

# Key Dimensions of Inhibitors for the Deployment of Web-Based Business-to-Business Electronic Commerce

Thompson S. H. Teo, C. Ranganathan, and Jasbir Dhaliwal

**Abstract**—There has been a rapid increase in the number of firms undertaking business-to-business (B2B) electronic commerce (e-commerce) initiatives. Although there are various benefits to B2B e-commerce, there are also inhibitors to its deployment. This study empirically investigates the inhibitors for deploying Web-based B2B e-commerce applications in organizations. A field survey of senior IT executives was conducted to examine the key problems that inhibit the deployment of Web-based B2B e-commerce. A comprehensive list of inhibitors was derived from an extensive review of the literature and pretested with senior IT executives. Data from 249 firms were factor analyzed to yield the underlying structural dimensions of inhibitors impacting the deployment of Web-based B2B e-commerce. Univariate t-test and multivariate discriminant analysis were carried out on the resulting ten dimensions to compare B2B (i.e., firms who have deployed B2B) and non-B2B firms (i.e., firms who have not deployed B2B). The results suggest that key inhibitors in B2B deployment are the lack of top management support, unresolved technical issues, the lack of e-commerce strategy, and the difficulties in cost-benefit assessment of e-commerce investments. Implications of the results for researchers and IT/engineering management executives are discussed.

**Index Terms**—Business-to-business e-commerce, deployment, inhibitors, problems, web.

## I. INTRODUCTION

THE growth of the Internet as a business medium since the advent of the World Wide Web in 1993 has been rapid. The Internet has considerably lowered barriers to entry, reduced switching costs, paved the way for many new entrants, enhanced market reach, decreased market transaction costs, and intensified intraindustry competition. For contemporary organizations, maintaining a Web presence has become more of a necessity than an additional tool to gain an edge. Organizations are increasingly trying to incorporate Web technologies in their business processes and systems, and building Web-based applications for transacting business with consumers and suppliers.

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These types of effort, popularly known as “business-to-business” (B2B) e-commerce have caught the attention of practitioners, academics and consultants.

Electronic B2B linkages among firms and suppliers have traditionally been carried out using electronic data interchange (EDI) via value-added networks or dedicated proprietary linkages. Since EDI systems are typically proprietary and costly in nature, there is a tendency for smaller firms not to use EDI [66]. However, the advent of user friendly Internet browsers in the early 1990s gave rise to cost-effective B2B systems affordable by even smaller firms. Key benefits of traditional EDI include quick response time, lower manpower costs, reduced purchase lead time, greater accuracy and improved customer service [106]. In addition to these benefits, Internet-enabled B2B systems also offer other advantages. These include: 1) ease of implementation (since they are platform independent); 2) access to a new business channel; 3) enhanced customer/supplier support capabilities; 4) ease of use [130]. Hence, it is not surprising that an increasing number of firms are deploying B2B e-commerce systems, particularly in the areas of electronic procurement and sourcing [45]. The Gartner group reported that the B2B market reached US\$433 billion in 2000 and US\$6 trillion in 2004 [90]. Further, Business Week [22] reported that businesses spent over US\$3.9 trillion in B2B e-commerce in 2003. Another study [21] suggested a 40% increase in B2B projects from 2002 to 2003.

Despite the exponential growth in B2B activities, there is no clear understanding of the severity of the various inhibitors firms face in deploying B2B e-commerce. Given the distinct nature of the Internet as compared to earlier information technologies, there is some ambiguity about the applicability of our current knowledge on conventional inter-organizational systems to the area of B2B applications. In this study, we address these concerns by examining the inhibitors affecting the deployment of B2B e-commerce in organizations. More specifically, the objectives of this research study are as follows:

- 1) to identify a comprehensive set of inhibitors for the deployment of B2B e-commerce from prior research and the practitioner literature;
- 2) to identify an underlying structure for these inhibitors that can serve as a basis for future research as well as provide a sounder theoretical guide for managerial initiatives pertaining to B2B deployment;
- 3) to compare the severity of the inhibitors between firms that have deployed Web-based B2B e-commerce and those that have not done so; and

- 4) to provide guidance to researchers and practitioners concerning the various types of problems that may inhibit B2B e-commerce deployment.

