of the ultimate customer (Lummus, Vokurka, and Alber 1998). Success for single business firms ultimately rests on the management's ability to integrate their firms with partner firms in the business network (Lambert, Cooper, and Pagh 1998). In 1994, the International Center for Competitive Excellence defined SCM (which was modified later in 1998 by the Global Supply Chain Forum) as the integration of key business processes from end user through original suppliers that provides products, services and information that add value to customers and other stakeholders. Its scope extends from dirt to dirt (Stevens 1989), meaning, from the source of supply down to the point of consumption. SCM's overall objective is to lower the total amount of resources required for providing necessary levels of customer service to a specific market segment. To realize this, SCM makes it imperative that the contributing processes be managed for optimum efficiency and effectiveness.

Interfirm partnerships and integration – how well a firm works with supply chain members upstream and downstream – is an essential dimension of SCM in effectively and efficiently transforming raw materials and delivering products to customers. Closely united partnerships and high visibility for a proactive response to volatile market conditions are fundamental to success. SCM provides a way to leverage the unique skills and expertise of each partner in key processes such as product development and commercialization, manufacturing flow management, and procurement (Lambert, Emmelhainz, and Gardner 1996). Firms such as Hewlett Packard and Toyota, which have embraced the concept, are testimony for above-average market success.

A key factor enabling integration in supply chains is business-to-business (B2B) e-commerce. Internet and other e-commerce tools have received a tremendous amount of attention from practitioners and academicians because of the potential performance implications derived from their adoption. However, sparse empirical studies in this research domain have serious implications for its pursuit as a discipline. The purpose of this dissertation is to model supply chain B2B e-commerce antecedents and performance outcomes. The study envisages measuring B2B e-commerce in supply chain activities, and understanding the determinants of its adoption. The results of the study will have important theoretical contributions for the emerging field, besides providing valuable practical guidelines to managers. This purpose is discussed in more detail in the section that follows.

Purpose of the Study

The purpose of the dissertation is to address the following research questions: What organizational and environmental variables antecede the adoption of supply chain B2B e-commerce, and what are the performance outcomes of supply chain B2B e-commerce?

In answering this question, the dissertation will examine organizational characteristics that should be associated with (as antecedents) the adoption of supply chain B2B e-commerce. Organizational adoption of innovation is a function of many variables, including environmental factors and organizational characteristics. This study will examine internal organizational characteristics that form latent structure. As seen in Figure 1, these include formalization, centralization, specialization, and integration. Context variables are also studied. These include environmental uncertainty, channel

partner influence strategies, and firm size. The innovation literature has examined the relationship of organizational characteristics and innovation adoption; marketing literature has studied environmental uncertainty variables in various contexts. Performance will be operationalized both as financial performance and as operational performance (e.g., inventory levels, lead time, order cycle time). No scale fully measuring supply chain B2B e-commerce has been developed. The study will thus develop a reliable and valid scale for measuring supply chain B2B e-commerce.

Specifically, the objectives of the proposed study are three fold:

1. Develop a measure of supply chain B2B e-commerce.
2. Examine empirically the conceptualized relationships of latent organizational design and context with supply chain B2B e-commerce adoption.
3. Examine empirically the impact of supply chain B2B e-commerce adoption on performance.

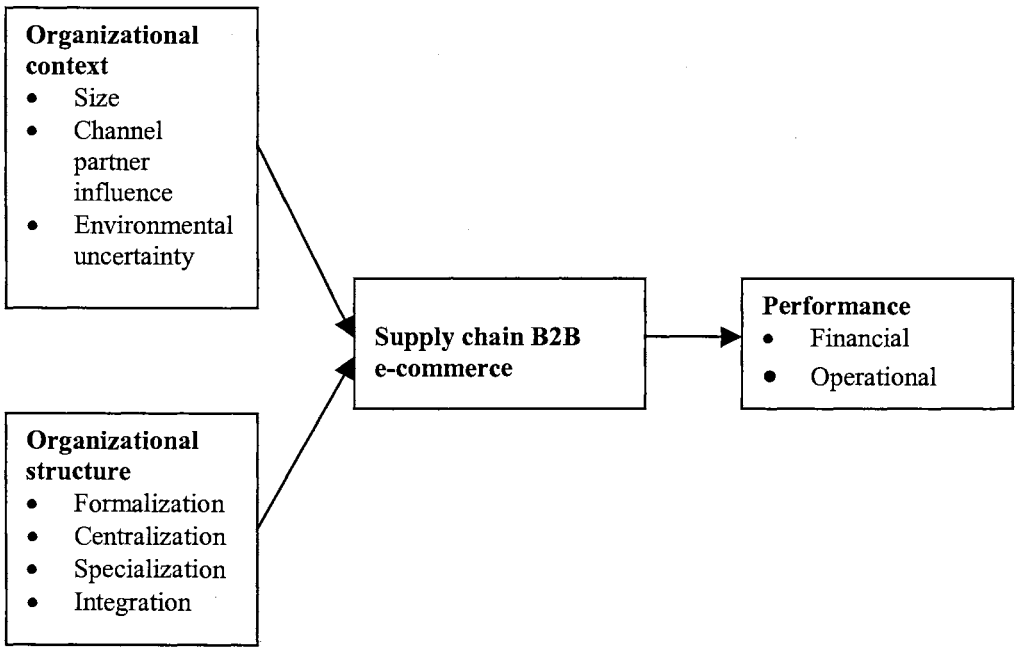

Figure 1. Theoretical Overview

Technological Innovation and Adoption of Innovation

The current international business environment has created a situation in which many old business models are rapidly supplanted by newer ones. Innovation is required across entire business processes for success, and supply chain partnerships are key factors contributing towards this endeavor (Graham and Hardaker 2000). Highly innovative organizations integrated through the supply chain in "marketspace" offer the potential for far greater levels of responsiveness than are traditionally accepted in the marketplace (Rayport and Sviokla 1994).

Firms adopt innovations to improve performance and process efficiencies and effectiveness. Innovation brings change to organizations as a response to changes in internal or external environments, or even as a preemptive move to influence the environment (Damanpour 1991). The literature categorizes a variety of innovations, however, this dissertation is concerned with technological innovations. Technological innovations are defined as those that occur in the operating component and affect the technological system of an organization. The technological system consists of the equipment and method of operation used to transform raw materials and information into product and services. In other words, a technological innovation can be a new idea pertaining to a new product or a new service, or new elements in an organization's production process or service operations (Damanpour and Evan 1984; Knight 1967). Technological innovations could include conversion technologies, as well as those pertaining to acquisition, maintenance, and distribution.

The adoption of innovations is a process encompassing activities such as problem perception, information gathering, evaluation and resource allocation, as well as those

facilitating implementation and continuous use that make the innovation part of routine operations. This research focuses on operationalizing the concept as encompassing the generation (internal, or externally purchased), development, and implementation of the technological innovation that is new to the adopting firm.

SCM and Electronic Commerce

Organizations are adopting supply chain B2B e-commerce, a technological innovation that has the potential to revolutionize the way business is conducted. Nevertheless, the application to interorganizational supply chains is a relatively recent phenomenon, and offers a promising research avenue. Collaborative partnerships and efficient movement of goods, the essence of SCM, are facilitated by e-commerce technology. The use of internet and other e-commerce tools collectively allows "supply chain partners to communicate information instantly and accurately to take excess inventory, activity, and cost out of the pipeline" (Quinn and Fitzgerald 2000, p.78). Achievement of multi-dimensional SCM goals such as cost minimization, increased service levels, and increased response time flexibilities is now a distinct reality, in part due to e-commerce. The vastly improved communication and knowledge links in the supply chain have brought together all key databases, ensuring a seamless value creation entity. E-commerce may "enable firms to achieve true efficiencies embodied in supply chain cost reductions" (Lancioni, Smith, and Oliva 2000, p.54).

Convincing evidence is growing on the success of supply chain partnerships that have incorporated e-commerce into their operations; industry leaders such as Dell, Procter & Gamble, and Wal-Mart stand proof to the claims. E-commerce technology "facilitates delivering solutions that provide collaboration, procurement, product ordering

and other inter-company processes" (Fischer 2000, p.133). The revolutionizing element of adopting e-commerce lies in providing value beyond performance improvements and efficiencies; the synchronized supply chains "are able to reach out to a bigger market, perform mass customization, and develop new products and services that adapt to the competitive and environmental needs" (Anderson and Lee 2000, p.15).

The term e-commerce is used to describe a wide range of tools and techniques utilized to conduct business in an almost paperless, digital environment. Among the variety of e-commerce tools, internet-enabled commerce has been the most innovative way of facilitating supply chain operations. The technology is being used to link suppliers, manufacturers, distributors and customers regardless of their location, enabling reduction of non value-added activities (Handfield and Nichols 1999).

E-commerce adoption in supply chains affects a variety of functions. The tool enables strategic purchasing professionals to make much better decisions on what to buy, from whom, and at what total cost, besides aiding supplier development and management, and a wide variety of collaborative operations. The complex decisions involved in sourcing and supplier selection process limit decision-makers' ability to make rational judgments. However, e-commerce facilitates rationalization by processing and exchanging vast amounts of data so that optimal decisions are made. The technology facilitates sourcing by evaluating a wide range of possible alternatives, reducing time and cost factors, and making sure important information is not overlooked or ignored. Collaborative buyer-seller partnerships in the "e-enabled" supply chain are a logical fallout. Product innovation also benefits from e-commerce. Shrinking product life cycles have made it necessary to capitalize on the gains from being the first to market. In

addition, the imperative to reduce inefficiencies and costs in production have made internet-enabled product collaborations a requirement for firms in the supply chain: "collaborative product design means that companies can iterate many more design alternatives with suppliers, and upgrade them effortlessly" (Anderson and Lee 2000, p.16). Traditional planning and forecasting models result in multiple forecasts from different supply chain members or even functions within a firm, misaligning operations and demand. However, e-commerce more easily allows the generation of a single forecast that is shared by all supply chain participants, encouraging companies to build trust levels and release key information (Anderson and Lee 2000).

While anecdotal evidence is building on the benefits of e-commerce in SCM, very few quantitative studies have been undertaken in this revolutionary area. E-commerce technology is used to improve operational efficiencies in many areas, besides being used in collaborative processes. Evaluating the activities and processes is also an implicit requirement in optimizing supply chain outputs. This dissertation proposes to capture the implementation of e-commerce in key supply chain activities and business processes. A purpose is to operationalize e-commerce adoption and implementation by firms in their supply chain partnerships among primary members.

Supply Chain B2B E-Commerce

Supply chain partnerships have become an accepted requirement for firms to maintain a competitive edge in the marketplace. A paradigm shift concerning e-commerce adoption across the supply chain has provided a giant leap in managing partnerships and streamlining collaboration efforts. Realizing the tremendous benefits e-commerce can bring to partnership efforts, supply chains have begun implementing the

technology in a wide variety of areas such as transportation, order processing, production scheduling, customer service, and partnership management – just to name a few. The benefits of real-time collaboration, high visibility, and relevant information sharing across the entire supply chain network include: (1) viewing of partners' logistics plans, production schedules, shipment details, etc., resulting in low inventory levels, high inventory turns, and improved cash flow; (2) reduction of the bullwhip effect or the variance in demand; (3) improved trust; and (4) consistently high customer service levels. Sharing real-time product content information leads to faster product design changes, faster reaction from partners, material flow synchronization, and ultimately decreased supply chain costs and higher revenues from better and higher quality products.

Implementing supply chain B2B e-commerce is essential in light of the basic premise of SCM: integration of critical business processes with key supply chain members. Davenport (1993) defines a business process as a structured and measured set of activities, crossing formal firm boundaries, and designed to produce a specific output for a particular customer or market. The impact of this integration on the value provided to the end-customer or other stakeholders determines which business processes are key to the integration process. Integrating too many supply chain members along numerous business processes may be counterproductive to the SCM initiative. Previous research (e.g., Cooper, Lambert, and Pagh 1997; Hewitt 1994) has identified up to 24 business processes.

As a prelude to a pilot study for scale development for supply chain B2B e-commerce, an extensive literature review of SCM and e-commerce research was conducted, which resulted in the generation of seven items representing critical business

processes. The selection of the items was based on research by the International Center for Competitive Excellence and the Global Supply Chain Forum which suggested seven key business processes that could be integrated across the supply chain. The scale development process for validity and reliability will follow the steps suggested by researchers such as Bollen and Lennox (1991) and Diamantopoulos and Winklhofer (2001). E-commerce use in SCM can be viewed as integration, facilitated by the technology, along key business processes encompassing primary upstream and downstream partners of the focal company, i.e., key suppliers and customers in the supply chain. Figure 2 is a depiction of the proposed construct. The design overview section that follows later in this chapter briefly describes the scale development for the construct.

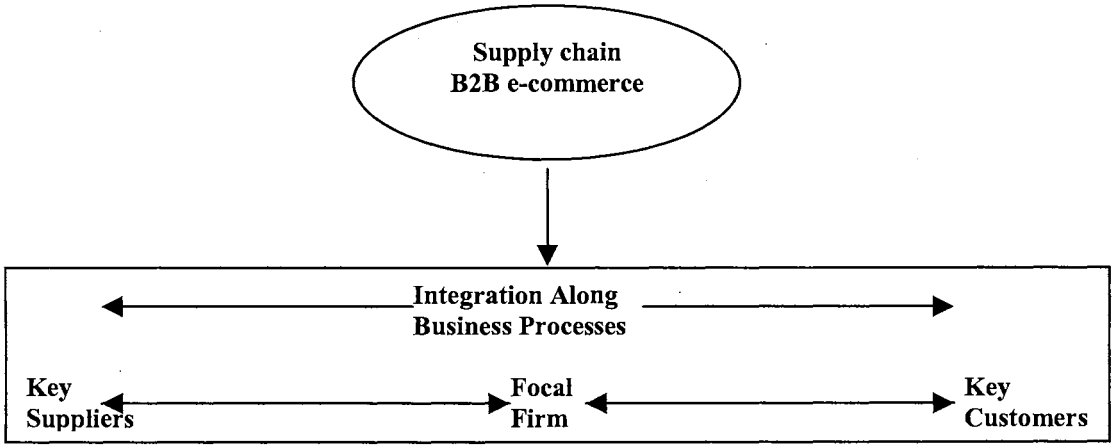

Figure 2. Theoretical Model - Supply Chain B2B E-commerce

Prior research has investigated determinants of organizational adoption of innovation. Commonly studied variables include organizational structure, context, and individual attitudes. Identifying the determinant characteristics of organizations will help us understand the conditions that facilitate adoption of electronic commerce in supply

chains. The research draws upon innovation adoption theory and organizational innovation literature to suggest a key set of specific organizational characteristics that facilitate or hinder the adoption of technological innovations by firms. A set of outcomes of adoption is included in the model to understand its impact on performance.

A focus on the internal latent characteristics or attributes of organizations provides an applied perspective in the area. Managers in organizations have a greater degree of control over these variables and therefore the study will enable them to deal more effectively with necessary adaptations to improve competitiveness in the marketplace. The proposed parsimonious model highlights key latent structural variables that may explain a significant portion of the variance in organizational adoption of B2B e-commerce. In addition to the organizational structural variables, key context variables may also influence innovation adoption decisions. The research proposes to investigate some of these key context variables. The following sections briefly discuss the context and structure variables. In addition, a set of outcome performance variables is investigated to understand the impact of B2B e-commerce adoption.

Organizational Context

Several organizational context variables are proposed for this study in view of their recognized influence on adoption behaviors. In particular, organizational size, channel partner influence (coercive and non-coercive customer influence strategies), and environmental uncertainty variables (market and technological turbulence) will be investigated. Organizational size refers to the scale of firm operations, indicated by measures such as the number of employees in the firm, revenues etc. The term "influence strategies" in the supply chain context refers to the structure and content of

communications by personnel in a "source" firm that are intended to change behaviors in a channel partner dubbed the "target" firm. Two environmental uncertainty components are used commonly in marketing literature: market turbulence and technological turbulence. Market turbulence refers to the rate of change in the composition of customers and their preferences, and technological turbulence refers to the rate of process change in, for example, production or logistics operations (Jaworski and Kohli 1993). These variables will be analyzed for their effects on supply chain B2B e-commerce adoption.

Organizational Structure

A review of the literature in organizational structure reveals that four dimensions dominate the research: formalization, specialization, centralization, and integration (Jablin 1987; Miller and Dröge 1986). Formalization represents the use of rules in an organization (Hage and Aiken 1967). In other words, it is the set of explicit rules and procedures used by the organization to handle situations (Hall 1982; Jablin 1987). Formalization refers to the extent to which rules, policies, procedures, job descriptions and authority structures are formalized, the use of written instead of oral communication channels, and the application of cost and quality controls (Hall et. al. 1967; Miller and Dröge 1986). Specialization as a construct refers to the division of labor and skills within an organization at the technocrat level (Pugh et. al. 1963). The higher the level of specialization, the more an individual performs only a part of an activity rather than an entire activity (Robbins 1991). As specialization increases in an organization, the organization becomes more differentiated or complex (Miller and Dröge 1986). Centralization is concerned with the distribution of power within the organization (Hall

1982). The more concentrated the decision making is within the upper echelons of the organization, the more centralized the organization (Robbins 1991). Integration is the level of collaboration achieved among differentiated subsystems or departments in an organization (Galbraith 1973). Integration within an organization is represented through the employment of liaison devices such as integrative personnel, task forces, committees, and teams (Galbraith 1973; Miller and Dröge 1986; Mintzberg 1979). Various researchers, such as those cited above, have suggested that these four structural elements influence the adoption of innovations in an organization.

Performance

Extant innovation adoption literature provides a set of outcome performance variables. This study will include a commonly measured variable, financial performance. Financial performance refers to the efficient utilization of firm resources and is measured as return on investment (ROI), and return on sales (ROS). A major objective of SCM is improving operational efficiencies (e.g., inventory turnover rates, delivery lead times etc.). Operational performance is the second variable investigated in the study.

Hypotheses

The constructs discussed in the above sections are included in the theoretical framework shown in Figure 1. The model incorporates the following hypotheses:

H1: the larger the firm size, the greater the level of supply chain B2B e-commerce.

H2a: the greater the firm's customer coercive influence, the lower the level of supply

chain B2B e-commerce.

H2b: the greater the firm's customer non-coercive influence, the greater the level of supply chain B2B e-commerce.

H3a: the greater the market turbulence, the greater the level of supply chain B2B e-commerce.

H3b: the greater the technological turbulence, the greater the level of supply chain B2B e-commerce.

H4: the greater the formalization, the greater the level of supply chain B2B e-commerce.

H5: the greater the centralization, the lower the level of supply chain B2B e-commerce.

H6: the greater the specialization, the greater the level of supply chain B2B e-commerce.

H7: the greater the integration, the greater the level of supply chain B2B e-commerce.

H8a: the greater the level of supply chain B2B e-commerce, the better the financial performance.

H8b: the greater the level of supply chain B2B e-commerce, the better the operational performance.

Design Overview

Although several approaches are possible to test the hypotheses, a survey research method is employed in this dissertation. A field study of key informants was conducted to obtain information on organizational and contextual characteristics associated with the

organization. The unit of analysis in the study is a unique manufacturing division, i.e., the business unit or an autonomous firm as represented by the perceptions of the respondent. The target population of the study is manufacturing firms in the U.S.A. The sample frame for the study is strategic-level managers from manufacturing organizations engaged in business-to-business marketing. Though surveying multiple key respondents per business unit is recommended because of the diverse nature of the scales (Phillips 1981), a single key informant was solicited in view of several constraints. The criterion variable, supply chain B2B e-commerce, is measured using a scale specifically developed in this study. Organizational latent structure variables, size, influence strategies, environmental uncertainty, and performance variables are measured using established scales. The study employs multiple regression analysis to ascertain the impact of context and structural variables on B2B e-commerce adoption decisions by firms. The technique also helps understand any mediating effect of B2B e-commerce on the relationship between the independent variables and performance measures.

Scale development

The scale development procedure for the supply chain B2B e-commerce construct broadly adheres to steps suggested for developing a valid and reliable index construction using formative measures. First, a literature review following a conceptual definition of the construct was undertaken, yielding seven items for the scale. Next, content validity was established by asking academicians and industry experts in the field to edit and refine the items, in addition to conducting a pilot study. The resulting measure of eight items was further refined in a pre-test survey of respondents from the sampling frame used in the main study. Construct validity was established by comparing

the scale with a global measure of supply chain B2B e-commerce (Diamantopoulos and Winklhofer 2001).

Summary of Contributions

This dissertation seeks to make both theoretical and managerial contributions, particularly in the areas of marketing and SCM. Current research is extended and conceptual relationships empirically tested.

Theoretical Contribution

The theoretical rationale for considering adoption and implementation of supply chain B2B e-commerce is rooted in the innovation adoption theories. Adoption of innovation is a social process representing a major change in the structure or procedures (behavior) of an organization's operating system. The dual-core theory (Daft 1978) posits that organic organizational structures facilitate generation and/or adoption of technological innovations. Integrated supply chains are supposed to be inherently organic structures both within member organizations and across them. The inherent nature of these organizations enables adaptations to environmental changes, and innovations are a means that facilitate the adaptation process (Damanpour 1987).

While the present study is derived from a strong theoretical foundation, the impetus is on generating some specific theoretical extensions:

1. Existing research is extended into the areas of SCM and business-to-business marketing. Whereas extant research provides some studies that contribute to theory building and corroboration, very little work is done in the emerging field of e-

commerce in SCM. This study focuses on developing a strong theoretical base necessary for this radically new business approach.

2. Conceptual relationships linking organizational characteristics and supply chain B2B e-commerce adoption to facilitate supply chain partnerships have been empirically tested. Support for the hypothesized relationships provides a strong background for further research incorporating an extended model or different models of key constructs.
3. An underlying basis for advancement of a field is the development of concepts and operationalizing them to help conduct research studies. The current dissertation operationalizes the adoption of e-commerce in supply chains, by developing a scale for measurement – particularly necessary if an emerging discipline is to be understood and analyzed in an academic setting.

Managerial Contribution

The dissertation study has important implications for managers. First, adoption of supply chain B2B e-commerce is expected to bring extensive benefits to firms in the supply chain. Companies can source goods faster, reduce cycle times and inventory levels, optimize use of personnel, reduce paper-work and costs, track shipments and inform customers real-time, just to mention a few of these benefits. Empirical results from the study provide more concrete evidence to managers of the benefits as expressed in the performance figures. This knowledge can guide technology adoption decisions to sustain competitive advantage.

Second, identification of organizational characteristics that affect adoption of e-commerce in the supply chain decision areas would help managers make changes to

enhance the adoption process. Managers can then take necessary steps to ensure that the right combination of structural characteristics is in place to realize benefits. Structural changes are expensive propositions, unless the benefits are tremendous. Theoretical guidance can save firms the costs of unnecessary changes required, as well as suggest dimensions that are candidates requiring change.

Supply chain management is a means for firms to leverage capabilities and resources in an efficient and effective way. The results have the potential to provide firms in the supply chain with insights into ways supply chain B2B e-commerce can enhance the capabilities for sustaining competitive edge in the market. Managers can integrate key member firms to desired levels along crucial business processes.

Outline of the Dissertation

This dissertation is organized into five distinct chapters. The current chapter, Chapter I, introduced the dissertation study, and reviewed the purpose, structure, and scope of this study. The second chapter delineates the concept of SCM, and the importance of e-commerce implementation in facilitating supply chain integration. The chapter also provides the theoretical rationale for the study by reviewing organizational innovation literature. Finally, organizational context and structural characteristics thought to influence e-commerce adoption in SCM are discussed. Chapter III presents the research objectives for the empirical investigation. Research hypotheses are proposed to study the relationships between the various groups of variables in the conceptual model. Furthermore, the chapter outlines the research design and methodology used in conducting this study. The chapter elucidates the issues associated with this study, along with the actions taken to ensure the validity of the study. Scale development process for

supply chain B2B e-commerce is also outlined in the chapter. In Chapter IV, results of the hypotheses testing are presented and reviewed. The last chapter, Chapter V, presents the academic and managerial implications of the study. Limitations of the study and opportunities for further research in the discipline are discussed.

CHAPTER II

LITERATURE REVIEW

Technological innovations have become increasingly important at the macroeconomic as well as the firm level. Acknowledging this development, strategy researchers and managers have been giving enhanced consideration to technology and its implications. Although a variety of perspectives have emerged on the strategy-technology relationship, the common thread linking them all is the argument that technologies contribute to firm efficiencies, thus improving firm performance. The suggestion is that a "critical link between technology and strategy exists" (Kantrow 1980, p.7). Another perspective holds that technology affects industry structure (Willard and Cooper 1985). Research has also explored the technology-strategy link by investigating aspects such as its role in inducing innovations (e.g., Kanter 1982; Ronstadt and Kramer 1982) or in influencing vertical integration and industrial relationships (Balakrishnan and Wernerfelt 1986; Sibbernsen 1986). Stressing the critical strategic importance of technology, Porter (1985) said it "is important because it affects competitive advantage" (p. 165).

The thrust of most of these research studies on technological innovation is captured by the following statements: (1) "valid prescriptions can be identified for its incorporation into the strategic management process" (Butler 1988, p.16); (2) identification, evaluation, and adoption of technological innovations is a critical

determinant of organizational productivity, competition, and survival (Bigoness and Perreault 1981; Morgan 1988; Zaltman et. al 1973); and (3) with the realization that R&D and new inventions alone are inadequate for sustaining competitiveness, there is a renewed focus on enhanced use of technologies (Wince-Smith 1991).

A recent technological innovation, e-commerce has revolutionized the way firms do business. Leading-edge firms have implemented this technology as part of their overall strategy for competitive advantage. Interfirm partnerships in the supply chain are predicted to receive a major boost with the implementation of this technological innovation. The purpose of this literature review is to examine this concept, B2B e-commerce, from an SCM perspective. Towards this endeavor, the following stages are reviewed:

1. A discussion of the organizational behavior foundation of innovation and adoption.
2. An examination of the type of e-commerce technology that is a major concern to SCM, namely, B2B e-commerce.
3. An investigation of selected organizational context and structural characteristics that determine adoption of innovative technologies such as B2B e-commerce.

The next three sections of the manuscript explore the relevant extant literature.

Innovation and Adoption of Innovation by Firms

Innovation research transcends several disciplines, and is an important area of pursuit in marketing. Two broad streams of research can be identified in marketing

literature (Sinha and Chandrashekar 1992). One stream of innovation research investigates analytical models of innovation diffusion at the aggregate level (e.g., Bass 1969; Mahajan et. al 1990; Mansfield 1968): *diffusion models*. The second stream explores antecedents of individual adoption decisions and behaviors, and takes on a disaggregate perspective (e.g., Gatignon and Robertson 1989; Pierce and Delbecq 1977): *adoption models*. This dissertation investigates innovation from the second perspective, and focuses on innovation adoption in the business-to-business supply chain context. Adoption is part of the overall strategy to sustain competitive advantage (Chisnall 1989), and typically is a long-term commitment when a higher degree of perceived risk is involved (Frambach et. al. 1998).

Innovation in social science research has connotations of improvement and is "laden with positive value" (Downs and Mohr 1976, p.700). However, conceptualizations of innovation have been a difficult proposition with seemingly little consensus about its exact meaning. There have been divergent views over time on what actually constitutes the concept. While Barnett (1953) defines innovation simply to imply invention of something new, Carroll (1967) understands innovation as a social process of adoption by firms, giving it a behavioral perspective. The latter view of innovation is reflected in Becker and Whisler's (1967) work: innovation is a social process apart from invention, and involves early employment of an idea. A similar view is echoed by Mohr (1969, P.112): "innovation is the successful introduction into an applied situation of means or ends that are new to that situation." This view is well captured by Thompson (1965) who defines innovation as the generation, acceptance, and implementation of new ideas, processes, products or services for the first time within an

organizational setting. This definition implies that an individual organization is the unit of analysis.

The above definition recognizes that adoption/implementation is "a strategic effort for [the] focal organization, regardless of whether other industries or organizations have already proceeded through that process" (Pierce and Delbecq 1977, p.28). The definition obviously acknowledges that innovation is a multiphased process occurring over time. In their research, Wilson (1966) and Shepard (1967) identify similar sequential phases of innovation. The sequence involves everything from the proposal to adopt the innovation through installing the adopted idea into a "sustained recognizable behavior pattern within the organization" (Pierce and Delbecq 1977, p. 29). In a meta-analysis of innovation literature, Damanpour (1991) captures the essence of Thompson's definition of innovation adoption to encompass the generation, development, and implementation of new ideas and behaviors. Summarizing previous work, he defines innovation as the "adoption of an internally generated or purchased device, system, policy, program, process, product or service that is new to the adopting organization" (p. 556). This dissertation takes Damanpour's (1991) perspective of including the entire sequence of behaviors in the definition.

A review of literature also suggests a variety of typologies of innovation. Arguing that a general theory does not explain the adoption behaviors of organizations or the determinants of adoption, many researchers have developed categorizations of innovations. Three typologies are prominent, and Table 1 summarizes Damanpour's (1991) categorization.

The focus of the dissertation is technical or technological innovation. As Schon (1967) explains, technology is a tool, physical equipment, or system that helps organizations extend their capabilities. Therefore technological innovations are those that result from the use of technology and alter the products and services or the way they are produced and delivered. The next section discusses in greater detail the technological innovation – B2B e-commerce – which is investigated in this research. As mentioned earlier, innovation adoption is conceptualized to include the entire sequence through concept to implementation. The argument is that innovation does not occur until the technology is actually utilized by the members of the organization (Damanpour 1987). The basic objective of enhanced performance is realized only after the innovation has actually been used.

TABLE 1

INNOVATION TYPOLOGIES

Innovation Typology	Category	Category	Research Examples
I	**Administrative** (include organizational structure and administrative aspects; indirectly related to work activities, but more directly to their management)	**Technical** (include products, services, and production process technology; directly related to work activities)	Daft 1978; Kimberly and Evanisko 1981; Damanpour 1987
II	**Product** (products or services introduced to meet a market need)	**Process** (new inputs into production or service operations such as task specifications, workflow mechanisms etc.)	Knight 1967; Utterback and Abernathy 1975; Ettlie 1983
III	**Radical** (produce a high degree of change, or fundamental changes in the activities resulting in clear departure from current practices)	**Incremental** (routine & produce little departure from existing practices)	Ettlie, Bridges, and O'Keefe 1984; Dewar and Dutton 1986; Nord and Tucker 1987;

E-Commerce Technology

Providing value to ultimate customers in extremely competitive market conditions implies a search for innovative ways to generate or retain competitive advantage. In the supply chain context, the ability to integrate and align relationships and processes with strategy is an increasingly valuable tool. Supply chain integration focuses on cooperative and coordinated partnerships of firms with strategic suppliers and customers, to improve the effectiveness and efficiency of the value chain. Integration spans relationships, activities, functions and processes both at the inter-firm level and within firms in the

supply chain. Within firms, individual departments and functions shed their "silo mentality" to become part of a coordinated and integrated process. Some researchers view this intra-firm integration as a precursor for interfirm partnerships (Bowersox and Closs 1996; Kanter 1994; Sabath 1995; Stevens 1990). Between firms, integration includes operational aspects, such as interfirm material flows, and collaborative aspects encompassing behavioral, communicational, and interactive flows of the supply chain (Morash and Clinton 1998).

Information technology plays a strategic role in the competitive strategy of firms (e.g., Bradley, Hausman, and Nolan 1993; Porter and Millar 1985). Interorganizational electronic networks improve integration and coordination between firms (Malone, Yates, and Benjamin 1987). Integration through such information networks leads to redistribution of competencies among firms so that firms focus on core competencies to maximize the value offered to the market (Kambil 1991). Literature provides examples of a variety of other benefits derived via such an integrative effort. However, the key is that the innovation should span business processes in the supply chain, encompassing all three levels: strategic, tactical, and operational (Graham and Hardaker 2000; Thomas and Griffin 1996). E-commerce technology plays a central role in the integration by lowering transaction costs, minimizing complexity, and adding more flexibility (Graham and Hardaker 2000). Use of e-commerce in SCM inherently involves an array of internet-and other electronic technology-facilitated partnerships and interactions in the supply chain. Graham and Hardaker (2000) list three such interactions:

1. Business-to-Business (B2B)
2. Business-to-Consumers (B2C)
3. Marketspace

B2B E-Commerce. The B2B "space" "includes the myriad upstream and downstream channel coordination and relationships" (Graham and Hardaker 2000, p. 288), and is a vital component of the overall supply chain strategy. The purpose of this dissertation is to investigate e-commerce adoption in the B2B context of supply chains. The innovation, often used interchangeably with the overarching concept of e-business, is defined by IBM as "a secure, flexible and integrated approach to delivering differentiated business value by combining the systems and processes that run core business operations with the simplicity and reach made possible by internet and other electronic data and information exchange technology." The advantage of the technology lies in its immense ability of fast, efficient, integrated, and interactive exchange of huge amounts of information both within firms and between firms. The multiple tools of B2B e-commerce enable firms to transmit and exchange information through a variety of formats. The adoption of this technological innovation enables businesses to integrate their activities within and across firms in the supply chain. Investigating the impact of B2B e-commerce on sales, Avlonitis and Karayanni (2000) attribute the importance of the technology in the business-to-business context to two characteristics:

1. Its interoperable nature (compatibility with a variety of information systems and networks) that provides a distinct advantage over other competing tools such as traditional EDI, value added networks etc. This in turn contributes to significant cost savings in setting up, switching and operational costs.

2. Its enhanced communication capabilities such as real-time interaction and rapid transfer of large amounts of information, which enable it to be used as a communication tool and a marketing channel for developing and sustaining interfirm relationships.

SCM & Business Process Integration. The SCM objective of improving the efficiency and effectiveness in delivering value presupposes that supply chain

relationships and business processes will be continuously integrated and aligned. In highly evolved supply chains, members view other firms as extensions of their own firm into a seamless entity. Integrated intra-company and inter-company supply chain process management is an initiative that maximizes total business process efficiency and effectiveness. Inarguably, "SCM offers the opportunity to capture the synergy of intra- and inter-company integration and management" (Lambert, Cooper, and Pagh 1998, p.1). The SCM process integrates member firm relationships, activities, functions, and locations (Bowersox and Morash 1989; Hammer 1990; Hammer and Champy 1993).

The key to implementing SCM lies in identifying critical supply chain members, and key business processes along which the partners are integrated, in order to maximize competitiveness and profitability for the focal firm as well as the entire network of supply chain partners (Lambert, Cooper, and Pagh 1998). This initiative, as mentioned earlier, has the goal of "boosting total process efficiency and effectiveness across members of the supply chain" (Lambert, Cooper, and Pagh 1998, p.4). Identifying key partners is premised on the contribution to value-addition in the final market offering. Generally, all business units or autonomous firms actually performing operational/managerial activities in the key business processes are candidates for integration (Lambert, Cooper, and Pagh 1998). Key business processes are linked with each other, and follow a logical progression: for example, customer service requires production information. Supply chain integration provides the necessary visibility and coordination among business processes to achieve the goal of providing value (Cooper, Lambert, and Pagh 1997).

The business process integration results in high degrees of collaboration and operational efficiencies in the supply chain network (Morash and Clinton 1998).

Research studies suggest that integrated supply chains reflect at least a minimum threshold level of implementation of collaboration among key partners (e.g., Morash and Clinton 1998; Treacy and Wiersema 1993, 1995), effecting a responsive supply chain. Coordination of operational aspects contributes to an efficient supply chain. Integration manifests at all levels of firms that are part of the initiative – strategic, tactical, and operational.

Collaboration in the supply chain involves "close and interactive relationships" (Morash and Clinton 1998, p. 107) among channel members, emphasizing behavioral, communicational, and interactive flows of the supply chain leading to a blurring of exact boundaries between firms (Bowersox, Morash, and Daugherty 1988; Bowersox and Morash 1989; Leifer and Delbecq 1978). Activities in this area include collaborative forecasting, contract negotiation, collaborative scheduling, and capacity sharing (Global Research Team 1995). Integrative aspects dealing with operational efficiencies emphasize physical, spatial, temporal, and economic operational elements (Morash and Clinton 1998). The effort seeks ways to minimize costs, to eliminate intermediate production steps, to reduce transactions and "friction" costs, and to optimize business processes across functional and organizational boundaries (Treacy and Wiersema 1993). Operational excellence implies efficient delivery of reliable products and services at competitive prices with minimal difficulty and inconvenience (Treacy and Wiersema 1995). The integrative partnership activities in this area include on-line purchasing or selling from catalogs, virtual tours of vendor products (or allowing customers to take virtual tours of the focal company's products), and automated procurement of MRO products.

A successful supply chain integration model implies continuous improvement and innovation, and its prerequisite, measurement and evaluation of supply chain process components. Evaluation is important, since it influences behavior that is linked to supply chain performance (Lapide 2000). Evaluation is necessary to improve business processes by ways such as eliminating redundant activities and reducing input requirements – the objective being maximizing value output. Clichés such as "anything measured improves" or "you can't manage what you do not measure" abound in the industry, underlining the importance of evaluation in ensuring that the SCM objectives are met. Evaluating supplier performance, material availability, or shipment schedule accuracy, etc., or providing performance information to customers, contributes to improved supply chain integration by enhancing efficiencies and effectiveness, responsiveness, and the resultant benefits. Thus evaluation activities become part of supply chain process integration, resulting in greater visibility and coordination, facilitating close supply chain partnerships. To sum up, business process integration across firm boundaries involving key partners provides a proactive supply chain network that constantly seeks ways to sustain competitive edge in the marketplace. The initiative sweeps across all key activities and systems across the chain network.

B2B E-Commerce and Supply Chain Integration. Supply chain B2B e-commerce facilitates the integrative process along key business processes – both within firms and between firms in the supply chain. B2B e-commerce drastically changes the way partners in the supply chain manage, plan and control their activities. The technology virtually becomes the medium of interaction through which essential processes of managing and synchronizing the chain across business partners is carried

out, integrating them into one logical enterprise. The technology not only provides integration of different categories, but also plays a critical role in all phases of planning and execution of SCM: across strategic, tactical and operational levels. B2B e-commerce is crucial in strategic level planning such as designing the partnership network, or optimizing the supply and distribution size. At the tactical level, the role is crucial in optimizing the flow of goods and services, plant allocation decisions, and sourcing raw materials and component parts. At the operational level, the technology is important in streamlining day-to-day activities. For example, effective scheduling and sequencing is facilitated to minimize work-in-process levels and maximize throughput and yield rates.

B2B e-commerce provides speed and extensive connectivity to the supply chain. Business processes are accelerated and streamlined as a result, and each partner's business processes are made highly visible to the others in the supply chain. This continuous connectivity of firms with their supply side and demand side partners has created immense opportunities for collaboration, sharing information, and providing more customized customer support. Visibility highlights bottlenecks and inconsistencies of the processes, catalyzing a change for improvement. Front-end applications are better integrated to back-end applications such as logistics. Collaboration between business partners is tremendously enhanced by the innovative technology. Collaborative B2B e-commerce extends the transactional and optimizational capabilities of enterprise resource planning (ERP) beyond enterprise boundaries, integrating value-chain planning and transaction processing with trading partners. ERP data of firms is critical for supply chain partners when high information flow is the dictating paradigm. Progressive supply chain capabilities are built on the backbone of ERP systems. Internet based technologies

facilitate the process. Improved supplier managed inventory, resulting from the ability of customers to share better downstream demand information, ensures adequate raw material flow for manufacturing activities while maintaining minimum inventory levels. Collaborative planning, forecasting and replenishment initiatives imply creating and using a shared repository of data for use by all partners. E-commerce facilitates this initiative and provides a common technical platform that alleviates many of the issues of version control, standards and confusion. Collaborative planning via e-commerce also allows supply chain business partners to create virtual inventory stores for access to all, reducing costs through lower stocks and more efficient shipment planning. High visibility also involves real-time monitoring and exception-based alerting of product and information flow, encompassing both inbound and outbound activities. Product content synchronization – integration of data needed for manufacturing a product to correct specifications – is another facet of collaboration through e-commerce that reduces bullwhip inefficiencies.

A B2B e-commerce initiative in the supply chain focuses on a two-fold strategy. The customer-side e-commerce application provides better customer service, order processing, and direct access to accurate market information. On the other hand, the supply-side application facilitates backward integration and creates efficiencies. The underlying factor is, as discussed earlier, the integration of key business processes enveloping both customer side and supply side applications to provide value to the ultimate customers and other stakeholders (Lambert, Cooper, and Pagh 1998). The following are just a few illustrative examples of benefits from B2B applications of e-commerce technology. Being able to better manage product and information flow

through e-commerce increases inventory turns, reduces cycle times and enhances product quality – resulting in greater customer satisfaction. High visibility enables companies to respond proactively to fulfillment problems before they impact customers. Increased delivery reliability and timeliness eliminates or reduces the bullwhip effect, resulting in cost savings. Bullwhip effect, as termed by Procter and Gamble and other firms, refers to the magnification of variability and demand uncertainties upstream along the supply chain. On the supply side, e-commerce facilitates strategic supplier management. Concurrent product design collaboration is another area the technology facilitates. Capturing information on suppliers' performance for improving value addition, besides enabling suppliers make better strategic decisions, provides more opportunities for effective SCM. E-commerce enables firms to provide visibility of every piece of quantifiable information to suppliers to speed up the whole procurement process, thus reducing cost and inventory.

While B2B e-commerce presents buyer and supplier firms with compelling value propositions to enhance the value captured in integrated business partnerships, the application of e-commerce in SCM is only a relatively new phenomenon. Even though the potential application areas are varied, there have been very few studies on the adoption or use of e-commerce in supply chains. The principal literature support comes from sources outside of empirical studies. The proposed study is an undertaking to mitigate this inadequacy by investigating the determinants and implications of B2B e-commerce adoption. The following sections provide a review of extant literature on contextual and structural determinants of the adoption behavior of firms.

Structural And Contextual Antecedents Of Supply Chain B2B E-Commerce Adoption

Understanding major organizational innovations involves focusing on the roles organizational structure and the environmental factors play in the adoption and implementation of innovations. As Baldridge and Burnham (1975) say, structural characteristics and environmental or contextual variables are powerful explainers of innovation behaviors, and account for much of innovation adoption. The following sections explore extant literature on these variables from the standpoint of innovation adoption. Contextual variables are addressed first, followed by structural factors.

Contextual Determinants

The context of an organization is an important predictor of organizational innovativeness. Ettlie's study of retailers (1983) suggests that the technology and market policy of organizations are influenced by contextual factors, which in turn influence innovation adoption. Context describes elements of both the long run and short-run operating situation or environment of an organization. Context encompasses: (1) the broader market environmental elements in which the firm competes, such as market attractiveness, entry barriers, and environmental uncertainty; and (2) the organizational level aspects that are not business-unit specific such as resources, size, processes, and culture (Burke 1984). Several contextual variables have been investigated in extant literature. In this study, three of them are discussed: size, influence strategy, and environmental uncertainty.

Size. Size refers to the operating scale of an organization (Duncan 1976). It has been conceptualized as the number of employees in the organization, assets, or both, budget value, and sales volume (e.g., Becker and Stafford 1967; Hage and Aiken 1967; Mohr 1969; Mytinger 1968). Many of the research studies have operationalized size as the logarithmic transformation of the sales volume, to adjust to the curvilinear relationships of size with other variables (Kimberly 1976; Moch and Morse 1977).

Much of organizational innovation research traces back to the seminal work of Schumpeter (1942). A crucial Schumpeterian suggestion is that size is an important cause of innovation; large firms innovate more than smaller ones (Scherer 1992). Studies by many researchers such as Ali (1994) and Galbraith (1952) derive from the above assumption, suggesting that radical innovations are associated with larger firms because of some inherent advantages. Larger firms, they argue, have economies of scale, are able to spread risks, and have more slack resources to utilize. Size is often assumed to imply availability of uncommitted or slack resources for radical innovations. It is assumed to facilitate adoption of innovations irrespective of the innovation's compatibility with a large portion of the organization (Moch and Morse 1977). The study by Damanpour (1989) finds a positive relationship between size and innovation.

However, research on the effects of size on innovation adoption is ambivalent. Mohr (1969) suggests that size operates more as a facilitator than as a motivator of innovation. In addition to having direct effects on innovation, size is also posited to have indirect or spurious effects, being mediated by other variables (Moch and Morse 1977). Size promotes organizational complexity (Blau 1970; Thompson 1969), which implies increased specialization and integration. Specialists seek new solutions by way of

innovations, and the integrative mechanisms promote innovations in order to reduce conflict and enhance coordination to accomplish organizational goals (Lawrence and Lorsch 1967; March and Simon 1958). Size also generates critical masses for some tasks and problems, stimulating the adoption of innovations (Baldridge and Burnham 1975). Giving credence to the qualified view that size indirectly affects innovation behavior, some researchers (e.g., Inkson, Pugh, and Hickson 1970; Moch and Morse 1977; Zaltman, Duncan, and Holbeck 1973) argue that size may cause structural adaptations leading to innovative consequences. A related suggestion is that organizational characteristics resulting from size cause innovation (e.g., Aiken and Hage 1971; Baldridge and Burnham 1975).

Partner Influence Strategies. The importance of social influence in supply chains has been widely acknowledged by the amount of research that has accumulated since the seminal study by French and Raven (1959). While one stream of research in the area has focused on power and the sources of power, another stream which has gained conceptual and empirical attention in the channels literature is interfirm influence strategies (e.g., Dwyer and Walker 1981; Frazier and Summers 1984; Frazier, Gill, and Kale 1989; Wilkinson and Kipnis 1978). Interfirm influence strategy, which includes the content and structure of the communication by a source firm in its influence attempt with a target firm, has the ultimate goal of effecting some modification of the target firm's behavior (Frazier and Summers 1984). Channel member attitudes, morale, and system performance are determined, in part, by the type and amount of influence applied by the channel partners (Frazier 1983).

The following excerpts from extant research highlight the importance of interfirm influence strategies in the channel context:

(1) the "study of power relationships and influences in channels provides useful insights into channel functioning and interorganizational interactions" (Reve and Stern 1979, p.407); (2) in a marketing channels context, exercise of influence can have a positive role in the achievement of integration and goal attainment within the channel system (Kotter 1977; Stern 1969; Stern and Heskett 1969); (3) interorganizational systems are sensitive to *dependence* positions in the environment (Dwyer, Schurr and Oh 1987); and (4) the structure of *reciprocal dependence* characterizes channel interdependence and provides important implications for relational exchange (Emerson 1962; Gundlach and Cadotte 1994).

Influence strategy is defined as, 'the structure and content of communications by personnel in a "source" firm that are intended to change behaviors in a channel partner or the "target" firm.' Channel communication is the means by which power is applied (Frazier and Summers 1984). The influence strategies center on strategy and tactics to alter a partner's behavior in an existing business relationship rather than on initiating new business partnerships (Frazier and Summers 1984). The focus of channel partner influence strategy investigation here is on the impact of downstream channel members' influence on the innovation adoption decisions and behaviors by firms in the supply chain.

A compelling taxonomy is provided by Frazier and his colleagues (cf. Frazier, Gill, and Kale 1989; Frazier and Rody 1991; Frazier and Summers 1984) which identifies six categories of influence strategies:

1. Promise: Source firm certifies to extend specified reward contingent on the target's compliance.
2. Threat: Source firm informs the target that failure to comply will result in negative sanctions.
3. Legalistic Plea: Source firm contends that target compliance is required by formal agreement.
4. Request: Source asks target to act; there is no mention of subsequent sanctions.
5. Information exchange: Source firm supplies information with no specific action requested or otherwise indicated.
6. Recommendation: Source stresses that specific target action is needed for the latter to achieve desired outcomes.

The channel partner influence strategies are categorized into a variety of dichotomizations. One important categorization is coercive versus non-coercive influence strategies (Frazier and Rody 1991; Hunt and Nevin 1974). Coercive influence strategies involve application of direct pressure by source firms on target partners to elicit a specific behavior or set of behaviors with a stress on adverse consequences for non-compliance (e.g., threats and legalistic influences). On the other hand, non-coercive influences focus primarily on beliefs and attitudes of target firms about general business issues, and do not involve direct pressures to comply (e.g., recommendations, requests, and promises). Much of theory and research has emphasized coercive aspects of interfirm influence relationships, neglecting the underlying stakes channel members have in partnerships (Bacharach and Lawler 1980). However, highly integrative partnering conditions as in supply chains are conducive to greater reliance on non-coercive influence strategies (Lusch and Brown 1982). Coercion is notable for "..its ability to hasten an abandonment of a channel relationship" (Spekman 1980, p.185), and invites retaliation (Frazier and Summers 1986).

Influence strategies used by suppliers in the channel relationship tend to be returned in kind by the distributor/customer and vice versa, supporting the basic tenets of

reciprocal action theory. As Frazier, Gill, and Kale (1989, p. 66) conclude, "the channel context appears to have a major bearing on the applicability of reciprocal action theory to interfirm behavior in channel relationships." When suppliers or manufacturers use non-coercive strategies, the other members follow a similar pattern fostered by the supportive atmosphere created in the exchange (Dwyer, Schurr, and Oh 1987). Similar findings are evident in Frazier and Rody's (1991) work: when a firm has high communicative influence in a dyadic channel relationship, avoiding any strong use of coercive influence fosters and maintains a strong relationship. Extant literature, however, suggests that it is frequently not the case where only a single strategy or a single basic approach (e.g., coercive or non-coercive influence) is used in influencing a target firm on an issue (French and Raven 1959; Frazier and Sheth 1985; Gaski 1987; Kotter 1977 etc.). Two or more strategies are simultaneously and correspondingly used within the same channel interfirm interactions (Frazier and Summers 1984; Gundlach and Cadotte 1994). Evidently both coercive and non-coercive influence strategies need investigation regarding their impact on innovation adoption behaviors of channel partners.

Environmental Uncertainty. The third contextual variable discussed is environmental uncertainty and its two prominent dimensions: market turbulence and technological turbulence. The task environment, meaning, conditions external to the firm, affects the organization's internal behaviors and functioning. Environmental uncertainty may be defined as external dynamism and unpredictability (Duncan 1976). Major organizational subsystems are related to the task environment components, especially consumers and competitors (Pierce and Delbecq 1977). The extent to which this environment is "turbulent" influences organizational innovation because the

organization braces up to face environmental changes and becomes more sensitive to external cues (Aiken and Alford 1970). Research by Meyer and Goes (1988) shows that characteristics of the environment account for unique variance in innovation adoption and assimilation. External shocks make organizations more amenable to radical innovations (Hage 1980). Organizations that learn rapidly about their environmental changes, and respond with suitable behaviors, are best positioned for competitive advantage (Day 1991; Degeus 1988; Senge 1990).

The role of competitive environment in innovation diffusion has received considerable attention in recent times. Empirical studies (e.g., Baldwin and Scott 1987; Kamien and Schwartz 1982; Robertson and Gatignon 1986) generally support the hypothesis that innovation adoption by firms is positively related to intense technological activities in the industry. Market characteristics also influence innovation. As Gatignon and Xeureb (1997) suggest, innovation is not independent of the market in which the firm operates.

The market turbulence dimension specifies the changes in the composition of customers and their preferences (Kohli and Jaworski 1990). This definition is similar to the description of "heterogeneity" by Miller (1987, p. 62) as the "change in diversity of production methods and marketing tactics required to cater to customers' needs." Technological turbulence, on the other hand, is the rate of technological change in a given market (Kohli and Jaworski 1990). It is an element of Miller's (1987) construct of "dynamism." Technological turbulence specifies the amount and unpredictability of change in production, process or service technologies.

Structural Determinants

Organization theory is a collection of a variety of theoretical perspectives. Weber's (1974) perspective of bureaucracy suggests that organizational structure is an important determinant of firm performance. Structural dimensions such as centralization, formalization, and specialization are of primary importance in the exploration of functioning of social systems and their behaviors (e.g., Dalton et al. 1980; Hage 1965; Pugh et al. 1968; Van de Ven 1976). In their research on innovation adoption, Baldridge and Burnham (1975, p. 169) delineate the importance of structural factors. They suggest two reasons as to why these factors need more attention:

(1) "Organizations are now the major adopters of social inventions."

(2) "Organizational dynamics are the major independent variables that influence the amount, the rate, and the permanence of innovations."

Organizational structure is the arrangement of components and subsystems of the firm. It describes the relationship patterns among the parts of the organization (Rogers and Agarwala-Rogers 1976). As Miller (1987, p.8) defines it, structure "is the enduring allocation of work roles and administrative mechanisms that allow organizations to conduct, coordinate, and control their work activities." The purpose of an organizational structure is allocation of labor and coordination of the roles to establish enduring behaviors within the organization (Mintzberg 1979).

The structural perspective is a dominant view on how organizational characteristics affect innovation. Collins, Hage, and Hull (1988) stress that the patterns of social relationships in the organization affect innovation adoption. The argument from this perspective is that the differences in organizational structures account for the variations in their capacity for change, due to the very different patterns of social actions

that emerge from the structures. The amount and quality of information flow in the organization, decision making perspectives, the stress on monitoring the market environment and the means adopted, etc., are all affected by the structure. Innovation adoption behaviors of firms have been investigated from this perspective, beginning with the seminal work of Burns and Stalker (1961) who studied adoption behaviors of firms with mechanistic versus organic structures. Related structural perspectives by Daft's (1978) dual-core model and Duncan's (1976) ambidextrous model bring additional insights into innovation adoption behaviors. These models of innovation have been either conceptually developed initially or derived empirically from studies on organizations.

The following table, Table 2, captures the main elements of the structural models of innovation. All models distinguish mechanistic organizations versus organic organizations. Mechanistic organizations have lower complexity, higher formalization and centralization, lower internal and external communication, and higher vertical differentiation than organic organizations (Burns and Stalker 1961). The meta-analysis by Damanpour (1991) provides considerable support for the mechanistic-organic, and dual-core models, but very little support for the ambidextrous model.

TABLE 2

STRUCTURAL THEORIES ON INNOVATION ADOPTION

Theory / Structure	Mechanistic v/s Organic Model (Burns and Stalker 1961)	Dual-Core Model (Daft 1978, 1989)	Ambidextrous Model (Duncan 1976)
Mechanistic	adoption of innovation is more difficult	facilitates adoption of administrative innovations	facilitates implementation of adopted innovations
Organic	adoption of innovation is easier	facilitates adoption of technological innovations	facilitates initiation of innovations

Empirical research on innovation adoption has not only investigated the broader organic and mechanistic structures, but also the more specific latent structural dimensions. For example, the Aston group of researchers (Pugh et al. 1968, 1969) isolated four central organizational dimensions: (1) structuring of activities (specialization & formalization); (2) concentration of authority (centralization); (3) line control of workflow; and (4) size of nonline or staffing function component. However, later research studies such as those by Champion (1975), Hall (1982), Jackson and Morgan (1982), Van de Ven (1976) etc., provide a cleaner set of dimensions that include formalization, complexity/specialization, and centralization.

Asserting that as organizations become more complex and differentiated, integrative mechanisms such as taskforces, committees, liaison personnel are needed, many researchers (e.g., Lawrence and Lorsch 1967; Miller and Friesen 1984; Mintzberg 1979) have included a new dimension to organizational structure: integration. The following paragraphs discuss in detail the four composite structural dimensions: formalization, specialization, centralization, and integration.

Formalization. Formalization specifies the degree of standardization of work processes in the organization, and the extent of deviation that is allowed from those standard procedures (Hage and Aiken 1967; Hall 1991; Mintzberg 1979). This dimension explicitly defines roles, authority relationships, norms and sanctions, procedures and communications within the organization (Hall, Haas, and Johnson 1967; Jablin 1987; Price and Mueller 1986). It is described as a form of control employed by bureaucratic organizations, and "refers to the degree to which a codified body of rules, procedures or behavior prescriptions is developed to handle decisions and work processing" (Pierce and Delbecq 1997, p. 31). The enforcement of the norms is posited to increase predictability of performance. Typically, formalization is measured by the presence of rule manuals and job descriptions. Written instructions describe behavior specifications: "who can or cannot do what, when, where, to whom, and with whose permission" (Mintzberg 1979, p.82).

Researchers have examined the impact of formalized structures on innovative behaviors of firms. For example, Shepard (1967) suggests that lesser degree of formalization permits more openness, which is a necessary prerequisite for idea generation. Similar views are evident in Knight's (1967) work, where he claims that routinized structures do not facilitate creative problem solving. Pierce and Delbecq (1967) also posit that low formalization permits openness, which encourages new ideas and behaviors. On the contrary, researchers such as Corwin (1969), Evan and Black (1967), and Mohr (1969) suggest that a high degree of formalization is necessary for adoption and implementation of innovative proposals. Zaltman, Duncan, and Holbeck,

(1973) capture the above two arguments in their suggestion that more flexible or organic structures benefit initiation of innovation, whereas formalization of decision processes at the adoption and implementation stages may be more appropriate.

Centralization. Centralization is the second organizational dimension to be discussed in this research. Centralization implies the locus of authority and decision-making, and is the extent of concentration of decision-making autonomy in the organization (Pfeffer 1981). The dimension is typically measured as the degree of participation by organizational members (Aiken and Hage 1971; Kaluzny, Veney, and Gentry 1974), or as the extent of freedom and authority members have in making their own decisions (Corwin 1975). It can be viewed as a tradeoff between concentration of decision making power at higher echelons of the organization, and power distribution throughout the organization (Jablin 1987; Price and Mueller 1986). This implies that high centralization portrays decision-making authority residing with top management. The inverse, i.e., minimum centralization or decentralization, reflects a situation where power is dispersed, and all or at least more members in the organization share equally in the exercise of power (Mintzberg 1979; Price and Mueller 1986).

Organizations fall somewhere on the continuum between the two extremes of centralization and decentralization, regarding the issue of hierarchical location of decision-making authority. Researchers linking centralization/decentralization and innovation generally seem to agree that less centralization found in organic structures is a primary predictor of innovation (e.g., Griffiths 1964; Hage and Aiken 1967; Mohr 1969). The notion that greater work unit and individual autonomy and less restricted communication flows foster innovative activities is implicit in many innovation studies

(Pierce and Delbecq 1977). Participatory work environments found in decentralized organizations are conducive to innovation because they enhance members' awareness, commitment, and involvement (Damanpour 1991).

Specialization. This dimension represents the extent of division of organizational tasks into separate jobs (Pugh et al. 1968). Specialization relates to the concept of division of labor within the organization (e.g., Pugh and Hickson 1976; Pugh et al. 1963; and Pugh et al. 1968). A highly specialized organizational structure implies a large number of specialists and experts, representing different specialties found in the organization. Therefore it is the structural dimension that is concerned with the number of official tasks and their allocation among positions in the organization (Mintzberg 1979; Pugh and Hickson 1976). It examines the extent to which tasks are divided into distinct elements (Ruekert, Walker, and Roering 1985). It is a way to differentiate the organization internally (Hedberg, Nystrom, and Starbuck 1976). The variable is usually measured by the number of different occupational types or job titles in the organization.

Specialization brings richness of experience, self-confidence, and increased boundary spanning activity (Leifer 1974; Thompson 1965, 1969). These conditions are suggested as being conducive to the innovative process (Pierce and Delbecq 1977). It increases the efficiency of information within work units. Research by Aiken and Hage (1971) and Kimberly and Evanisko (1981) suggests that a greater variety of specialists bring a broader knowledge base into the organization, and facilitate increased cross-fertilization of ideas – necessary for increased innovativeness, as well as easier assimilation of innovations in the organization.

Specialization, as it is investigated here, is distinct from the job specialization related to the breadth of tasks performed by shop-level or assembly line workers. Hage (1980) provides a clear differentiation between knowledge-based specialization referred to in this study, and the task specialization as popularly used in industry. He states that there is a need to "...make a distinction between task specialization and person specialization. Task specialization occurs along the assembly line and is not the same as the development of new professional or managerial specialties (p.388)."

Integration. Integration is the fourth latent structural dimension discussed in this dissertation. Integration specifies the extent of collaboration between departments and the flow of lateral communications throughout the organization (Lawrence and Lorsch 1967). The level of coordination achieved among the work units in an organization represents the construct (Schermerhorn 1993). It is related to the coordination among individuals and groups within the organization, meaning, cross-functional coordination (Galbraith 1994; Mintzberg 1979).

Organizations usually develop integrative mechanisms for encouraging interfunctional interactions, and high levels of integration are reflected by a variety of mechanisms such as face-to-face devices and task-force liaison personnel. In fact Galbraith (1963) proposes seven such integrative mechanisms, later collapsed into four broad groups in Mintzberg's (1979) work: (1) liaison personnel: non-managerial positions that link various departments; (2) task forces, standing committees, cross-functional teams: temporary or permanent groups linking several departments; (3) integrating managers: formal leadership positions for using authority to integrate

departments; and (4) matrix structures: dual authority structures for cross-functional interaction at critical points in the organization.

Integration creates extensive lateral relationships within the organization, facilitating increased information flow and processing ability (Galbraith 1973). This leads to cross-fertilization of ideas and enhanced coordination of behaviors, which is conducive to innovation adoption. Integration also provides flexibility to the organization to respond to market conditions (Galbraith 1994) and to adopt innovations to deal with changes in the environment. Organizational learning increases due to integration, facilitating faster assimilation of innovations.

Performance

Performance provides a basis for continuous improvement by affecting behaviors that are determinants of supply chain and firm improvement. Key performance indicators provide valuable information to firms, showing the extent to which objectives are met.

The marketing literature has extensively studied both market performance (e.g., market share, market share growth, customer satisfaction) and financial performance (e.g., return on investment, return on sales, shareholder wealth creation). Besides objective performance, perceived or subjective indicators are commonly used in studies investigating strategic business units or private firms. Perceived relative performance indicators are popular in literature as there is a strong correlation with the objective performance indicators (Dess and Robinson 1984; Pearce et al. 1987). In addition, relative performance indicators control for differences across the business unit's industries and served markets (Slater and Narver 1994).

This study measures perceived financial performance and operational performance. While financial measures are common, there is criticism that they deal inadequately with intangibles and improperly value sources of competitive advantage (Day and Wensley 1988). Besides being historical in perspective and therefore not forward-looking, another inadequacy of these measures is that they are not directly tied to operational efficiency and effectiveness in the supply chain. The main objective of an SCM initiative in adopting B2B e-commerce technology is to increase the degree of enterprise-wide integration and extended enterprise integration. Performance measures that are employed must address them adequately. The Supply Chain Council's SCOR Model, for example, provides guidance on the types of performance metrics that give a balanced measure of the supply chain performance.

A good performance measure provides not only adequate visibility to strategic aspects of supply chain performance but also a diagnostic viewpoint of specific areas of performance. Therefore this study will measure perceived financial performance of the strategic business unit as well as operational indicators that encompass cross-functional and extended-enterprise measures (e.g., inventory turnover rates, on-time shipments).

CHAPTER III

RESEARCH HYPOTHESES AND METHODOLOGY

The previous chapter discussed innovation adoption, technological innovation, and supply chain B2B e-commerce as one type of technological innovation adopted in a supply chain context. The chapter also dealt with structural and contextual determinants related with adoption of the technology. A thorough research in the area of innovation began in the 1960s (Hage and Aiken 1967; and Daft and Becker 1968). However, e-commerce as an innovation is a more recent phenomenon, and serious research is still relatively conceptual, with only a few exploratory empirical studies (e.g., Croom 2000; Lancioni, Smith, and Oliva 2000). These articles have introduced some very relevant research questions, forming a foundation for the emerging area to offer rich research possibilities in marketing. Questions closely related to the present research include: What is the role of e-commerce in relationship marketing? How can marketers make the best use of e-commerce as an emerging marketing tool? What are the determinants of success for e-commerce marketing (McGaughey and Mason 1998)?; What is the impact of e-procurement on purchasing strategy (Croom 2000)? What is the extent of e-commerce use in the operation and management of supply chains (Lancioni, Smith, and Oliva 2000)?

To provide initial empirical support for the conceptualized relationships between supply chain B2B e-commerce and selected structural and contextual characteristics,

besides relationship with adoption outcomes, this study is designed to investigate the following research questions: What organizational and environmental variables antecede the adoption of supply chain B2B e-commerce and what are the performance outcomes of supply chain B2B e-commerce? Specific hypotheses developed in the next section provide a framework for studying the research question.

Hypotheses

Investigation of the research question outlined above requires development of hypotheses predicting empirical relationships between supply chain B2B e-commerce and the various predictor variables from the organization's structure and environment, and between supply chain B2B e-commerce and outcome performance variables. The prerequisite, however, is to clarify the perspective from which supply chain B2B e-commerce will be investigated in the current study.

The basic underlying perspective used for the investigation is organizational adoption of innovation. Summarizing previous work, Damanpour (1991) defines innovation adoption to include the entire sequence of behaviors that envelop the proposal to adopt, through to installation of the adopted innovation that can be recognized as a sustained behavior pattern. This definition recognizes adoption as pertaining to all or most parts of the organization, and to all or most aspects of operation. Consistent with this view, the adoption of B2B e-commerce as a technological innovation encompasses both intra-firm functions and activities and interfirm business processes relating the firm to its business partners in the supply chain. A second justification for adopting this perspective is that unless the innovation is implemented, the intended contribution to the firm and supply chain performance or effectiveness is not realized. Performance

measures will then be ineffective in capturing the intended benefits. In light of this argument, the operational definition of the adoption of supply chain B2B e-commerce that will be used in the study is as follows:

> *The proposal, decision, installation, and use of a secure, flexible and integrated approach to delivering business value by integrating the supply chain network systems and management components that run core business processes between key business partners in the supply chain with the simplicity and reach of electronic data and information exchange technology and its various application tools.*

This construct, supply chain B2B e-commerce, will be the criterion variable of hypotheses H1 through H7, developed in the following sections of this manuscript. For hypotheses H8a and H8b, the construct will be the predictor of performance outcome variables. The previous chapter examined several structural and contextual variables related to supply chain B2B e-commerce. The following sections provide conceptual and empirical evidence supporting the relationships developed in the hypotheses.

Organizational Context

Size. Firm size should correlate with supply chain B2B e-commerce. With reference to firm size, a basic supporting argument is founded on the Schumpeterian assumption that large firms are more innovative relative to smaller firms. Larger firms have the advantage of economies of scale, can spread risks, and have access to financial and other resources necessary for adopting radical innovations (Ali 1994; Galbraith 1952). Economies of scale enhances "feasibility of innovation adoption" (Moch and Morse 1977, p. 717) justifying the adoption of new technologies (Dewar and Dutton

1986). Supporting literature includes studies such as those by Becker and Stafford (1967), Carroll (1967), Mansfield (1963), Moch and Morse (1977), Mohr (1969), and Mytinger (1968). Size provides firms the critical mass necessary for certain problems, stimulating innovation (Hage and Aiken 1967; Sapolsky 1967; and Wilson 1962). New technologies that contain substantially new knowledge components can be experimented and adopted easily in larger firms (Dewar and Dutton 1986). Size relates with slack resources, specialists and engineers – all facilitating the ability of larger firms to invest in innovations, particularly radical technological innovations (Ettlie 1983; Thompson 1969). Therefore in summary, it is hypothesized that:

H1: The larger the firm size, the greater the level of supply chain B2B e-commerce.

Customer Influence Strategies. In regard to channel partner influence strategies, both customer coercive and non-coercive influence are predicted as correlating with supply chain B2B e-commerce. Support is based on the argument that interfirm and interindustry interdependence of organizations sets the stage for effective innovation strategy (Clelland and Finkelstein 1990; Granovetter 1985; Osborn and Baughn 1990). For example, using an upstream influence case, supplier influence impacts the type of innovation strategy that is feasible with downstream partners (Holland, Lockett, and Blackman 1992). Numerous flows tie upstream and downstream channel members together and lend opportunity for powerful members to influence others to adopt compatible technological innovations such as EDI (Stern and Kaufmann 1985). More support is found in William's (1994) study, where she finds from personal interviews that channel power influence has a significant correlation with EDI adoption.

It is argued that firms in the channel that lack alternative choices and status are likely to yield to coercive influence strategies and not retaliate (Blalock and Wilkin 1979; Bucklin 1973; Frazier, Gill, and Kale 1989). Frazier and Rody (1991) do find support for this argument. On the other hand, literature supports the argument that as relationalism increases in a channel exchange (as in integrated supply chains), the use of coercive influence strategies decreases (e.g., Boyle et. al 1992). In high-magnitude relationships, non-coercive strategies will be favored over coercive influences because of their less volatile nature (Raven and Kruglanski 1970). In view of the above arguments, it is hypothesized that:

H2a: The greater the firm's customer coercive influence, the lower the level of supply chain B2B e-commerce.

H2b: The greater the firm's customer non-coercive influence, the greater the level of supply chain B2B e-commerce.

Environmental Uncertainty. The two environmental uncertainty dimensions, market turbulence and technological turbulence, should correlate with adoption of innovations such as supply chain B2B e-commerce. Heterogeneous or changing environments may produce problems demanding solutions such as adoption of innovations (Hage and Aiken 1967; Sapolsky 1967; Wilson 1963). Rapidly changing environments often increase expectations at a faster rate than firms offer, thereby encouraging adoption of innovations that facilitate rapid and better service (Baldridge and Burnham 1975). Examples of empirical and conceptual support are also provided by the literature (Aiken and Alford 1970; Mohr 1969; and Palumbo 1969). Uncertainty, in the form of frequent changes in technology or market preferences, requires organizations

to adjust to those changes, and to be more aware of external innovations and information, and to adopt more radical innovations (e.g., Ettlie 1983; Gatignon and Robertson 1989; Hage 1980; Pierce and Delbecq 1977). More empirical support corroborating the relationship between intensity of innovative activities (technological turbulence) and innovation adoption is provided by literature (e.g., Baldwin and Scott 1987; and Kamien and Schwartz 1982). A study by Williams (1994) suggests that demand uncertainty in the environment drives supply chain partners to adopt innovative technologies such as EDI: "each member is able to look into its partner's production schedule, inventory levels, and freight tracking systems. This reduces time and uncertainty while conceptually bringing the channel closer together" (p. 198). In summary it is hypothesized that:

H3a: The greater the market turbulence, the greater the level of supply chain B2B e-commerce.

H3b: The greater the technological turbulence, the greater the level of supply chain B2B e-commerce.

Organizational Structure

Formalization. Formalization is predicted to correlate positively with supply chain B2B e-commerce. Singleness of purpose is a general prerequisite for effective adoption and implementation of innovative ideas. Proposals are more likely to be implemented in situations of higher formalization, where there is a clearly specified and codified body of rules (Corwin 1069; Evan and Black 1967; Mohr 1969). There is an argument for high desirability of formal structures, at least during implementation of innovations, if not during initiation (Zaltman et al. 1973). As a collectivity, it is in the

interest of organic, highly differentiated firms to encourage formal performance monitoring and control (Moch and Morse 1977). Formal appraisal/performance evaluation of personnel is linked to more compatible and firm-wide information systems such as B2B e-commerce. Therefore, it is hypothesized that:

H4: The greater the formalization, the greater the level of supply chain B2B e-commerce.

Centralization. Centralization should correlate negatively with supply chain B2B e-commerce. The obverse, decentralization, should in fact correlate positively with higher levels of supply chain B2B e-commerce. Participatory work environment, or a dispersion of power, as opposed to a more concentrated decision-making environment, is conducive for innovation because of increased awareness, commitment, and involvement (Thompson 1965). Costs of control and distortions in communication increase with greater centralization. Resentment from specialist units in the organization increases when an innovation is thrust on them by a central authority (Coughlan et al. 1972; Wilson 1966; Zaltman et al. 1973). A more decentralized structure facilitates specialized units to adopt innovations compatible to their interests and needs (Moch and Morse 1977).

> *"Decentralization of authority increases the total pool of available ideas, keeps decisions close to the source of variation or need, improves the chance that compatible technologies will be proposed and adopted, limits the number of filtering devices and thereby limits the inevitable loss of information as decisions are passed up the organizational hierarchy, and increases the acceptance of and commitment to change"* (Collins, Hage, and Hull 1988, p. 515).

Other research findings and arguments supporting the relationship include Burns and Stalker 1961; Imai, Nonaka, and Takeuchi 1985; Kohli and Jaworski 1990; and McGuiness and Ackelsberg 1983.

Therefore it is hypothesized that:

H5: The greater the centralization, the lower the level of supply chain B2B e-commerce.

Specialization. Specialization in technocratic areas or at levels above the shop floor should correlate positively with greater levels of supply chain B2B e-commerce. Research indicates that a larger number of specialists in the firm provides a broader knowledge base, increasing the cross-fertilization of ideas necessary for adopting firm-compatible technologies such as e-commerce. It increases the awareness about the innovation across the firm, encourages debates on the merits and other aspects, and brings more cognitive breadth to the decision-making process (Aiken and Hage 1971; Collins, Hage, and Hull 1988). Greater specialization of indirect labor (which includes expertise and skills of personnel at the technocrat levels, but excludes assembly line task specialization of direct labor) means better understanding of new innovations and procedures for installation and effective utilization (Dewar and Dutton 1986). Results from Dewar and Dutton's (1986) study corroborate the argument that the depth of knowledge resources in the firm support radical innovations. Specialization "promotes the existence of innovation champions and creates the perception of greater economic congruence between an innovation and the organization adopting it" (Dewar and Dutton 1986, p. 1431). Support for the hypothesis relating the two constructs is also provided by other research studies. Moch and Morse (1977) find links between specialization and innovations compatible (such as B2B e-commerce) with a larger number of functions. Damanpour's (1987) study finds a positive association between specialization and technological innovation. A study by Germain (1996) also reveals a positive association

between specialization and logistical innovation. In view of the above arguments, it is hypothesized that:

H6: The greater the specialization, the greater the level of supply chain B2B e-commerce.

Integration. Integration should correlate positively with supply chain B2B e-commerce. Few empirical research studies are available linking integration to innovation adoption. A supporting argument for the hypothesis is that integration across levels and functions in the firm is necessary for developing firm capability. Therefore to share and integrate aspects of skills and resources, firms adopt facilitating mechanisms such as B2B e-commerce (Grant 1996); "integration – through relationship building, meetings and interactions with other divisions – stimulates adoption of these innovations" (Sciulli 1998, p. 18). The study by Sciulli's (1998) study found that integration is conducive to the adoption of radical innovations. Support for the hypothesis is also provided by research findings in Ettlie and Reza's (1992) study, where integration at various levels in the organization facilitates firms' adoption of compatible process technological innovations. More support comes from Carroad and Carroad (1982), and Hull and Azumi (1989): R&D-marketing coordination, and R&D multifunctional teamwork appear to be essential to successful innovation. In light of the above arguments, it is hypothesized that:

H7: The greater the integration, the greater the level of supply chain B2B e-commerce.

Performance

Financial and operational performance each should correlate positively with supply chain B2B e-commerce. The relationship between innovation and financial performance is well documented in extant literature. The rationale offered for a strong relationship between adoption of innovation and financial performance is that innovation facilitates accommodating the uncertainties in the market (Ettlie and Bridges 1982). Successfully integrating technical innovations into the organizational structure improves the level of achievement of firm's goals (Damanpour and Evan, 1984). Strong support is obtained for the innovation-financial performance relationship in the study by Han, Kim and Srivastava (1998). Research by Lawless and Anderson (1996) also supports the argument that firms ahead on innovation perform better: a firm's financial performance is affected by its position on adopting new technologies relative to the others in the industry.

The use of e-commerce in supply chains is a relatively recent phenomenon – the primary literature support is provided by anecdotal evidence on the applications of the technology in managing supply chains. On the other hand, there is some support in literature on the operational impact of innovation adoption. Research by Crum, Johnson, and Allen (1998) supports the hypotheses – linking EDI adoption with operational benefits such as improved communications, increased accuracy, quicker response, and reduced paperwork. Research by Croom (2000) also provides support for operational performance improvements from adopting B2B e-commerce. In his study, implementing e-procurement lead to a drastic reduction in administrative costs of the entire procurement process. The research study also suggests significant improvement in audit

of each transaction throughout the process, resulting from high visibility and real-time data. In view of the above arguments, it is hypothesized that:

H8a: The greater the level of supply chain B2B e-commerce, the better the firm's financial performance.

H8b: The greater the level of supply chain B2B e-commerce, the better the firm's operational performance.

Research Design

This section discusses the research approach for this study. Besides a brief explanation of the study undertaken, the following paragraphs discuss the choice of a survey approach, the survey sample, and key informants. Next, the survey instrument and specific scales to measure the constructs are discussed. Finally, a brief discussion is presented on the type of quantitative technique for analyzing the data.

Field Study

To test the hypotheses presented earlier in this chapter, a field survey of key informants was conducted to obtain information on elements of organizational structure, context, and supply chain B2B e-commerce, as well as, perceived performance measures. The unit of analysis is the business unit or autonomous firms as represented by the perceptions of the respondent. There is a statistical preference for a multiple informant approach (Phillips 1981), i.e., soliciting a second informant from selected firms. Nevertheless, in the face of time and other resource constraints, a single informant was selected from each organization in order to maximize the number of organizations that could be surveyed (Conant, Mokwa, and Varadarajan 1990).

Survey Approach

A unique challenge to the proposed study is effective measurement of supply chain B2B e-commerce as a phenomenon used by firms in their supply chain partnerships with other firms. Several approaches were considered to test the concept and related hypotheses. For example, the institutional approach is one possible approach, where archival documents such as organizational charts and manuals are collected to measure variables (Blau and Schoenherr 1971; Child 1972; Hinings and Lee 1971; John and Martin 1984). However, the drawback to this approach is that organizational characteristics are measured in terms of how an organization is supposed to operate (Deshpande 1982), and not necessarily how it really operates. Another shortcoming of this approach is that not every construct is amenable to measurement. The breadth of this study precludes the use of an institutional approach. The method selected for the study was the survey approach. It operationalizes the constructs using multiple items for measuring them (John and Martin 1984). This method has been used in a large number of studies that measured some of the variables of interest in this study (e.g., Avlonitis and Karayanni 2000; Damanpour 1987; Ettlie and Reza 1992; Frambach et al. 1998; Robertson and Gatignon 1986). The survey approach is consistently used to obtain managers' perceptions of major theoretical concepts. The method taps the organization (i.e., its characteristics and behaviors) from the viewpoint of the respondent managers (Deshpande 1982). For example, in terms of organizational structure, "the questionnaire measures tend to reflect the degree of structure experienced by organizational members in work-related activities on a day-to-day basis and, to the extent that such information is

not biased, describe the emergent structure" (Sathe 1978, p.234). Based on this perspective and its arguments, the survey method seemed more appropriate to the present study. It is capable of capturing the perceived behaviors and relationships representing supply chain B2B e-commerce and its proposed determinant organizational characteristics such as structure and context. Therefore, the survey method of measuring the organizational variables in the model was utilized in this study.

Sample Selection

Testing the hypotheses requires a large representative sample. Because of the sample size requirement for providing an adequate level of statistical power, a cross-sectional field study survey method was employed. The target population for the survey is the manufacturing firms (autonomous firms or business units) in the U.S.A. The survey population was selected to include a cross-section of U.S.-based manufacturing firms generally engaged in marketing a variety of products. The specific sampling frame consisted of 1372 manufacturing firms in the U.S.A., which were members of the council of logistics management (CLM). Executives from these firms listed in the database were chosen as respondents. The list consisted of organizations spanning SIC codes 20 to 39, as depicted in Table 3. Because of the breadth of information that was requested within the focal organization surveyed, as well as regarding the relationships between the focal organization and its key suppliers and customers, it was critical that the informants possess the knowledge and experience necessary to respond effectively to all the questions in the instrument. Strategic level managers who had a broad-based view of the business processes that contribute to SCM were chosen as key informants. These managers typically were involved in, or at least had extensive broad-based knowledge on

the diverse activities associated with SCM, including relationships with key suppliers and upstream partners, and activities with downstream customers. They were also able to provide a reasonable perspective related to organizational structure and context. The objective of the study is to generalize the results across a wide range of firms and industries. Hence the manufacturers in the sample were selected to represent a wide range of industries, firms and products.

TABLE 3

SIC CODES AND RESPONSE DISTRIBUTION

SIC code	Description	n	%
20	Food and Kindred Products	20	13.2
21	Tobacco Products	1	0.7
22	Textile Mill Products	1	0.7
23	Apparel and Other Textile Products	1	0.7
24	Lumber and Wood Products	3	2.0
25	Furniture and Fixtures	7	4.6
26	Paper and Allied Products	2	1.3
27	Printing and Publishing	1	0.7
28	Chemicals and Allied Products	40	26.3
29	Petroleum and Coal Products	0	0.0
30	Rubber and Miscellaneous Plastics	4	2.6
31	Leather and Leather Products	0	0.0
32	Stone, Clay, and Glass Products	3	2.0
33	Primary Metal Industries	1	0.7
34	Fabricated Metal Products	1	0.7
35	Industrial Machinery and Equipment	15	9.9
36	Electronic and other Electric Equipment	23	15.1
37	Transportation Equipment	10	6.6
38	Instruments and Related Products	9	5.9
39	Miscellaneous Manufacturing	10	6.6
--	missing	0	0.0
	TOTAL	152	100

TABLE 4

DESCRIPTION OF SURVEY RESPONDENTS

Title	n	%	Functional Area	n	%
CEO	1	0.7	Supply Chain Mgmt.	18	11.8
V P	23	15.1	Logistics	78	51.3
Director	43	27.6	Distribution	33	21.7
Manager	69	45.4	Purchasing	4	2.6
Specialist	9	5.9	Manufacturing	2	1.3
Leader	4	2.6	Operations	6	3.9
Other	3	2.0	IS/E-commerce	4	2.6
			Materials Mgmt.	4	2.6
TOTAL	152	100	Other (forecasting)	2	1.3
			Not Applicable	1	0.7
			TOTAL	152	100

Data Collection

A multi-step data collection process was used for the study. A random sample of 914 names was drawn from the CLM executive list. As a first screening step, a pre-survey phone contact was undertaken to identify respondents who had sufficient knowledge in the areas of SCM and e-commerce application. In addition some participants were eliminated because they either did not represent a manufacturing company or were unwilling to participate. The survey was then faxed to the participant (some participants requested that the survey be sent as an e-mail attachment). Reminders were sent out to those participants who did not respond within a period of 14 days. All together a total of 914 organizations were contacted and surveys were sent out to 538 willing participants. Of these, 152 questionnaires were returned (with one discarded for

excessive missing data), yielding an overall response rate of 152/538 = 28.3%. It appears as though the personal contact and direct solicitations over the phone helped overcome some inattentiveness, and increased enthusiasm for the study resulting in a relatively higher response rate compared to mail surveys. A remark made by one of the respondents buttresses this argument: "*dear..., I am approached several times a week regarding surveys, your personal call impressed me, it was not just a mass survey or an e-mail copy... best regards to your success.*" Table 4 gives a description of the survey respondents.

After the responses were obtained, an analysis was performed to compare respondent firms with non-respondents. One approach for such an analysis is using extrapolation based on successive mailings/faxes of the survey instrument. This method is based on the premise that "[p]ersons who respond [to surveys] in later waves are assumed to have responded because of the increased stimulus and are expected to be similar to non-respondents" (Armstrong and Overton 1977, p.397). Using extrapolation in the study helps compare organizations that respond in the first wave of mailing with those that respond to later stages after being provided with the telephone stimulus or reminders. The comparison helps assess non-response bias. A set of t-tests for independent samples was performed to identify significant differences between early (n = 120) and late (n = 31) respondents. The late respondents were executives who replied only after the reminders were sent. The reminders were sent to participants who did not respond within 14 days after the initial survey was sent. However, as Table 5a. indicates, the comparison failed to identify differences for any variable in the model, providing evidence that non-response bias was unlikely to be a major problem in this study.

A more rigorous and reliable non-response bias analysis was conducted by culling a set of ten items from the main survey and faxing the survey to executives who agreed to participate, but did not return the questionnaire. The ten items selected covered both antecedent and dependent variables. From among the 283 randomly selected non-respondents who were sent the one-page survey, 28 responded, for a 10% response rate. A set of t-tests for independent samples was performed to identify significant differences between respondents and non-respondents. However, as Table 5b. indicates, the comparison failed to identify differences for any item in the analysis, providing further evidence that non-response bias is not a major problem in this study.

TABLE 5a

NONRESPONSE BIAS ESTIMATION:
COMPARISON OF
EARLY RESPONDENTS AND LATE RESPONDENTS

Variable	Mean		*p*-value
	Early Respondents (n = 120)	Late Respondents (n = 31)	
Size	6.83	6.49	.441
Market Turbulence	4.01	4.09	.720
Technological Turbulence	3.70	3.44	.263
Non-Coercive Influence	4.28	3.99	.357
Coercive Influence	3.26	3.26	.987
Formalization	5.46	5.52	.734
Centralization	3.74	3.88	.245
Specialization	7.25	7.23	.962
Integration	4.65	4.80	.627
B2B e-commerce	3.94	3.73	.462
Financial Performance	4.69	4.40	.233
Operational Performance	5.09	4.93	.237

TABLE 5b

NONRESPONSE BIAS ESTIMATION:
COMPARISON OF
RESPONDENTS AND NON RESPONDENTS

Item	Mean		*p*-value
	Respondents (n = 151)	Non Respondents (n = 28)	
Size A1	5421.38	2947.36	.418
Full Time Employees A2	12166.91	9827.36	.630
Firm Age A3	55.42	56.04	.943
Formalization C1	5.03	5.07	.882
Formalization C3	5.55	5.61	.823
Formalization C5	5.63	5.68	.862
B2B e-commerce I5	4.50	4.14	.363
B2B e-commerce I7	4.09	3.82	.491
Global B2B e-commerce K3	3.13	3.36	.495
Global B2B e-commerce K4	2.79	3.07	.403

Measurement

The present study explores and defines the construct of supply chain B2B e-commerce, a concept based on research streams such as innovation, SCM, and internet technology. A later section discusses the development of the scale, created to measure the construct. On the other hand, the elements of organizational structure and context discussed in the model are already well defined and tested in the marketing and management literatures. These scales are used in this study with only slight modifications. The following sections describe specifically how the predictor and outcome variables are operationalized and measured.

Predictor Variables

Context Variables. Organizational context variables have recognized and/or anticipated influence on adoption of innovations (e.g., Dewar and Dutton 1986; Hage and Aiken 1967; Moch and Morse 1977; Stern and Kaufmann 1985). This study therefore includes several context variables for investigation. In particular, measures of organizational size, environmental uncertainty (market and technological turbulence), and channel partner influence (customer coercive and non-coercive influence) are obtained. The context variables will be analyzed for their possible direct effects on the adoption of supply chain B2B e-commerce.

Established measures used in extant literature are used for measuring the context variables. Organizational size is typically measured as annual sales or the number of employees. This study will measure size as the sales volume at the surveyed firm location; this measure is easier to obtain, and is also strongly correlated with the number of employees (Smith, Guthrie, and Chen 1989). The measure will be obtained from the proposed respondent by asking the question, "annual sales volume?" in the instrument. The actual measure for analysis will be the natural logarithm of the annual sales volume; this corrects for the diminishing effect of size on the dependent variable as size increases (Blau 1970; Kimberly 1976).

Channel partner influence strategy is assessed using scales from Boyle et. al (1992); and Gundlach and Cadotte (1994) that operationalize the measure as both coercive and non-coercive key customer influence strategies. The five item measure, is adopted for this study in view of findings and suggestions in extant literature on the

impact of coercive and non-coercive influence strategies on channel partner behavior (e.g., Frazier, Gill, and Kale 1989; Frazier and Summers 1986; Lusch and Brown 1982; Spekman 1980). The construct is operationalized to capture key downstream customer coercive as well as non-coercive influence strategies, and to investigate their impact on supply chain B2B e-commerce adoption by the focal firm. Respondents are asked to indicate the frequency of use of the influence strategies by customers in dealing with their firm. Both coercive and non-coercive influence strategies are determined by calculating the mean of the scores across the relevant items. High scores on the measures indicate frequent use of the related influence strategy by key customers.

Environmental uncertainty is assessed as a two-dimensional measure: (1) market turbulence; and (2) technological turbulence. The specific seven-item scale used in this study derives from the scale employed by Celly and Frazier (1996), and Miller and Droge (1986). Three items correspond directly with Celly and Frazier's (1996) scale, while three items including two unique items correspond with Miller and Droge's (1986). Two items relating to new products and logistics processes are unique to this study; they are included given their importance to SCM and B2B practices. The dimensions of uncertainty are determined by calculating the mean of the scores across the seven items. High environmental uncertainty scores indicate that the organizations operate within relatively dynamic uncertain markets and technological changes.

Tables 23a-23c in Appendix C display the list of the specific scale items for all the organizational context variables. The tables also display the established scales from which the scale items are derived. The items in each of the context variables are displayed in Figure3 and Figure 4.

CUSTOMER INFLUENCE STRATEGY ITEMS

NON-COERCIVE INFLUENCE

1. Making a case based upon financial payoff/outcome from adopting B2B e-commerce
2. Making it clear that by following their recommendations for adopting B2B e-commerce, our business would benefit
3. Providing a clear picture of the anticipated positive impact on our business that B2B e-commerce adoption will have

COERCIVE INFLUENCE

4. Threatening us of poorer service to our business should we fail to implement B2B e-commerce
5. Communicating their ability to reduce the amount of business with our firm, if their demands for implementation are not met

Figure 3. Customer Influence Strategy Items

ENVIRONMENTAL UNCERTAINTY ITEMS

MARKET TURBULENCE

1. Sales are predictable/unpredictable
2. Market trends are easy to monitor/difficult to monitor
3. Sales forecasts are likely to be accurate/inaccurate

TECHNOLOGICAL TURBULENCE

4. Logistics processes change slowly/rapidly
5. Products become obsolete slowly/quickly
6. Core production processes change slowly/rapidly
7. New products are introduced infrequently/frequently

Figure 4. Environmental Uncertainty Items

Structure Variables. A variety of structural variables have been used in extant literature to investigate adoption of innovations by firms (e.g., Burns and Stalker 1961;

Damanpour 1987, 1991; Galbraith 1994; Evan and Black 1967; Pugh et al. 1968, 1969). Existing scales from these studies are adapted for the present study to measure organizational structure variables. Specifically, measures are borrowed to investigate the influence of four variables on supply chain B2B e-commerce: formalization, centralization specialization, and integration.

Formalization is measured using a scale from Miller and Droge (1986), which traces back to a scale previously developed by Khandwalla (1974) that investigated formalization as a formal performance control measure. The five-point scale corresponds with Miller and Droge's (1986) scale, and the items are scored on a seven-point scale ranging from "rarely used" to "frequently used". The items are displayed in Figure 5. An organization's formalization score is determined by computing the mean of the scores across the five items. A high score on the scale denotes relatively active use of formal performance control devices by the firm.

The centralization scale consists of the nine items displayed in Figure 6. The items measure the degree to which the organization's decision-making is centralized. This scale is taken from Germain and Droge (1997), and traces back through to previous studies by Miller and Droge (1986), and Pugh et. al (1968). One item corresponds with Miller and Droge's (1986) scale, and four correspond with items in Germain and Droge's (1997) scale. Five new items are added in order to represent dimensions relating to SCM and e-commerce activities. All items included in the measure are scored on a seven-point scale ranging from decision-making authority being "above [the] chief executive" to "operatives at [the] shop level". The centralization score is determined by calculating the mean of the scores across the nine items. A high score indicates highly centralized

decision-making, whereas a low score denotes that the firm is highly decentralized in its decision-making authority.

Early measures of specialization include the series of organizational studies, popularly referred to as the Aston Studies (Pugh et al. 1963; Pugh et al. 1968; Pugh and Hickson 1976). The scale used in this study, however, is mainly taken from Miller and Droge's (1986) sixteen item scale which was used to determine the number of activities in an organization that are performed exclusively by at least one full-time person in the organization. Four items are adapted from this scale. Six additional items are included in the scale to reflect new specializations that are consistent with SCM and e-commerce practices. The scale items are presented in Figure 7. Respondents are asked to answer "yes" or "no" if the listed activity is dealt with exclusively by at least one full-time person in the organization. A "yes" answer on an item denotes that particular activity as specialized within the organization; a "no" indicates low specialization. "Yes" answers are scored as one, and "no" answers are scored as zero. Data analysis is performed by treating the summated score on all the ten items as interval-scaled. A high overall score denotes an organization as comprised of a relatively large number of specialists.

Integration is operationalized as a three item scale adopted from Miller and Droge (1986), measuring the compatibility of decisions across functional areas in the firm (Miller 1983; Miller and Droge 1986). The items are scored on a seven-point scale, anchored between "rarely used" and "frequently used." Mean scores across the items, shown in Figure 8, determine an organization's integration. A high score indicates that

the firm is relatively active in using integrative mechanisms. The scale history of all the four structural variables discussed above is provided in Appendix C, Tables 24a –24d.

FORMALIZATION ITEMS

1. A comprehensive management control and information system
2. Use of cost centers for cost control
3. Use of profit centers and profit targets
4. Quality control of operations using sampling and other methods
5. Formal appraisal of personnel

Figure 5. Formalization Items

CENRALIZATION ITEMS

1. B2B e-commerce adoption decisions
2. Enterprise resource planning adoption decisions
3. EDI adoption decisions
4. The selection of suppliers
5. Delivery dates to customers and priorities of orders
6. Production scheduling
7. Transportation scheduling
8. Factory / warehouse location planning
9. Inventory planning

Figure 6. Centralization Items

SPECIALIZATION ITEMS

1. Production scheduling
2. Inventory planning and control
3. Warehouse/factory location planning
4. Warehouse/factory layout planning
5. Business to business e-commerce
6. ERP systems
7. EDI systems
8. Transportation scheduling
9. Materials handling
10. Sales forecasting

Figure 7. Specialization Items

INTEGRATION ITEMS

1. Interdepartmental committees which are set up to allow departments to engage in joint decision-making on an ongoing basis
2. Cross-functional teams which are temporary bodies set up to facilitate interdepartmental collaboration on a specific project
3. Liaison personnel whose specific job it is to coordinate the efforts of several departments for the purposes of a specific project

Figure 8. Integration Items

Outcome Performance Variables. The performance construct is operationalized as a two-dimensional measure: (1) financial performance; and (2) operational performance. Financial performance is adopted from Droge and Germain (2000); the measure is a three-item scale measuring performance based on return on investment, sales, and profits

over a period of three years. The scale is a seven-point measure anchored with, "well below industry average" and "well above industry average" at the ends. The mean of the items measures the overall financial performance. High scores on the scale denote a better financial performance for the firm in the industry, as perceived by the respondent. Another aspect of performance, particularly relevant to B2B SCM activities, is operational performance. A five-item scale is used to measure operational performance of the firm. Two items correspond with a previous scale used by Georgantzas and Shapiro (1993), while three items are adopted from the scale used by Small and Yasin (1997). One item in the scale corresponds with an item in both the scales. The measure is a seven-point scale anchored by "Substantially worse" and "Substantially better" at the ends. The mean score across the five items gives the measure of a firm's operational performance in the last three years, as perceived by the respondent. High scores indicate relatively higher improvement in operational efficiency and effectiveness of the firm in the last three years. Scales for measuring each of the dimensions are depicted in Figure 9 and Figure 10. Tables 25a and 25b in Appendix C provide the scale history for the outcome performance variables.

FINANCIAL PERFORMANCE ITEMS

1. Average return on investment
2. Average profit
3. Profit growth

Figure 9. Financial Performance Items

OPERATIONAL PERFORMANCE ITEMS

1. Delivery lead times
2. Inventory turnover rates
3. Ability to change production lot sizes
4. On time deliveries to customers
5. Reject levels, scrap, and rework

Figure 10. Operational Performance Items

Supply Chain B2B E-Commerce Scale Development

Introduction

The scale development process for B2B e-commerce follows a perspective that is quite distinct from the conventional methodological procedures outlined by extant literature that includes seminal articles such as those by Churchill (1979) and Peters (1979). This perspective derives from the basic realization that the scale involves the creation of an index from a collection of indicators to form a formative measure. The perspective originally derives from the "operational definition" model as opposed to the classical "test theory", and suggests that a construct is a function of its measurements (Bagozzi and Fornell 1982). The implication of this view is that reliability measures such as coefficient α, and other psychometric issues such as convergent and discriminant validity are not meaningful in this context (Bagozzi 1994). However, the need for a scale with good psychometric properties is in no way reduced when such measures are developed. This study therefore follows some suggested steps as discussed below, that

the current literature provides, to come up with a valid measure for supply chain B2B e-commerce.

A primary necessity in constructing a formative measure is specification of the scope of the construct, i.e., content specification. The need for defining the breadth of a formative construct is critical since the index measure is more abstract than a conventional reflective construct (Bagozzi 1994; Nunnally and Bernstein 1994). The definition of supply chain B2B e-commerce includes the domain of e-commerce use by firms in business processes spanning key supply chain partners. This seeks to capture at the overall level, the entire breadth of the concept. A second issue in scale refinement is indicator specification – the need to select indicators that cover the entire scope of the construct domain (Diamantopoulos and Winklhofer 2001). The initial set of items selected for the measure after a thorough review of SCM and e-commerce literature, were seven business processes that were suggested by the Global Supply Chain Forum (ref. Lambert, Cooper, and Pagh 1998) as the most critical cross-firm processes. So capturing e-commerce implementation along these processes will satisfactorily encompass the domain of the construct.

To further refine the scale items, a pilot study was conducted as outlined in the proceeding sections. The exploratory pilot study, and an intensive discussion with industry experts, resulted in a refined set of 8 items for the scale. Following the inputs, the wording for the initial set of items was refined as well. Figure 12 lists the final refined set of items used in the main study.

Multicollinearity is another important issue that needs to be taken care of, in the development of formative measures. As Diamantopoulos and Winklhofer (2001)

suggest, "excessive collinearity among indicators makes it difficult to separate the distinct influence of the individual items on the latent variable." The scale items in the supply chain B2B e-commerce construct measure were analyzed following a pre-test, and the results suggested that multicollinearity did not pose a problem. The maximum variance inflation factor (VIF) was far below the suggested threshold of 10 (e.g., Kleinbaum, Kupper, and Muller 1988). All the eight items were therefore retained in the measure.

External validity of the scale is also suggested as an important indication of the quality of the indicators used in the B2B e-commerce scale. Diamantopoulos and Winklhofer (2001) suggest the inclusion of a global measure of the construct that essentially captures the domain. Accordingly, a global measure of B2B e-commerce was included in the pre-test and main study. The correlations of each item in the formative scale with the global measure indicate the quality of the items. As will be discussed in Chapter IV, all items have significant correlations (at $p < .01$) with the global measure, and are therefore retained in the final scale.

Data Collection for the Pilot Test

A random sample of 286 names was drawn from a list of manufacturers operating in the Southeastern United States. The list was selected to include firms that have their headquarters or divisional headquarters, in the region. Respondents who occupied a strategic level position in their firm were selected to receive the pilot survey. The instrument was mailed in three waves: 206 in the first; 40, three weeks later; and 40, two weeks after that. Of these, a total of 36 were returned (with two discarded, because of

missing data) for an overall response rate of 36/280 = 13% (with six non-deliverable). The 34 usable surveys represented a wide range of manufacturing industries.

The Pilot Test Measure of Supply Chain B2B E-Commerce

Supply chain B2B e-commerce is measured by the extent of e-based applications used in critical business processes by the firm as part of its SCM practices. Cooper, Lambert, and Pagh (1997) argue that integration of critical business processes across firm boundaries in the supply chain constitutes SCM. Therefore measurement of the extent of e-commerce use in business processes that span partner supply chain firms in a business-to-business context, constituted the sufficient measure of the construct.

The original development of the scale items as indicated, was based on a review of conceptual and empirical literature in SCM and B2B e-commerce, and discussion with experts in academics and industry. Respondents rated their firm's application (or use) of e-commerce in each of the business processes listed in Figure 11. All items were scored on a 7-point response scale ranging from "Rarely Used" to "Frequently Used." In order to capture the use in activities with key partner firms, a second set of seven-point scales was used. This scale is anchored by "Used Rarely with Key Trading Partners" at one end, and "Used Frequently with Key Trading Partners" at the other. An organization's score for each item on the supply chain B2B e-commerce scale was determined after extensive consultation, as the mean of the scores on the second set of responses that measures B2B e-commerce use with key partners.

1. Customer relationship management: identifying customer target markets and implementing programs with customers.
2. Customer service management: providing current information to customers on orders, products, production, and distribution status.
3. Demand management: forecasting.
4. Order fulfillment:
5. Manufacturing flow management: providing products when customers need them.
6. Procurement: managing activities and relationships with strategic suppliers.
7. Product Development: integrating suppliers and customers into product development activities.

Figure 11. Pilot Study Items – Supply Chain B2B E-commerce

SUPPLY CHAIN B2B E-COMMERCE ITEMS

1. Product development: integrating suppliers and customers into product development processes
2. Procurement: managing activities and relationships with strategic suppliers
3. Demand management: forecasting
4. Materials inventory management:
5. Order management: fulfillment & delivery
6. Finished goods inventory management:
7. Customer management (inbound): customer initiated inquiries, e.g. order status, invoices
8. Customer management (outbound): firm initiated information distribution to customers

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Figure 12. Supply Chain B2B e-commerce Items

GLOBAL SUPPLY CHAIN B2B E-COMMERCE ITEMS

1. We have extensively integrated B2B e-commerce into our business processes
2. Our firm uses B2B e-commerce extensively with key partners
3. We use B2B e-commerce in most of our critical business processes
4. We rely extensively on B2B e-commerce

Figure 13. Global Supply Chain B2B e-commerce Items

Data Analysis

This study addresses the following questions: (1) is there a relationship between supply chain B2B e-commerce and the two sets of determinants: organizational structure and context? and (2) is there a relationship between supply chain B2B e-commerce and firm performance? To answer these questions, this study empirically examines the conceptualized relationships between supply chain B2B e-commerce and selected elements of organizational structure, context and performance. Hypotheses presented earlier in the chapter posit relationships between the variables.

Data collected in the study is factor analyzed to examine support for the *a priori* scales. Reliabilities are estimated by computing their coefficient alphas and item-to-total correlations. The results of the analyses for each relevant construct in the model will be discussed in the next chapter. Copies of the main study survey instrument and the pilot-test instrument are provided in Appendix A and Appendix B respectively.

The proposed hypotheses are investigated using multiple regression analysis. Regression techniques help assess the hypothesized relationships between supply chain

B2B e-commerce adoption and the various determinant and outcome variables. The data for the analysis, as mentioned earlier, is obtained via a field study.

CHAPTER IV

RESEARCH FINDINGS

This chapter describes the empirical investigation results for the proposed relationships hypothesized in the conceptual model. The research findings are presented in four sections. The sections describe the findings from: (1) scale development process for supply chain B2B e-commerce construct; and (2) empirical examination of the conceptualized relationships between supply chain B2B e-commerce, and selected predictor and outcome variables. The first section describes the reliability assessment of the predictor (organizational structure and context) and outcome (performance) variables, in addition to the supply chain B2B e-commerce scale validity. Next, descriptive statistics of the study's variables are provided. In the third section, hypotheses relating supply chain B2B e-commerce to select predictor variables in organizational context and structure, are tested using the final measures from scale development. Finally, the effects of supply chain B2B e-commerce on the outcome variables, and its mediating role on the relationship between predictor and outcome variables, are explored.

Scale Reliabilities

Supply chain B2B e-commerce

Scale development for the supply chain B2B e-commerce scale began with a pilot test. At the same time, the study obtained rich feedback from industry and academic

experts on the scale items, and incorporated the suggestions for the measure used in the final study. The descriptive statistics from the pilot study are presented below.

Descriptive Statistics. Descriptives summarize the number of items, mean score, standard deviation, range, minimum and maximum values for the supply chain B2B e-commerce construct. The overall composite score for the construct is the mean of the items making up the scale. Survey responses to the measure are adequately dispersed, providing evidence of sufficient variance. A good variance for the scale contributes to better reliability. For the seven-item scale, the mean was 3.25, with a standard deviation of 3.28. The range of scores was 5, minimum value being 1.00 and maximum, 6.00. Table 6 provides the correlations (Pearson correlation coefficients) between the scale items (numbers in bold are significant at .05 or .01 levels).

TABLE 6

BIVARIATE CORRELATIONS BETWEEN SCALE ITEMS

	B2B1	**B2B2**	**B2B3**	**B2B4**	**B2B5**	**B2B6**	**B2B7**
B2B1	–						
B2B2	.29	–					
B2B3	.65a	.40b	–				
B2B4	.26	.61a	.44b	–			
B2B5	.64a	.62a	.68a	.57a	–		
B2B6	.45a	.16	.20	-.03	.24	–	
B2B7	.48b	.29	.23	.12	.28	.51a	–

a $p \leq .01$; b $p \leq .05$

Global measure - Supply chain B2B e-commerce. The scale development process requires validation of the items in the formative scale. A good external criterion to assess the quality of the items is a global measure that summarizes the essence of the construct that the set of formative items purport to measure. A global measure consisting of four

items, and developed by the author, was therefore included in the study. The measure of internal consistency of the global scale items was assessed by testing the value of coefficient α (Peter 1979). Coefficient α for the four-item scale was .96, indicating a high level of internal consistency or reliability. Coefficient α and item-to-total correlations for the global measure are displayed in Table 7. The relatively high correlations (ranging from .86 to .92) indicate that the items are part of the domain of the supply chain B2B e-commerce construct.

TABLE 7

COEFFICIENT α AND ITEM-TO-TOTAL CORRELATIONS FOR GLOBAL MEASURE OF B2B E-COMMERCE

Survey Item	Item Description	Item-to-Total Correlation
Global Supply Chain B2B E-commerce: Coefficient α = .96		
K.01	Extensively integrated B2B e-commerce into business processes	.92
K.02	B2B e-commerce with key partners	.89
K.03	B2B e-commerce in most of critical business processes	.90
K.04	Rely extensively on B2B e-commerce	.86

Scale Validity. The quality of the items in the formative measure can be assessed by investigating the correlations with the global measure. Only those indicators that significantly correlate could be retained for further analysis (see Spector 1992). The correlations of the eight-item B2B e-commerce scale that resulted from the pilot study and the summated global measure are reported in Table 8. All of the eight items correlate significantly with the global measure (correlations range from .63 to .75, and all are

significant at .01 level), indicating that subsequent analysis can proceed with all the eight items retained in the scale.

TABLE 8

CORRELATIONS OF B2B E-COMMERCE ITEMS WITH GLOBAL MEASURE OF B2B E-COMMERCE

Survey Item	Item Description	Item-to-GB2B Correlation
I.01	Product development	.68a
I.02	Procurement	.63a
I.03	Demand management	.67a
I.04	Materials inventory management	.68a
I.05	Order management	.69a
I.06	Finished goods inventory management	.74a
I.07	Customer management (inbound)	.69a
I.08	Customer management (outbound)	.75a

a $p \leq .01$

Organizational Context Variables

The study employs existing scales from extant literature for measuring the context variables of environmental uncertainty, and customer influence strategy. Another context variable, size, is measured as a one-item measure – the annual sales volume of the firm. And as commonly done in literature, the analysis incorporates the natural logarithm transformation of this measure to correct for the diminishing effect of size on the dependent variables (Blau 1970; Kimberly 1976).

Environmental Uncertainty. The context variable environmental uncertainty is measured using the scales from Celly and Frazier (1996), and Miller and Droge (1986).

The seven-item scale used in the study, has two dimensions – i.e., market turbulence and technological turbulence. Factor analysis was performed to confirm the *a priori* dimensionality of the construct. Responses were subject to a principal component factor analysis with an orthogonal rotation (varimax rotation). The latent root criterion (i.e., only eigen values greater than 1.0 are considered), as well as the examination of the scree-plot confirm a two-dimensional model, and the items load on the two dimensions as previous scales suggest. The scale items, factor loadings, and factor descriptions are presented in Table 9. The first dimension, technological turbulence, accounted for 38.81% of the variance. The second dimension, market turbulence, accounted for an additional 22.41% of variance. The construct of environmental uncertainty, with its two dimensions explained 61.22% of the variance. The relatively moderate to high item-to-total correlations among the items of each dimension, and high coefficient α values (.75 and .73), as shown in Table 10, indicate good reliability in the measures.

TABLE 9

ENVIRONMENTAL UNCERTAINTY
FACTOR ANALYSIS LOADINGS

Survey Item	Item Description	Factors 1	2
	Dimension 1: Technological Turbulence		
B.03	Logistics processes change slowly/rapidly	.69	.14
B.04	Products become obsolete slowly/quickly	.77	.09
B.05	Core production processes change slowly/rapidly	.75	.16
B.07	New Products are introduced infrequently/frequently	.80	.03
	Dimension 2: Market Turbulence		
B.01	Sales are predictable/unpredictable	.05	.90
B.02	Market trends are easy to monitor/difficult to monitor	.09	.83
B.06	Sales forecasts are likely to be accurate/inaccurate	.19	.67
	Eigenvalue	2.72	1.57
	Percent Variance Explained	38.81	22.41
	Cumulative Variance Explained	38.81	61.22

TABLE 10

COEFFICIENT α AND ITEM-TO-TOTAL CORRELATIONS FOR DIMENSIONS OF ENVIRONMENTAL UNCERTAINTY

Survey Item	Item Description	Item-to-Total Correlation
	Dimension 1: Technological Turbulence: Coefficient α = .75	
B.03	Logistics processes change slowly/rapidly	.46
B.04	Products become obsolete slowly/quickly	.58
B.05	Core production processes change slowly/rapidly	.57
B.07	New Products are introduced infrequently/frequently	.59
	Dimension 2: Market Turbulence: Coefficient α = .73	
B.01	Sales are predictable/unpredictable	.66
B.02	Market trends are easy to monitor/difficult to monitor	.59
B.06	Sales forecasts are likely to be accurate/inaccurate	.45

Customer Influence Strategy. The measure of customer influence is derived from the extant literature, from established scales used by Boyle et. al (1992), and Gundlach and Cadotte (1994). The five-item measure suggests *a priori,* two dimensions for the construct – coercive influence and non-coercive influence strategy. Factor analysis of the responses was conducted to confirm the dimensions as suggested in extant literature. Principal component factor analysis with an orthogonal rotation (varimax rotation) yielded a two-dimensional solution validating the *a priori* two-dimensional nature of the construct. The scale items, factor loadings, and factor descriptions are presented in Table 11.

The first factor, the dimension measuring non-coercive influence strategy, accounted for 64.81% of the variance. The second factor relating to the coercive

influence component, accounted for an additional 25.89% of variance. The construct in total, with its two dimensions explained 90.70% of the variance. The relatively high coefficient α and "r" (α= .95 for the three-item scale, and "r"= .81 for the two-item scale), and the item-to-total correlations, depicted in Table 12, indicate very good reliability of the scales.

TABLE 11

CUSTOMER INFLUENCE STRATEGY
FACTOR ANALYSIS LOADINGS

Survey Item	Item Description	Factors 1	2
	Dimension 1: Non-coercive Influence		
J.01	Making a case based upon financial payoff/outcome from adopting B2B e-commerce	.94	.16
J.02	Making it clear that by following their recommendations for adopting B2B e-commerce, our business would benefit	.93	.23
J.03	Providing a clear picture of the anticipated positive impact on our business that B2B e-commerce adoption will have	.93	.18
	Dimension 2: Coercive Influence		
J.04	Threatening us of poorer service to our business should we fail to implement B2B e-commerce	.16	.94
J.05	Communicating ability to reduce amount of business if demands for implementation are not met	.22	.93
	Eigenvalue	3.24	1.29
	Percent Variance Explained	64.81	25.89
	Cumulative Variance Explained	64.81	90.70

TABLE 12

COEFFICIENT α AND ITEM-TO-TOTAL CORRELATIONS FOR DIMENSIONS OF CUSTOMER INFLUENCE STRATEGY

Survey Item	Item Description	Item-to-Total Correlation
	Dimension 1: Non-coercive Influence: Coefficient α = .95	
J.01	Making a case based upon financial payoff/outcome from adopting B2B e-commerce	.89
J.02	Making it clear that by following their recommendations for adopting B2B e-commerce, our business would benefit	.91
J.03	Providing a clear picture of the anticipated positive impact on our business that B2B e-commerce adoption will have	.88
	Dimension 2: Coercive Influence: r = .81	
J.04	Threatening us of poorer service to our business should we fail to implement B2B e-commerce	na
J.05	Communicating ability to reduce amount of business if demands for implementation are not met	na

Organizational Structure

The present study borrows and adapts established scales from extant literature to measure the aspects of organizational structure: formalization, centralization, specialization, and integration.

The structural dimension of formalization is measured using an existing scale developed by Miller and Droge (1986). On the other hand, the nine-item centralization scale is derived and adapted from the scale originally developed by Miller and Droge (1986) which was later refined by Germain and Droge (1997). Several of the items in the

current study reflect modern manufacturing and supply chain practices using the latest technological innovations. The scale for centralization is widely recognized as an interval scale. Specialization, the third structural variable, is measured, as described in Chapter III, using a "yes"/ "no" scale. The scale is derived mainly from the existing scale used by Miller and Droge (1986). Several items were adapted to reflect current technological adoptions in business activities. The composite score was computed by replacing "yes" responses with 1.00 and "no" responses with 0.00, and then summing the responses for all 10 items in the scale to form an index. The final variable, integration is measured using the scale borrowed from Miller and Droge (1986). The scale measures extent of use of integrative mechanisms by firms. As mentioned in Chapter III, mean-summated values across the items were used as scale scores for the structural variables.

Although extant literature since the seminal studies by the Aston group, has used the structural measures as reflective scales (e.g., Germain, Droge, and Daugherty 1994; Miller and Droge 1986), current discussion on scale development (e.g., Bollen and Lennox 1991; Diamantopoulos and Winklhofer 2001) suggests that these scales are formative measures (with causal indicators). Therefore scale reliability measures such as factor analysis, coefficient α etc. may not be appropriate in this situation (e.g., Bollen and Lennox 1991). Hence the study does not report reliability measures for the structural variables of formalization and integration. The study uses these scales as formative index measures.

Outcome Performance

Two outcome performance variables are measured in the study – operational performance and financial performance. The scales are borrowed from extant literature.

Operational performance. The scale for the study is borrowed from operations literature, and items derive from two established scales – Georgantzas and Shapiro (1993), and Small and Yasin (1997). Factor analysis of the scale confirms the *a priori* evidence of a single factor (based on the latent root criterion). The single factor model accounted for 46% of the variance. The relatively moderate to high item-to-total correlations and coefficient α (.71), as depicted in Table 13, indicate good reliability in the scale.

TABLE 13

OPERATIONAL PERFORMANCE SCALE
COEFFICIENT α AND ITEM-TO-TOTAL CORRELATIONS

Survey Item	Item Description	Item-to-Total Correlation
Operational Performance: Coefficient α = .71		
H.01	Delivery lead times	.52
H.02	Inventory turnover rates	.43
H.03	Ability to change production lot sizes	.51
H.04	On time deliveries to customers	.47
H.05	Reject levels, scrap, and rework	.37

Financial performance. Financial performance scale is adopted from Droge and Germain (2000). The *a priori* unidimensionality of the scale is confirmed by factor

analyzing the responses. The single factor model accounts for 85.62% of the variance. The relatively high item-to-total correlations and coefficient α (.92), presented in Table 14, indicates good scale reliability.

TABLE 14

FINANCIAL PERFORMANCE SCALE
COEFFICIENT α AND ITEM-TO-TOTAL CORRELATIONS

Survey Item	Item Description	Item-to-Total Correlation
Financial Performance: Coefficient α = .92		
E.01	Average return on investment	.81
E.02	Average profit	.88
E.03	Profit growth	.80

Descriptive Statistics

Supply Chain B2B e-commerce

Table 15 summarizes the number of items, mean scores, standard deviations, ranges, minimum, and maximum values for B2B e-commerce, as well as the predictor and outcome performance variables. The composite score for supply chain B2B e-commerce is the mean summate of the eight items making up the scale. As the table indicates, the dispersion of the survey responses is adequate, providing enough variance across the sample, thus allowing the examination of the hypothesized relationships. The mean score (3.89) is very close to the scale mean of 4.

Context Variables

As mentioned in the previous section, descriptives for each of the context variables of size, environmental uncertainty, and customer influence strategy are provided in Table 15. Size is computed as the natural logarithm of the company sales volume (million U.S. $). The mean scores for size are close to the mathematical mid-point. The scores for environmental uncertainty and customer influence strategy dimensions are all relatively close to the midpoint of 4.0, and the dispersion is adequately distributed to provide variance across the sample for analyzing the conceptualized relationships.

Organizational Structure Variables

Table 15 summarizes descriptives for each of the structural dimensions in the study: formalization, centralization, specialization, and integration. For centralization and integration, the mean scores of the measures are relatively close to the mathematical midpoint of the scales. Formalization and specialization show a departure from the midpoint, and represent higher scores (5.4 for formalization). It may be recalled that specialization is measures as a "yes" "no" response on ten items, and therefore the mean of the summated scale is 5.00. The relatively higher mean scores on the two variables is insufficient to adversely impact the analysis, and merely indicates that the surveyed firms rely actively on formal performance control mechanisms, and have more specialists in the organization, as is expected in the current business environment.

The dispersions of the survey responses on these variables are however, adequately distributed to provide sufficient variance across the sample – necessary for examination of the hypothesized relationships.

Performance Variables

Table 15 also summarizes the number of items, mean scores, standard deviations, ranges, minimum, and maximum values for each of the outcome performance variables: operational and financial performance. The mean score for operational performance is relatively higher, while that of financial performance is relatively closer to the mathematical midpoint of 4.0. This only suggests that very few organizations in the sample have extremely low operational efficiencies compared to the industry average. The distributions show adequate variance necessary for analyzing the hypothesized relationships in the model.

TABLE 15

DESCRIPTIVE STATISTICS
FOR ORGANIZATIONAL CONTEXT, STRUCTURE, B2B E-COMMERCE
AND PERFORMANCE VARIABLES

Variable	No. of Items	Mean	s.d.	Range	Min.	Max.
Supply chain B2B e-commerce	8	3.90	1.47	6.00	1.00	7.00
Size (natural logarithm)	1	6.77	2.10	12.68	-.69	11.98
Market Turbulence	3	4.03	1.04	4.67	1.67	6.33
Technological Turbulence	4	3.65	1.16	5.00	1.25	6.25
Non-coercive Influence Strategy	3	4.21	1.48	6.00	1.00	7.00
Coercive Influence Strategy	2	3.26	1.59	5.50	1.00	6.50
Formalization	5	5.47	0.99	4.20	2.80	7.00
Centralization	9	3.77	0.57	2.91	2.20	5.11
Specialization	10	7.24	2.30	10.00	0.00	10.00
Integration	3	4.68	1.48	6.00	1.00	7.00
Operational Performance	5	5.06	0.68	3.40	3.60	7.00
Financial Performance	3	4.63	1.23	6.00	1.00	7.00

Correlation Analysis

Table 16 represents the correlation matrix of all the variables in the conceptual model for the study: supply chain B2B e-commerce, context variables (size, uncertainty dimensions of market and technological turbulence, coercive and non-coercive customer influence strategies), organizational structure (formalization, centralization, specialization, and integration), and outcome variables (operational and financial performance). An inspection of the correlations in the matrix seems to suggest at this

basic level, that some of the hypotheses proposed may be supported. There are relatively higher correlations between B2B e-commerce and each of non-coercive influence, technological turbulence, specialization, and integration. There is also relatively higher correlation between B2B e-commerce and operational performance.

TABLE 16

CORRELATION MATRIX OF
ORGANIZATIONAL CONTEXT, STRUCTURE, B2B E-COMMERCE
AND PERFORMANCE VARIABLES

		SIZ	*MT*	*TT*	*NCI*	*CI*	*FRM*	*CNT*	*SPL*	*INT*	*B2B*	*OPF*	*FPF*
SIZ	Size	-											
MT	Market Turbulence	-.06	-										
TT	Technological Turbulence	*.07*	*.26a*	-									
NCI	Non-coercive Influence	.13	.04	.19b	-								
CI	Coercive Influence	.04	.14	.16	.39a	-							
FRM	Formalization	*.16b*	*-.15*	*.08*	*.18b*	*-.06*	-						
CNT	Centralization	-.09	.04	-.10	-.04	.01	-.18b	-					
SPL	Specialization	.32a	.02	.21a	.27a	.04	.36a	-.14	-				
INT	Integration	.12	-.03	.22a	.31a	-.01	.46a	-.17b	.23a	-			
B2B	B2B e-commerce	.29a	-.01	.37a	.44a	.22a	.31a	-.16	.40a	.35a	-		
OPF	Operational Performance	.06	.05	.39a	.21b	.13	.14	-.05	.07	.30a	.47a	-	
FPF	Financial Performance	.07	-.18b	.02	.27a	.04	.18b	.09	.07	.10	.17b	.25a	-

a $p \leq .01$; b $p \leq .05$

Hypotheses Testing

The previous chapter developed a set of eight hypotheses based on the conceptual model in the study. All the hypothesized relationships are analyzed using multiple regression. Given the size of the response sample, an *a priori* significance level of less than or equal to .05 was determined as adequate. The criterion variable for the first set of hypotheses (H1 to H7) analyzed in this section, is supply chain B2B e-commerce adoption. The predictor variables for the analysis include the set of context variables (size, environmental uncertainty, and customer influence strategy) and latent organizational structure dimensions (formalization, centralization, specialization, and integration). The results of the multivariate analysis for testing the hypotheses are presented in the following discussion.

Hypotheses: Context Variables

In reference to the context variables in the conceptual model, it is hypothesized that:

- H1: the larger the firm size, the greater the level of supply chain B2B e-commerce.
- H2a: the greater the firm's customer coercive influence, the lower the level of supply chain B2B e-commerce.
- H2b: the greater the firm's customer non-coercive influence, the greater the level of supply chain B2B e-commerce.
- H3a: the greater the market turbulence, the greater the level of supply chain B2B e-commerce.
- H3b: the greater the technological turbulence, the greater the level of supply chain B2B e-commerce.

These hypotheses (except H2a), stated in the form of the alternative hypotheses, generally postulate that firms operating within relatively high degrees of context are more likely to have adopted relatively higher levels of supply chain B2B e-commerce. Hypothesis H2a

postulates that higher degrees of coercive influence by key customers leads to relatively lower levels of B2B e-commerce use in the firm. The results of the multivariate analysis testing the above hypotheses are displayed in Table 17.

Hypotheses: Structural Variables

In relation to the latent structural variables in the model, it is hypothesized that:

H4: the greater the formalization, the greater the level of supply chain B2B e-commerce.
H5: the greater the centralization, the lower the level of supply chain B2B e-commerce.
H6: the greater the specialization, the greater the level of supply chain B2B e-commerce.
H7: the greater the integration, the greater the level of supply chain B2B e-commerce.

Stated as alternative hypotheses, these hypotheses (except H5) broadly postulate that relatively higher degrees of the structural variables are more likely to result in higher levels of adoption of supply chain B2B e-commerce by firms. Hypothesis H5 postulates the opposite view that less centralized, or relatively highly decentralized, structures are more conducive for the adoption of higher levels of B2B e-commerce. The results, as mentioned earlier, are provided in Table 17.

As illustrated in Table 17, the overall regression model is significant ($F = 17.005$, $p < .001$) with an R-Square value indicating that 40.1% of the variance in the relationship is explained by the model. Partial support for the hypothesized relationships is indicated, because (1) the model is significant; (2) the null hypotheses cannot be rejected for H2b, H3a, H4, and H5. In other words, the model supports the hypothesized relationships (statistically significant parameter estimates) presented for the following variables: size (as natural logarithm of sales volume), non-coercive influence,

technological turbulence, specialization, and integration. The regression model was estimated after removing the item that had low correlation with the rest of the items in the scale for market turbulence (B.06). The results, nevertheless, did not appear to improve much indicating that there may be some other explanation for the results regarding market turbulence. Further discussion of the results is found in Chapter V.

TABLE 17

MULTIPLE REGRESION ANALYSIS OF
ORGANIZATIONAL CONTEXT AND STRUCTURAL VARIABLES
WITH B2B E-COMMERCE

	Variable	Expected Sign	Std. Coefficient Beta	t	Prob. t
H1	Size	+	.15	2.06	.042
H2a	Non-coercive Influence	+	.26	3.59	.000
H2b	Coercive Influence	-	.09	1.15	.251
H3a	Market Turbulence	+	-.04	-.51	.611
H3b	Technological Turbulence	+	.23	3.17	.002
H4	Formalization	+	.11	1.40	.163
H5	Centralization	-	-.04	-.56	.576
H6	Specialization	+	.23	3.01	.003
H7	Integration	+	.19	2.65	.009

Model F = 17.005
Prob. F = .000
R-Square = .401
Adj. R-Square = .377

Mediating Effect of Supply Chain B2B E-commerce and Hypothesis Testing for Outcome Performance Variables

Two hypotheses are postulated in Chapter III for the outcome variables. These hypotheses are tested using multiple regression analysis. The sample size suggested an *a priori* significance level less than or equal to .05 as suitable. The criterion variables for the two hypotheses are financial performance and operational performance. The predictor variables included in the regression models were the context (size, environmental uncertainty, and customer influence strategy) and latent structural variables (formalization, centralization, specialization, and integration), as well as supply chain B2B e-commerce. The results of the analysis for testing the proposed hypotheses are presented in this section.

Hypotheses: Outcome Variables

In relation to the outcome performance variables, it is hypothesized that:

H8a: the greater the level of supply chain B2B e-commerce, the better the financial performance.
H8b: the greater the level of supply chain B2B e-commerce, the better the operational performance.

These hypotheses generally postulate that firms using relatively high levels of B2B e-commerce in their supply chain processes are likely to have relatively higher financial and operational performance levels. The results of the regression analyses are displayed in Table 18 and Table 19.

TABLE 18

MULTIPLE REGRESION ANALYSIS OF
ORGANIZATIONAL CONTEXT, STRUCTURAL VARIABLES AND
B2B E-COMMERCE WITH FINANCIAL PERFORMANCE

	Variable	Expected Sign	Std. Coefficient Beta	t	Prob. t
H8a	B2B e-commerce	+	.07	.81	.420
	Size		.02	.27	.787
	Non-coercive Influence		.27	3.28	.001
	Coercive Influence		-.04	-.40	.690
	Market Turbulence		-.18	-2.22	.029
	Technological Turbulence		.01	.12	.901
	Formalization		.09	1.06	.293
	Centralization		.16	1.89	.061
	Specialization		-.01	-.10	.917
	Integration		-.01	-.08	.936

Model F = 7.801
Prob. F = .001
R-Square = .107
Adj. R-Square = .093

TABLE 19

MULTIPLE REGRESION ANALYSIS OF
ORGANIZATIONAL CONTEXT, STRUCTURAL VARIABLES, AND
B2B E-COMMERCE WITH OPERATIONAL PERFORMANCE

	Variable	Expected Sign	Std. Coefficient Beta	t	Prob. t
H8b	B2B e-commerce	+	.37	4.72	.000
	Size		-.02	-.25	.806
	Non-coercive Influence		.02	.19	.846
	Coercive Influence		.02	.22	.825
	Market Turbulence		.07	.99	.324
	Technological Turbulence		.33	4.20	.000
	Formalization		-.01	-.17	.864
	Centralization		.07	.89	.374
	Specialization		-.12	-1.48	.142
	Integration		.14	1.86	.065

Model F	= 31.469
Prob. F	= .000
R-Square	= .326
Adj. R-Square	= .316

As illustrated in Table 18, the overall regression model for financial performance is significant ($F = 7.801$, $p < .001$) with an R-Square value indicating that 10.7% of the variance in the relationships is explained by the model. Nevertheless, no support is found for H8a (supply chain B2B e-commerce and financial performance), as indicated by the regression parameter estimate in the table. Though the result is surprising, there may be some explanation. It was found from estimating another regression model that operational performance fully mediated the relationship between B2B e-commerce and

financial performance. Since this analysis is out of the scope of the current study, the results are not presented.

The analysis results in Table 19 illustrate that the overall regression model is significant ($F = 31.469$, $p < .001$) with an R-Square value indicating that 32.6% of the variance in the relationships is explained by the model. The hypothesis for operational performance (H8b) is supported, as indicated by the significant parameter estimate. Further discussion of the above results for the outcome performance variables is found in the next chapter.

Mediation Effect of Supply Chain B2B E-commerce

A mediating variable represents a generative mechanism through which focal independent variables are able to influence the dependent variable (Baron and Kenny 1986). So in effect, a mediating variable accounts at least in part, for the relationship between the independent and dependent variables. Baron and Kenny (1986) suggest that mediation effects can be tested using a set of three regression equations and estimating separate coefficients for each of the three regression models: (1) regression of the mediating variable on the independent variable; (2) regression of dependent variable on the independent variables; and (3) regression of dependent variable on both the independent and mediating variables. Results of the above set of regression equations will suggest a mediating effect if the following criteria are met (Baron and Kenny 1986): (1) the independent variable(s) impact the mediator, as well as the dependent variable; and (2) the mediating variable affects the dependent variable. A full mediation effect is evident if the independent variable has zero effect when the mediating variable is

controlled. However, a partial mediation occurs if the parameter estimates indicate lower values when the mediator is controlled.

Based on the suggestions, three sets of regression equations were estimated for each of the outcome variables: operational performance and financial performance. In addition to the tables already presented in the previous discussions, Table 20, and Table 21 provide regression results of each of the outcome variables with the independent variables (context and structural variables). As illustrated in Table 21, the overall regression model is significant ($F = 23.598$, $p < .001$) with an R-Square value indicating that 26.6% of the variance in the relationships with operational performance is explained by the model. Technological turbulence and specialization significantly affect operational performance, as indicated by the parameter estimates. On the other hand, Table 20, also illustrates that the overall regression model is significant ($F = 7.801$, $p < .001$) with an R-Square value indicating that 10.7% of the variance in the relationships with financial performance is explained by the model. Non-coercive influence and market turbulence (in the negative direction) affect financial performance.

An observation of the results in tables 17, 19 and 21 indicates that supply chain B2B e-commerce mediates the effects of integration on operational performance. Besides, it also partially mediates the impact of technological turbulence (parameter estimate for technological turbulence is significant even after controlling for supply chain B2B e-commerce as indicated in Table 21). However, supply chain B2B e-commerce has no mediating effect on the relationships between the predictor variables in the conceptual model and financial performance (the relationship between supply chain B2B e-commerce and financial performance is not significant, as observed in Table 18).

TABLE 20

MULTIPLE REGRESION ANALYSIS OF
ORGANIZATIONAL CONTEXT AND STRUCTURAL VARIABLES
WITH FINANCIAL PERFORMANCE

Variable	Expected Sign	Std. Coefficient Beta	t	Prob. t
Size		.02	.27	.787
Non-coercive Influence		.27	3.28	.001
Coercive Influence		-.04	-.40	.690
Market Turbulence		-.18	-2.22	.029
Technological Turbulence		.01	.12	.901
Formalization		.09	1.06	.293
Centralization		.16	1.89	.061
Specialization		-.01	-.10	.917
Integration		-.01	-.08	.936

Model F = 7.801
Prob. F = .001
R-Square = .107
Adj. R-Square = .093

TABLE 21

MULTIPLE REGRESION ANALYSIS OF
ORGANIZATIONAL CONTEXT AND STRUCTURAL VARIABLES
WITH OPERATIONAL PERFORMANCE

Variable	Expected Sign	Std. Coefficient Beta	t	Prob. t
Size		.06	.74	.461
Non-coercive Influence		.10	1.23	.222
Coercive Influence		.09	1.19	.235
Market Turbulence		.06	.72	.472
Technological Turbulence		.41	5.32	.000
Formalization		-.01	-.10	.922
Centralization		.06	.73	.467
Specialization		-.01	-.14	.890
Integration		.24	3.14	.002

Model F = 23.598
Prob. F = .000
R-Square = .266
Adj. R-Square = .255

Summary of Research Findings

The empirical results of this study find support for the majority of the hypothesized relationships of: (1) context and latent organization structural dimensions with supply chain B2B e-commerce adoption; and (2) supply chain B2B e-commerce adoption with outcome performance variables. This provides answers to the study's original research question: What organizational and environmental variables antecede the adoption of supply chain B2B e-commerce, and what are the performance outcomes

of supply chain B2B e-commerce? As hypothesized, organizations characterized by bigger size (larger values of the natural logarithm of sales volume size), greater degrees of non-coercive influences by their customers, higher technological turbulence in the industry, and with greater number of specialists and integrative mechanisms, are likely to implement supply chain B2B e-commerce. The empirical results also show evidence of better operational performance by firms that have implemented higher levels of B2B e-commerce. The summary of the analysis results for the hypotheses is presented below in Table 22.

The results of this study, while providing ample support for the majority of the hypothesized relationships, must however be interpreted with some caution. The study started out to investigate manufacturing firms, and therefore the results do not generalize beyond inter-firm relationships involving focal firms that are manufacturing entities. For example, SCM could involve retailing firms or firms in the service industry, and these were not part of the investigation. The study has tried to obtain data from a broad spread of manufacturing firms in all SIC code categories (refer Table 3). Even though the non-response bias analyses provide evidence of representativeness of the survey sample, the majority of the firms are in the high technology industries – biotechnology, electronics, industrial instruments etc. Caution must be exercised in generalizing the results to low-technology industries, and industries far upstream in the supply chain. The generalizability of the results is also influenced by the fact that the key respondents are self-selected into the CLM database, and only a single respondent was surveyed to understand business process in the supply chain. Also, less than a fifth of the firms in the survey had annual sales volume less than $200 million. The results, while fairly

generalizable to medium and large firms, need to be interpreted with caution in applying to small sized firms. A more detailed discussion of the analyses is found in the next chapter.

TABLE 22

SUMMARY OF HYPOTHESIZED EFFECTS

H1	The larger the firm size, the greater the level of supply chain B2B e-commerce.	**S**
H2a	The greater the firm's key customer coercive influence, the less the level of supply chain B2B e-commerce.	**NS**
H2b	The greater the firm's key customer non-coercive influence, the greater the level of supply chain B2B e-commerce.	**S**
H3a	The greater the market turbulence, the greater the level of supply chain B2B e-commerce.	**NS**
H3b	The greater the technological turbulence, the greater the level of supply chain B2B e-commerce.	**S**
H4	The greater the formalization, the greater the level of supply chain B2B e-commerce.	**NS**
H5	The greater the centralization, the less the level of supply chain B2B e-commerce.	**NS**
H6	The greater the specialization, the greater the level of supply chain B2B e-commerce.	**S**
H7	The greater the integration, the greater the level of supply chain B2B e-commerce.	**S**
H8a	The greater the level of supply chain B2B e-commerce, the better the financial performance.	**NS**
H8b	The greater the level of supply chain B2B e-commerce, the better the operational performance.	**S**

(S = Hypotheses is supported; NS = Hypotheses is not supported)

CHAPTER V

DISCUSSION

The discussion of this study is presented in five sections: (1) an overview of the supporting literature; (2) review of the research findings; (2) theoretical and managerial implications emanating from the study; (4) investigation of the limitations of the study; and finally (5) an outline of recommendations for further research.

Overview of supporting Literature

The fundamental motivation for undertaking this study is the recognition of the growing importance of supply chain management in the achievement of multi-dimensional goals of organizations, and the need to underline the significant opportunities for success that a key ingredient, e-commerce, has provided companies and their supply chains. Furthermore, linking organizational context and latent structure to the adoption of e-commerce by firms in their supply chain processes, particularly in the business-to-business segment, provides a basis for:

- understanding the nature of effective use of e-commerce by firms in the business-to-business supply chain context, and developing effective measures to empirically investigate its adoption and implementation.

- investigating the factors that influence firms in the supply chain to adopt innovations such as e-commerce, since many organizational (the forms of organizational structural arrangement) and environmental variables primarily determine such adoptions (e.g., Damanpour 1991; Grewal, Corner and Mehta 2001; Kimberly and Evanisko 1981).

- evaluating the impact of e-commerce adoption in providing firms with performance improvement opportunities (Lancioni, Smith and Oliva 2000).

Based on these ideas, the study specifically addressed the following research Questions: What organizational and environmental variables antecede the adoption of supply chain B2B e-commerce, and what are the performance outcomes of supply chain B2B e-commerce? To answer the research questions, the construct for supply chain B2B e-commerce was developed and its association with organizational context and structural characteristics, as well as outcome performance measures was examined.

Supply Chain B2B E-commerce

The construct of supply chain B2B e-commerce is developed by synthesizing literatures associated with SCM, e-commerce, innovation adoption, and epistemology. The construct is defined as the adoption and use of B2B e-commerce tools of EDI, Web and Internet applications by firms to generate cross-firm business process integration. SCM is defined as the mechanism for integration of key business processes across firms in the supply chain that maximizes customer value.

Researchers across a variety of disciplines have generally determined that adoption and implementation of innovative technologies contribute to the performance or effectiveness of the adopting organization (e.g., Damanpour 1991; Han, Kim and Srivastava 1998; Li and Calantone 1998). Though research in the area of B2B e-commerce technology is sparse, business literature provides case studies and anecdotal corroboration to the above argument. Recent exploratory research in the discipline, however, does provide empirical support (e.g., Avlonitis and Karayanni 2000; Croom 2000). Current SCM literature suggests that the goals of maximizing competitiveness

and performance among partner firms in the supply chain is premised on identifying crucial partners and fundamental business processes for integration (Lambert, Cooper, and Pagh 1994; 1998). Accordingly, this study identifies these critical cross-firm processes for inter-firm e-commerce integration.

Supply chain B2B e-commerce adoption is anchored in the innovation adoption theories which take a disaggregate perspective in the investigation of an individual firm's adoption decisions and behaviors (Burns and Stalker 1961; Daft 1978 etc.).

Context

Meyer and Goes (1988) argue that the characteristics of the environment, i.e., context, account for unique variance in assimilation of innovations by firms. Consistent with previous research, the context variables of size (e.g., Dewar and Dutton 1986; Ettlie 1983; Moch and Morse 1977), environmental uncertainty dimensions of market and technological turbulence (e.g., Burns and Stalker 1961; Gatignon and Robertson 1989; Pierce and Delbecq 1977), and customer influence (coercive and non-coercive) strategies (e.g., Clelland and Finkelstein 1990; Stern and Kaufmann) were considered most appropriate for inclusion in this study.

Organizational Structure

In an effort to investigate the research questions, relevant elements of the latent organizational structure are identified and measured in the study. The organizational structure literature is well established with the development of pertinent dimensions of structure clearly delineated based on numerous studies spanning an extended period of time (e.g., Aiken and Hage 1971; Burns and Stalker 1961; Collins, Hage, and Hull 1988;

Damanpour 1987). The following four dimensions of latent structure clearly emerge as the most important and well-recognized variables in innovation adoption literature: formalization, centralization, specialization, and integration). These elements were modeled in the study.

Performance

Performance measures provide valuable inputs to firms, as the bases for continuous improvement. Perceived relative measures of financial and operational performance are well established in marketing and operations literature (e.g., Georgantzas and Shapiro 1993; Lawless and Anderson 1996) and were modeled in the study for investigation.

Summary of Findings

The conceptualized relationships between supply chain B2B e-commerce and each of antecedent characteristics and outcome performance variables were investigated premised on meeting the following research objectives:

1. The development of a measure for the supply chain B2B e-commerce construct.

2. The empirical investigation of the conceptualized direct effects of each of the organizational context and latent structural variables on the adoption of supply chain B2B e-commerce.

3. The examination of the impact of supply chain B2B e-commerce adoption on outcome performance variables, and its mediating role on the relationship between the antecedent (context and structure) and outcome performance variables.

In order to accomplish the objective of developing a measure for B2B e-commerce, the following operational definition for the construct was developed:

The proposal decision, installation, and use of a secure, flexible and integrated approach to delivering business value by integrating the supply chain network systems and management components that run core business processes with key business partners in the supply chain with various electronic data and information technology application tools such as EDI, Web- and Internet- based e-commerce.

Previous research in SCM suggests that supply chain integration of a firm with its key upstream and downstream partners occurs across critical business processes (Lambert, Cooper, and Pagh 1998). Therefore supply chain B2B e-commerce is measured using a refined eight-item scale that encompasses e-commerce use across partner firms along eight critical business processes. Extant literature does not provide any sort of measure of e-commerce use in supply chains, as the discipline is only now beginning to emerge as a field for academic pursuit. The scale development is therefore a pioneering effort, based on the definition of SCM.

Scales designed to measure the contextual characteristics (i.e., organizational size, customer influence strategy, and environmental uncertainty), as well as those measuring the four latent structural variables (i.e., formalization, centralization, specialization, and integration) are identified from extant literature. The scales for outcome performance variables (operational and financial performance) are also borrowed from well-established extant research sources. A questionnaire survey that included measures of supply chain B2B e-commerce, the context and structure variables, and outcome performance variables, was faxed to 538 willing participants from the CLM (Council of Logistics Management) manufacturing members "Executive List." Of these 152 were returned for an effective response rate of 152/538 = 28.3%.

The reflective scales used in this study were subject to reliability testing and factor analysis prior to the investigation of the hypotheses. With the exception of supply chain B2B e-commerce scale, all other scales, including formative measures, are extensively used and therefore well established in marketing and management literature. This ensures that the investigation of the hypotheses is not confounded by scales that do not have adequate validity and reliability.

As mentioned previously, another objective of the study is to empirically investigate the conceptualized relationships between each antecedent context (i.e., size, customer influence strategy dimensions, and environmental uncertainty dimensions) and latent structure (i.e., formalization, centralization, specialization, and integration) variable, and the criterion variable (B2B e-commerce adoption).

Context

Investigation of the hypothesized relationships between size (H1), customer influence strategy (H2a, H2b), and environmental uncertainty (H3a, H3b) yields the following results. Among the five hypotheses, the estimates of the relationships between the size (H1), non-coercive influence strategy (H2b), and technological turbulence dimension of environmental uncertainty (H3b) are significant, thus providing partial support for the relationship of B2B e-commerce and context. The lack of support for H2a, is corroborated by evidence in extant literature and in market practice. Extant supply chain and power literature suggests that supply chain partners probably exert coercive influences on each other, but on a low key, when the integration levels are high as in the case of supply chain partnerships with key members (e.g., Boyle et. al 1992; Raven and Kruglanski 1970). The lack of support for H3a can be explained by the fact

that market turbulence is not as critical compared to technological turbulence in the adoption of radical innovations such as e-commerce (e.g., Gatignon and Robertson 1989).

Organizational Structure

Analysis of the hypothesized relationships between the latent structural variables of formalization (H4), centralization (H5), Specialization (H6), and Integration (H7) with supply chain B2B e-commerce, shows only partial support. The estimates of the relationships of formalization, and centralization with supply chain B2B e-commerce are not significant. On the other hand, the relationships between specialization and B2B e-commerce (H6), and integration and B2B e-commerce (H7) are significant ($p < .01$). Extant literature has some supportive explanation for such a result. Burns and Stalker (1961) proposed that innovations occur in more organic organization structures as opposed to mechanistic structures; mechanistic structures are characterized by higher formalization and more centralization of decision making. A meta-analysis by Damanpour (1991) suggests that adoption of innovations such as B2B e-commerce is indeed easier when organizations have organic structures i.e., less formalization and more decentralization, rather than mechanistic characteristics.

The final purpose of the current study was to investigate the impact of supply chain B2B e-commerce adoption on firm performance. In addition, the objective was also to understand the mediating role, if any, of supply chain B2B e-commerce in the relationships between the predictor variables (context and structure) and the outcome performance variables. Towards understanding the first set of relationships, additional analyses were performed by regressing each of the performance variables on context, structure, and B2B e-commerce.

Outcomes of B2B e-commerce

Analysis of the relationships between supply chain B2B e-commerce, and financial (H8a) and operational (H8b) performance provides contrasting results. As expected, the estimates of H8b are significant, providing support to the arguments that adoption of B2B e-commerce improves operational efficiencies. However, the estimate for H8a is not significant, and seems to run contrary to anecdotal evidence and results in innovation literature. Further analysis provides an explanation of the result in this study. Analysis indicates that operational performance mediates the influence of B2B e-commerce on financial performance, and has a significant relationship with financial performance. Obviously, improvement in quality levels, delivery times etc. as a result of e-commerce use, does contribute to enhanced financial performance in turn.

Mediation effect of supply chain B2B e-commerce

Analysis of the mediating effects of supply chain B2B e-commerce required the examination of three sets of regression equations: (1) regression of B2B e-commerce on the predictor (context and structure) variables; (2) regression of each of financial and operational performance on the predictor (context and structure) variables; and (3) regression of each of financial and operational performance on the predictor (context and structure) variables and supply chain B2B e-commerce. Examination of the three equations for operational performance indicated that the necessary conditions for mediation (ref. Baron and Kenny 1986) were met. The values of the coefficient of determination (R-Square) and the absolute size of the parameter estimates provide evidence that B2B e-commerce partially mediated the impact of technological turbulence

and integration on operational performance. They also suggest that besides B2B e-commerce there could be other mediating variables. The investigation of the three regression equations for financial performance suggests that the conditions for understanding the mediation effect are not met: the impact of supply chain B2B e-commerce on financial performance is not significant. The possible explanation is, as mentioned earlier, the mediating effect of operational performance. Nevertheless, the findings partially support the argument in innovation literature that the adoption of innovations (such as B2B e-commerce), is intended to contribute to performance and effectiveness of the adopting firms, and that innovations are a means of changing the organization in response to the impact of internal (structure) and external (context) environments (Damanpour 1991).

Implications

The findings from this study contribute to the fields of marketing and SCM in both theory and practice. These contributions are discussed in the following sections.

Theoretical Implications

From the theoretical perspective, the present study:

1. Extends extant research in the areas of supply chain management and marketing.
2. Introduces and operationalizes the construct of supply chain B2B e-commerce for future research.
3. Empirically examines the conceptualized relationships linking environmental characteristics and structural dimensions to supply chain B2B e-commerce.

4. Investigates the impact of adopting supply chain B2B e-commerce on firm performance.
5. Integrates supply chain management, marketing, and e-commerce to advance an integrated perspective of marketing management.

Supply chain management has emerged as a topic of great interest and an important necessity to both academic researchers and practitioners. However, very little systematic research relates to SCM, specifically in the area of e-commerce use in SCM as a means for creating customer value. This study extends existing research in the areas of SCM and business-to-business marketing. Furthermore, it extends research in the organizational innovation arena by examining the conceptualized relationships between e-commerce as a technological innovation, and various structural and environmental characteristics in the backdrop of supply chains.

The study also contributes to the discipline by conceptualizing and operationalizing supply chain B2B e-commerce. This is an important step for the field of SCM. The field is only just emerging as an academic pursuit, and therefore needs scales to measure concepts for empirical investigation of conceptual models and theory building. The scale development process is also a contribution to and acknowledgement of an emerging alternative scale development methodology based on the causal indicator model.

The third theoretical implication relates to the empirical investigation of the conceptualized relationships between supply chain B2B e-commerce and various predictor variables. The development and testing of a conceptual model that includes the dimensions of context and latent structure adds to the theoretical foundations of

organizational innovation theories (e.g., Burns and Stalker 1961; Daft 1978). The inclusion of various context and latent structure variables in the model provides valuable insights into the direct effects of these variables on the adoption and implementation of supply chain B2B e-commerce.

The inclusion of performance variables and the investigation of their relationships with supply chain B2B e-commerce, provides insights into the impact of adopting e-commerce. In the very least, the empirical results corroborate findings in extant literature, and therefore strengthen the theory that innovations such as e-commerce contribute to firm performance. Support is also provided for the theoretical arguments that the inherent nature of organizations in the supply chain enables adaptations needed for competitive advantage, and that innovation adoption facilitates this process.

Finally, a more comprehensive perspective of marketing management is advanced through the integration of organizational innovation theory, e-commerce, business-to-business marketing, and supply chain management. The rich backgrounds of organizational innovation literature provide a theoretical foundation for examining the fundamentals of e-commerce in marketing management from a supply chain management perspective. In addition, with its ultimate objective of maximizing customer value, the SCM perspective adds to the breadth of literature and research related to business-to-business marketing management.

Managerial Implications

The results of the study have significant contribution value for practitioners. First, the operationalization of e-commerce use in supply chain management provides a useful means for managers, particularly in manufacturing firms, to measure the extent of

use of e-commerce. The revolutionizing element of adopting e-commerce lies in its considerable impact on customer value creation process through performance improvements and efficiencies. Nevertheless, the operationalization of B2B e-commerce has far greater implications for managers: it invests them with an immense opportunity to better synchronize their supply chains that can provide the capabilities not only to improve performance, but also to reach out to a bigger market, and develop new products and services that adapt to the competitive and environmental needs. The scale identifies the critical business processes along which supply chain partners can be closely integrated employing e-commerce tools, to realize those benefits. Supply chain integration is a means for firms to leverage capabilities and resources in an efficient and effective way.

Second, the findings of this study related to the understanding of the type of latent structural design characteristics that facilitate and encourage e-commerce adoption, will arm managers with the knowledge of conducive structures that are necessary for enhanced performance. The knowledge helps managers to better plan structural changes that could be initiated, and reduce the risks of unnecessary changes that could be expensive propositions.

Specifically, it is found that greater integration and specialization facilitate B2B e-commerce adoption, while formalization and centralization do not. These results, while corroborating innovation adoption models, suggest that managers may plan for more organic structures with greater levels of decentralized authority, and lesser degrees of formal mechanisms, to derive benefits from adopting radical technologies such as e-commerce. As firms increase their SCM activities with partners in the supply chain,

greater integration levels and the resulting enhanced performance, are facilitated by organic organizational structures.

The results of the study relating to context also provide managers with valuable insights. Rapid technological changes in certain industries may deprive competitive capabilities of firms. As the results indicate, e-commerce adoption is not only a way to mitigate the debilitating impact of these environmental uncertainties, but also a means to enhanced performance efficiencies. The results also suggest that exercise of non-coercive influence by channel partners can have a positive role in achieving integration and goal attainment in the channel structure. High degree of mutually beneficial relational exchanges such as those in well integrated supply chains can only sustain in a non-coercive supporting environment. Managers can anticipate that communication of threats or punishments to supply chain partners in enforcing certain behaviors are detrimental to the realization of benefits from SCM practices.

The relationships between size and adoption of B2B e-commerce by firms in the supply chain, is perhaps a bit difficult to understand, but no less important. Large firms in general have adopted and implemented e-commerce to a greater extent than smaller ones. It is very likely that large firms have some inherent advantage to reap the benefits deriving from e-commerce. It is also likely that size is a surrogate indicator of greater decentralization, and specialization. For managers, the implication is that some amount of slack resources is beneficial in facilitating organizations to experiment with technological innovations such as e-commerce.

An obvious implication for managers is the performance improvements realized as a result of B2B e-commerce adoption. The results suggest that B2B e-commerce

brings extensive operational benefits to organizations in the supply chain in terms of reduced cycle times, better inventory management, improved quality etc. As further analysis indicated, B2B e-commerce indirectly enhances financial performance. This knowledge can guide technology adoption decisions in firms to sustain competitive advantage.

Limitations

This study has some limitations that need to be noted. First, the study contacted only one key informant from each participating organization; as with many organizational studies, time and resource constraints dictated the use of a single key-informant approach. This may present some problems because an individual manager's insights into cross-functional and interorganizational activities may be limited. An argument put forward is to select the chief executives as respondents, since they have a broad-based view of the functioning of the organization. However, this study erred on the side of a larger sample size, which would not have been possible without contacting other executives. Besides, most of the respondents in the sample were logistics or supply chain managers. Logistics function is interdisciplinary and spans many functional areas such as marketing, manufacturing, purchasing etc., and therefore, the respondents in the sample have the broadest possible knowledge in the firm. In addition, the high level positions held by the informants should help overcome some of the problems associated with this limitation.

Another limitation of the study, consistent with survey research, is that the results are constrained by issues related to common method variance and self-selection. However, the study has tried to minimize the impact by assessing non-response bias. The

comparison of respondents with non-respondents, in addition to early and late respondents in the sample yielded no significant differences, thus indicating representativeness of the sample with the population.

The third limitation is related to the scales used in the study, especially the measures for organizational structure. The scales are well established in extant literature, and their methodological and psychometric soundness has been reiterated over an extensive number of studies in the past following conventional wisdom based on the classical test theory. However, the recent debate on scale development indicates that these scales have formative characteristics, and therefore, conventional procedures for assessing their reliability and validity are not appropriate. Extant literature has not assessed the psychometric properties of these measures from the alternative perspective. Since the scope of this study did not encompass establishing the psychometric properties of the scales for the structural variables, some caution has to be exercised in interpreting the results of the study.

A fourth limitation is the newness of the supply chain B2B e-commerce scale. This study represents the first time e-commerce application in SCM has been measured using a scale, and one of the very few times innovation (e-commerce in this study) adoption is measured as a multi-item measure (as opposed to the commonly used dichotomous "yes"/ "no" response). Besides, the scale is developed to measure a formative latent construct. The guidelines for developing a formative measure with well-established psychometric properties are still nascent and hazy. However, the scale development process has rigorously followed the suggestions currently available in extant literature for establishing a refined measure. In addition, the empirical results in the

study are generally consistent with the theory-based relationships. Therefore, while some concern over this limitation may be expressed, the analysis provides support for the psychometric properties of the scale.

A fifth limitation in the study is the causal ordering of the variables in the model. Specifically, the assumptions in this study regarding the set of dependent and independent variables may be challenged. Although there is precedence and theoretical justification for the relationships investigated in this study, alternative models are plausible. For example, extant literature argues that organizational structure could be an adaptation response to environmental characteristics (e.g., Burns and Stalker 1961; Child 1972; Lawrence and Lorsch 1967; Mintzberg 1979). In other words, structural variables could be modeled as mediating the influence of context on supply chain B2B e-commerce adoption. Similarly, as shown by further analysis, operational performance mediates the effect of B2B e-commerce on financial performance suggesting a model specification error. The present study, however, was not designed to examine various causal orderings of the variables. The use of different methodologies (e.g., longitudinal studies) or different data analysis techniques (e.g., structural equation modeling) to explore these issues is left to further research.

Further Research

The findings of the present study provide avenues for further research. First, as mentioned earlier, further research could incorporate different measurement (for example, scales for structural variables) and analysis methods such as structural equation modeling to investigate the relationships in the study. And an investigation of the causal ordering of the variables is in order. Such research would extend the understanding to

give the correct causal sequence of relationships between the environment, structure, innovations and performance.

The antecedent (context and structure) variables used in the study also deserve further investigation. The research did not investigate the effects of interaction between context and structural variables. Specifically, previous research (e.g., Damanpour 1991) suggests that the type of organization and environmental uncertainty are effective moderators of the relationship between determinants and innovation adoption. Such an investigation will provide a more comprehensive perspective on the impact of various variables.

The third area of research opportunity involves the underlying perspective of the present study. The study limits the investigation to an individual firm's view of SCM and its partners in the supply chain. Also, only a single respondent's perception is investigated in the study. As described in the literature review, SCM is a broad-based interfunctional and inter-organizational concept. Attempt should be made in future research to enlist multiple respondents from each firm as well as across established supply chains, in order to better measure the function-independent and firm-independent nature of business processes. Dyadic level or even a more comprehensive, supply chain level investigation to capture the inherent characteristics of SCM will provide valuable insights. Such research would provide interesting measurement and analysis challenges.

It is suggested that the ultimate objective of SCM is maximization of customer value. Besides, value addition happens throughout the supply chain. To test these propositions, further research is needed to include various measures of performance at the individual firm level as well as overall supply chain level. While the measurement of

constructs such as value addition and customer value might prove problematic initially, research will greatly enhance our understanding of SCM and its performance implications both at the firm level and collectively as supply chains.

The study investigated the adoption of supply chain B2B e-commerce from a snapshot, cross-sectional perspective. However, more insight into the adoption process could be obtained by considering the different stages of the adoption process such as decision processes, personal (within the buying center in each organization) and partner-firm interactions etc. By considering the determinants of each stage within the adoption process separately, marketing management policies could be better formulated and resources more strategically allocated, in consonance with the typical characteristics inherent in these different stages of the adoption process.

A sixth area of opportunity for further research is related to the scale for measuring supply chain B2B e-commerce. The scale is premised on literature that identifies the critical business processes in SCM. But further research is needed to understand what determines which business process is fundamental to SCM, and which supply chain partner to link the processes with. The research findings will provide stronger conceptual underpinnings for the supply chain B2B e-commerce scale developed in the study.

Another area of research opportunity relates to the use of e-commerce in marketing activities. Further research is needed to understand the role of strategic considerations that motivate organizations and their supply chains to view technologies, such as e-commerce, as tools for building capabilities to sustain competitive advantage. Strategic considerations such as providing better customer service, or pre-empting

competition have significant roles to play in the decision of firms to adopt e-commerce. Further research is also needed in understanding the consequences of e-commerce adoption on interfirm partnerships in the supply chain.

Finally, the present research is founded on innovation theories and structural perspectives of innovation adoption. However, further research is needed to investigate other theoretical bases for the arguments. Extant literature suggests that besides business processes and structures, organizational motives have a long-lasting impact on firm behaviors such as adopting B2B e-commerce (Baum and Oliver 1992; Schulz 1998). For example, firms driven by efficiency motives (Rindfleisch and Heide 1997) to provide effective and efficient customer value may experiment with new ways and innovations such as e-commerce technologies. Alternatively, organizations may be driven by legitimacy motives (DiMaggio and Powell 1983; Scott 1987) for adopting B2B e-commerce in order to be perceived as technologically savvy in today's business environment. The perception in the market is that technological knowledge is definitely an advantage, even if it involves mimicking behaviors of successful benchmarked groups.

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APPENDIX A

SURVEY INSTRUMENT

S U R V E Y
Supply Chain Management E-Commerce

Code:

TO: M

FAX: ( ) - ***DATE:***

FROM: Dr. Gary L. Frankwick / Karthik N.S. Iyer

THANKS for agreeing to participate in this important research project.

Please check here ☐ and provide complete mailing instructions in the space below if you wish to receive a summary of research results (we anticipate sending summaries out about October 15, 2001).

Name: _____

Title: _____

Functional Area: _____

Primary Industry: 2-DIGIT SIC:

Mailing Address: ☐ home ☐ business

_____

_____

_____

PLEASE RETURN (with this cover) TO:
Dr. Gary L. Frankwick, OSU Marketing Department
FAX: 405-744-5180
Questions? Call Karthik at 405-744-5418 or 405-744-5192 (Mktg. Dept.)

E-mail: nanjund@okstate.edu

A. OPERATING CONTEXT:

1. Annual sales ..... $_____
2. Number of full time (FTE) employees..... _____
3. Organizational age ..... _____

B. ENVIRONMENTAL UNCERTAINTY: Please rate your firm's primary industry on the following:

1.	Sales are	predictable	1	2	3	4	5	6	7	unpredictable
2.	Market trends are	easy to monitor	1	2	3	4	5	6	7	difficult to monitor
3.	Logistics processes change	slowly	1	2	3	4	5	6	7	rapidly
4.	Products become obsolete	slowly	1	2	3	4	5	6	7	quickly
5.	Core production processes change ...	slowly	1	2	3	4	5	6	7	rapidly
6.	Sales forecasts are likely to be	accurate	1	2	3	4	5	6	7	inaccurate
7.	New products are introduced ...	infrequently	1	2	3	4	5	6	7	frequently

C. FORMAL PERFORMANCE CONTROL: Rate the extent to which the following control devices are used to gather information about the performance of your firm.

	Rarely						Frequently
1. A comprehensive management control and information system..	1	2	3	4	5	6	7
2. Use of cost centers for cost control	1	2	3	4	5	6	7
3. Use of profit centers and profit targets	1	2	3	4	5	6	7
4. Quality control of operations using sampling and other methods	1	2	3	4	5	6	7
5. Formal appraisal of personnel	1	2	3	4	5	6	7

D. INTEGRATION: In assuring the compatibility among decisions in one area (e.g., purchasing) with those in other areas (e.g., production), to what extent are the following integrative mechanisms used?

	Rarely used						Frequently used
1. Interdepartmental committees which are set up to allow departments to engage in joint decision-making on an ongoing basis...	1	2	3	4	5	6	7
2. Cross-functional teams which are temporary bodies set up to facilitate interdepartmental collaboration on a specific project...	1	2	3	4	5	6	7
3. Liaison personnel whose specific job it is to coordinate the efforts of several departments for the purposes of a specific project	1	2	3	4	5	6	7

E. PERFORMANCE: Rate your firm's performance over the past 3 years in each of the following areas

	Well below industry average						Well above industry average
1. Market share growth	1	2	3	4	5	6	7
2. Sales growth	1	2	3	4	5	6	7
3. Average return on investment	1	2	3	4	5	6	7
4. Average profit	1	2	3	4	5	6	7
5. Profit growth	1	2	3	4	5	6	7

F. SPECIALIZATION: Which of the following activities are dealt with exclusively by at least one full-time person?

	Yes	No		Yes	No
1. Production scheduling.....	[ ]	[ ]	6. ERP systems.....	[ ]	[ ]
2. Inventory planning and control...	[ ]	[ ]	7. EDI systems.....	[ ]	[ ]
3. Warehouse/factory location planning	[ ]	[ ]	8. Transportation scheduling	[ ]	[ ]
4. Warehouse/factory layout planning	[ ]	[ ]	9. Materials handling.....	[ ]	[ ]
5. Business to business e-commerce	[ ]	[ ]	10. Sales forecasting.....	[ ]	[ ]

G. DECENTRALIZATION: Which level in your firm has authority to make the following decisions?

Select 1 shop level operatives
2 first level supervisor
3 sub-department head
4 functional/div. manager
5 V.P. / director
6 chief executive
7 board of directors/owner

1. B2B e-commerce adoption decisions	1	2	3	4	5	6	7
2. Enterprise resource planning adoption decisions	1	2	3	4	5	6	7
3. EDI adoption decisions	1	2	3	4	5	6	7
4. The selection of suppliers	1	2	3	4	5	6	7
5. Delivery dates to customers and priorities of orders	1	2	3	4	5	6	7
6. Production scheduling	1	2	3	4	5	6	7
7. Transportation scheduling	1	2	3	4	5	6	7
8. Factory / warehouse location planning	1	2	3	4	5	6	7
9. Inventory planning	1	2	3	4	5	6	7

H. OPERATIONAL EFFICIENCY: Please rate change over past 3 years in your firm's performance in the following operational areas.	Substantially Worse						Substantially Better
1. Delivery lead times	1	2	3	4	5	6	7
2. Inventory turnover rates	1	2	3	4	5	6	7
3. Ability to change production lot sizes	1	2	3	4	5	6	7
4. On time deliveries to customers	1	2	3	4	5	6	7
5. Reject levels, scrap, and rework	1	2	3	4	5	6	7

I. B2B E-COMMERCE: Please rate the extent to which your **firm** uses Supply Chain B2B E-Commerce to generate cross-firm process integration. B2B E-Commerce includes EDI, Web- and Internet-based applications. Software source is irrelevant: e.g., in-house development versus application service providers. Exclude e-mail.

With Key Partners

	Used Rarely						Used Often
1. Product development: integrating suppliers and customers into product development processes.....	1	2	3	4	5	6	7
2. Procurement: managing activities and relationships with strategic suppliers.....	1	2	3	4	5	6	7
3. Demand management: forecasting.....	1	2	3	4	5	6	7
4. Materials inventory management:.....	1	2	3	4	5	6	7
5. Order management: fulfillment & delivery.....	1	2	3	4	5	6	7
6. Finished goods inventory management:	1	2	3	4	5	6	7
7. Customer management (inbound): customer initiated inquiries, e.g. order status, invoices	1	2	3	4	5	6	7
8. Customer management (outbound): firm initiated information distribution to customers.....	1	2	3	4	5	6	7

J. CUSTOMER INFLUENCE STRATEGY: Please indicate the level of use, on average, of the following influence strategies by your firm's key customers in the implementation of B2B e-commerce.

	Low						High
1. Making a case based upon financial payoff/outcome from adopting B2B e-commerce	1	2	3	4	5	6	7
2. Making it clear that by following their recommendations for adopting B2B e-commerce, our business would benefit	1	2	3	4	5	6	7
3. Providing a clear picture of the anticipated positive impact on our business that B2B e-commerce adoption will have	1	2	3	4	5	6	7
4. Threatening us of poorer service to our business should we fail to implement B2B e-commerce	1	2	3	4	5	6	7
5. Communicating their ability to reduce the amount of business with our firm, if their demands for implementation are not met	1	2	3	4	5	6	7

K. GLOBAL B2B E-COMMERCE: please rate your firm's overall level of B2B e-commerce use.

	Strongly Disagree						Strongly Agree
1. We have extensively integrated B2B e-commerce into our business processes	1	2	3	4	5	6	7
2. Our firm uses B2B e-commerce extensively with key partners.....	1	2	3	4	5	6	7
3. We use B2B e-commerce in most of our critical business processes.....	1	2	3	4	5	6	7
4. We rely extensively on B2B e-commerce.....	1	2	3	4	5	6	7

THANK YOU FOR YOUR PARTICIPATION

IT IS IMPORTANT AND APPRECIATED

Do you want a copy of the summary results? Yes { } No { }

APPENDIX B

PILOT TEST SURVEY INSTRUMENT

PLEASE ANSWER FOR YOUR BUSINESS UNIT, DIVISION OR FIRM

A. B2B E-COMMERCE: Please rate the extent to which your **firm** uses Supply Chain B2B E-Commerce to generate cross-firm process integration.

B2B E-Commerce includes EDI, Web- and Internet-based applications. Software source is irrelevant: e.g., in-house development versus application service providers. Exclude e-mail.

	1= Rarely Used	7= Frequently Used	1=Used Rarely with Key Trading Partners	7=Used Frequently with Key Trading Partners
1. Customer relationship management: identifying customer target market & implementing programs with customers	1 2 3 4 5 6 7		1 2 3 4 5 6 7	
2. Customer service management: providing current information to customers on orders, products, production, and distribution status...	1 2 3 4 5 6 7		1 2 3 4 5 6 7	
3. Demand management: forecasting	1 2 3 4 5 6 7		1 2 3 4 5 6 7	
4. Order fulfillment	1 2 3 4 5 6 7		1 2 3 4 5 6 7	
5. Manufacturing flow management: providing products when customers need them	1 2 3 4 5 6 7		1 2 3 4 5 6 7	
6. Procurement: managing activities and relationships with strategic suppliers	1 2 3 4 5 6 7		1 2 3 4 5 6 7	
7. Product development: integrating suppliers and customers into product development process	1 2 3 4 5 6 7		1 2 3 4 5 6 7	

B. ORGANIZATIONAL INNOVATIVENESS: Please indicate the extent to which the following describe your **firm's** orientation towards innovation.

	1= Not Descriptive	7= Very Descriptive
1. Technical innovation, based on research, is readily accepted.....	1 2 3 4 5 6 7	
2. Management actively seeks innovative ideas.....	1 2 3 4 5 6 7	
3. Innovation is readily accepted in program/project management.....	1 2 3 4 5 6 7	
4. People are penalized for new ideas that don't work.....	1 2 3 4 5 6 7	
5. Innovation is perceived as too risky and is resisted.....	1 2 3 4 5 6 7	

C. BUSINESS PERFORMANCE: Please assess the performance of your business.

	1= Poor						7= Excellent
1. Overall performance of the firm last year.....	1	2	3	4	5	6	7
2. Overall performance relative to major competitors last year.....	1	2	3	4	5	6	7

THANK YOU FOR YOUR PARTICIPATION
IT IS IMPORTANT AND APPRECIATED

Do you want a copy of the summary results? Yes { } No { }

APPENDIX C

SCALE HISTORY

TABLE 23a

CONTEXT VARIABLES: CUSTOMER INFLUENCE STRATEGY

Customer Influence Strategies: Coercive and Non-coercive	**Boyle et. al (1992)**	**Gundlach and Cadotte (1994)**
7 point semantic differential scale	5 point semantic differential scale	5 point semantic differential scale
1. Making a case based upon financial payoff/outcome from adopting B2B e-commerce		1. Make a case based upon financial payoff/outcome that you should comply
2. Making it clear that by following their recommendations for adopting B2B e-commerce, our business would benefit	1. Makes it clear that by following their recommendations, our business would benefit	4. Directly recommend that you comply
3. Providing a clear picture of the anticipated positive impact on our business B2B e-commerce adoption will have	2. Provides a clear picture of the anticipated positive impact on our business a recommended course of action will have	
4. Threatening poorer service to our business should we fail to implement B2B e-commerce	4. Threatens poorer service to our business should we fail to agree to their requests	
5. Communicating their ability to reduce the amount of business they will do with our firm, should their demands for implementation not be met	5. Threatens to reduce the amount of business they will do with our firm, should their demands not be met	
		2. Make a case based upon good sound business judgment that you should comply
		3. Make a case based upon market research that you should comply
	3. "Reminds us" of any of our obligations stipulated in our sales agreement	5. Directly request that you comply
	6. Makes it explicit, when making a suggestion, that it is intended for the good of our operation	6. Make a case based upon past experience that you should comply
	7. Refers to portions of our agreement which favor their position to gain our compliance on a particular demand	7. Directly ask you to comply
	8. Makes a point to refer to any legal agreements we have when attempting to influence our actions	8. Directly suggest that you comply
	9. Uses sections of our sales agreement as a "tool" to get us to agree to their demands	
	10. Makes biased interpretations of our selling agreement in order to gain our cooperation in following a request	
	11. Makes it clear that failing to	

	comply with their requests will result in penalties against our business	
	12. Uses threats of disturbing our business, such as higher prices for supplies, slow delivery times, and lower fill rates	
	13. Communicates their ability to make "things difficult" for our business if specific demands are not met	
	14. States that specific services will be discontinued for not complying to requests	

TABLE 23b

CONTEXT VARIABLES: MARKET TURBULENCE

Environmental Uncertainty: Market Turbulence	**Celly & Frazier 1996. Alpha = .85**	**Miller & Droge 1986. Alpha = .74**
7 point semantic differential scale	5 point semantic differential scale	7 point semantic differential scale
1. Sales are predictable/ unpredictable	1. Market is predictable/ unpredictable	Demand and consumer tastes are fairly easy to forecast/ almost unpredictable
2. Market trends are easy/ difficult to monitor	3. Easy to monitor trends/ difficult…	
3. Sales forecasts are likely to be accurate/ inaccurate	6. Sales forecasts are likely to be accurate/ inaccurate…	
	2. Stable market shares/ volatile...	The production/ service technology is not subject to very much change and is well established/ change often and in a major way
		The rate at which products/ services are getting obsolete in the industry is very slow/ high
	4. Stable industry volume/ unstable…	Actions of competitors are easy to predict/ unpredictable
	5. Certain that selling efforts will pay off/ uncertain…	Our firm must rarely/ (frequently) change its marketing practices to keep up with the market and competitors
	7. Sufficient information for marketing decisions/ insufficient…	
	8. Confident of results of marketing actions/ unsure	

TABLE 23c

CONTEXT VARIABLES: TECHNOLOGICAL TURBULENCE

Environmental Uncertainty: Technological Turbulence	**Celly & Frazier 1996. Alpha = .85**	**Miller & Droge 1986. Alpha = .74**
7 point semantic differential scale	5 point semantic differential scale	7 point semantic differential scale
1. Logistics processes change slowly/ rapidly		
2. Products become obsolete slowly/ quickly		The rate at which products/ services are getting obsolete in the industry is very slow/ high
3. Core production processes change slowly/ rapidly		The production/ service technology is not subject to very much change and is well established/ change often and in a major way
4. New products are introduced infrequently/ frequently		
	1. Market is predictable/ unpredictable	Demand and consumer tastes are fairly easy to forecast/ almost unpredictable
	2. Stable market shares/ volatile...	Actions of competitors are easy to predict/ unpredictable
	3. Easy to monitor trends/ difficult...	Our firm must rarely/ (frequently) change its marketing practices to keep up with the market and competitors
	4. Stable industry volume/ unstable...	
	5. Certain that selling efforts will pay off/ uncertain...	
	6. Sales forecasts are likely to be accurate/ inaccurate...	
	7. Sufficient information for marketing decisions/ insufficient...	
	8. Confident of results of marketing actions/ unsure	

TABLE 24a

STRUCTURE VARIABLES: FORMALIZATION

Formalization	**Miller & Droge 1986. Alpha = .78**
7 point (1=rarely used, 7=frequently used)	7 point (1=rarely/narrowly , 7=frequently/broadly)
1. A comprehensive management control and information system	1. A comprehensive management control and information system
2. Use of cost centers for cost control	2. Use of cost centers for cost control
3. Use of profit centers and profit targets	3. Use of profit centers and profit targets
4. Quality control of operations using sampling and other methods	4. Quality control of operations by using sampling and other techniques
5. Formal appraisal of personnel	5. Formal appraisal of personnel

TABLE 24b

STRUCTURE VARIABLES: CENTRALIZATION

Centralization	**Miller & Droge 1986 Alpha =.82**	**Germain & Droge 1997 Alpha = .80**
7 point scale (1= shop level, 7=above CE)	6 point scale (0=above CE, 5=shop level/NA)	7 point scale (1=above CE, 7=below 1st line superv.)
1. B2B e-commerce adoption decisions		
2. Enterprise resource planning adoption decisions		
3. EDI adoption decisions		
4. The selection of suppliers		8. Selecting suppliers
5. Delivery dates to customers and priorities of orders		6. Delivery dates to customers and priority of orders
6. Production scheduling	d. overtime to be worked at the shop level e. delivery dates and priority of orders f. production plans to work on	4. Overtime at the plant level 7. Production scheduling
7. Transportation scheduling		
8. Factory/ warehouse location planning		12. The location of factories
9. Inventory planning		
	i. method of work to be used	9. Production volume
	a. the number of workers required	1. The number of workers reqd.
	c. internal labor disputes	2. Allocation of work among available workers
	b. whether to employ a worker	3. Internal labor disputes
	g. dismissal of a worker	5. Plant machinery or equipment to be used

	h. methods of personnel selection	10. Goods to be manufactured
	j. machinery or equipment to be used	11. The number of factories to operate
	k. allocation of work among available workers	

TABLE 24c

STRUCTURE VARIABLES: SPECIALIZATION

Specialization	**Miller & Droge 1986. Alpha = .80**
Check Yes or No if dealt with exclusively	Which areas dealt with full-time
1. Production scheduling	d. Acquires and allocates human resources
2. Inventory planning and control	g. Obtains and controls materials and equipment (buying and stock control)
3. Warehouse/factory location planning	
4. Warehouse/factory layout planning	h. Maintains and erects buildings and equipment
5. Business to business e-commerce	
6. ERP systems	
7. EDI systems	
8. Transportation scheduling	
9. Materials handling	c. Carries outputs, resources, and other material from one place to another
10. Sales forecasting	
	k. Takes care of quality control (inspection)
	l. Assesses and devises ways of producing output
	a. Is responsible for PR, advertising, or promotion
	b. disposes of, distributes, or services the output
	e. Develops and trains personnel
	f. Takes care of welfare, security, or social services
	i. Records and controls financial resources (accounts)
	j. Controls workflow (planning and scheduling)
	m. Devices new outputs, equipment, and processes
	n. Develops and carries out administrative procedures
	o. Deals with legal and insurance requirements

TABLE 24d

STRUCTURE VARIABLES: INTEGRATION

Integration	**Miller & Droge 1986. Alpha = .85**
7 point scale (1=rarely used, 7=frequently used)	7 point scale (1=rarely used, 7=frequently used)
1. Interdepartmental committees which are set up to allow departments to engage in joint decision-making on an ongoing basis	1. Interdepartmental committees which are set up to allow departments to engage in joint decision making
2. Cross-functional teams which are temporary bodies set up to facilitate interdepartmental collaboration on a specific project	2. Task forces which are temporary bodies set up to facilitate interdepartmental collaboration on a specific project
3. Liaison personnel whose specific job it is to coordinate the efforts of several departments for the purpose of a specific project	3. Liaison personnel whose specific job it is to coordinate the efforts of several departments for purposes of a specific project

TABLE 25a

OUTCOME VARIABLES: FINANCIAL PERFORMANCE

Financial Performance	**Droge & Germain 2000 Alpha = .94**
7 point scale (1= well below industry average, 7= well above industry average over past 3 years)	7 point scale (1= well below industry average, 7= well above industry average)
1. Average return on investment	1. Average return on investment over past three years
2. Sales growth	2. Average return on sales over past three years
3. Profit growth	3. Average profit over past three years

TABLE 25b

OUTCOME VARIABLES: OPERATIONAL PERFORMANCE

Operational Performance	**Georgantzas & Shapiro 1993. Alpha = .97**	**Small & Yasin 1997 Alpha = .66**
7 point scale (1=substantially worse, 7= substantially better, over the past 3 years)	9 point scale (1=much deterioration, 9 = much improvement)	7 point scale (-3 = substantial decline, 3 = substantial improvement)
1. Delivery lead times	3. Cycle time	1. Delivery lead times
2. Inventory turnover rates		2. Inventory turnover rates
3. Ability to change production lot sizes		3. Ability to change production lot sizes
4. On time deliveries	8. On time deliveries	
5. Reject levels, scrap, and rework	9. Reject levels, scrap, and rework	
	1. Absenteeism rate	
	2. Cost of quality	
	4. Down time	
	5. Field failure rates	
	6. Floor-space requirements	
	7. New parts design requirements	
	10. Setup times	
	11. Productivity [= Output/ (Capital + Energy + Labor + Material)]	
	12. Utilization of workers, machines, and inventory	
	13. Work-in-process (WIP) inventory	

APPENDIX D

IRB APPROVAL FORM

Oklahoma State University
Institutional Review Board

Protocol Expires: 5/14/02

Date : Friday, June 01, 2001 IRB Application No BU0117

Proposal Title: SUPPLY CHAIN MANAGEMENT E-COMMERCE: AN EMPIRICAL STUDY OF ORGANIZATIONAL AND CONTEXTUAL ANTECEDENTS AND PERFORMANCE OUTCOMES

Principal Investigator(s) :

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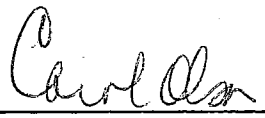
Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s) : Approved **Modification**

Please note that the protocol expires on the following date which is one year from the date of the approval of the original protocol:

Protocol Expires: 5/14/02

Signature : 

Carol Olson, Director of University Research Compliance

Friday, June 01, 2001
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

VITA

Karthik N. S. Iyer

Candidate for the Degree of

Doctor of Philosophy

Thesis: SUPPLY CHAIN MANAGEMENT E-COMMERCE: AN EMPIRICAL STUDY OF ORGANIZATIONAL AND CONTEXTUAL ANTECEDENTS AND PERFORMANCE OUTCOMES

Major Field: Business Administration

Biographical:

Education: Graduated from University College of Engineering, Bangalore University, at Bangalore, India, with a Bachelor of Engineering Degree in September 1990; Received the Master of International Business Administration Degree from Banaras Hindu University, at Varanasi, India, in May 1995. Completed the requirements for the Doctor of Philosophy degree with a major in Business Administration at Oklahoma State University, Stillwater, Oklahoma, in December 2001.

Experience: Employed in a small scale industry, as a Production Engineer, at Bangalore, India, from 1991-1992; employed from 1995-1997 as Sales Engineer at Faxtel Systems India, Bangalore, and Elgi Equipment India, Bangalore, India; employed as instructor for undergraduate marketing classes, by Oklahoma State University, from 1997 to 2001.

Professional Membership: American Marketing Association, Academy of Marketing Science.