## II. LITERATURE REVIEW

### A. Web-Based B2B E-Commerce

Information technologies have had a fundamental impact on interfirm relationships. The famous success stories in airlines, hospital supplies, finance and several other industries in the mid-1980s and 1990s were all rooted in IT-enabled interorganizational arrangements [71]. There is little doubt about the potential role of information technologies in influencing, enhancing and extending interfirm relationships.

Recognizing the capabilities of information technologies in creating and developing interfirm relationships, many organizations deployed interorganizational systems (IOS) to automate and enhance their interfirm transactions. Most of these IOS started as bilateral, dyadic applications connecting two organizations, and soon emerged as multilateral systems connecting many more organizations [29]. Most of these IOS were also proprietary in nature, thus, effectively locking-in the partners, thereby providing a strategic edge to the organizations deploying the IOS.

Though IOS and electronic data interchange (EDI) have been prevalent, the advent of the Internet has drastically changed the dynamics in several ways [103]. First, the Internet has considerably reduced the coordination costs involved in interorganizational transactions. Firms no longer need to make heavy investments in establishing dedicated electronic networks. Second, the ubiquitous nature of the Internet has made it possible for several partners in remote locations to come together and participate in electronic transactions [72]. Third, widespread adoption of open standards has greatly reduced the complexities involved in conducting Web-based interorganizational transactions. Fourth, the proprietary technology base of the traditional IOS and EDI systems (that provided a “lock-in” advantage) is being increasingly replaced by systems that are based on open architectures. This has considerably lowered the switching costs, thereby providing more freedom for companies on the choice of business partners [100].

Due to the enhanced capabilities and cost advantages offered by B2B systems, many firms are increasingly deploying B2B e-commerce. For example, through the Cisco supplier connection (CSC), suppliers have access to Cisco’s enterprise resource planning (ERP) order fulfillment systems and inventory databases so that they can respond to customer requests in real time. Cisco is also able to track and transfer inventory between different manufacturers to respond to component shortages [78]. In contrast, Dell developed customized intranet sites called “*premier pages*” for over 200 global business customers. These pages provide purchasing and technical information for computer configurations approved by the firm so that employees can place direct orders, thereby resulting in less paperwork and time savings for both parties [86]. El-Sawy [40] makes the case that just as business process reengineering (BPR) was used as the managerial trigger for radically changing internal business processes in the early 1990s, it is

now imperative for organizations to radically redesign their interorganizational supply chains using B2B technologies.

There is anecdotal as well as empirical evidence regarding the performance impacts of B2B e-commerce. For example, using B2B systems, Cisco has reduced its operating cost by \$75 million and 45% of its products are shipped directly from suppliers to customers [78]. Through virtual integration of its supply chain using B2B systems, Dell holds inventory for 11 days compared to 80 days for its competitors [86]. Empirical studies also suggest that markets suitably reward firms involved in B2B e-commerce initiatives, leading to significant market value gains [122]. Though firms might realize significant benefits from deploying B2B e-commerce, they also tend to encounter several problems [32]. Therefore, our research goal is to identify, categorize, prioritize and analyze the problems in deploying B2B e-commerce applications.

We broadly define a B2B e-commerce application as an *information system based on Web-technologies that is used by a firm for conducting business transactions with its suppliers, customers, or other partner firms*. In other words, B2B e-commerce applications are Web-based IOS connecting two or more firms. Examples of such applications include Internet-based EDI, Web-based extranets linking multiple firms, private B2B exchanges established by firms for interacting with their business partners, electronic procurement systems and similar firm-specific B2B application initiatives. Our specific intent is to identify those factors that inhibit these firms in deploying Web-based B2B applications. We do not examine issues concerning e-markets, public B2B portals and exchanges, and third-party or consortia operated electronic marketplaces.

### B. Inhibitors for B2B E-Commerce

As new web technologies become prevalent, firms must adopt and assimilate them to streamline and enhance their interorganizational transactions [25]. Despite the recognition of the potential value of B2B technologies, firms differ in their efforts to adopt and implement these systems [31]. These stem from the inherent variations in organizational routines, business processes, resources and the environmental contexts in which firms operate. Interfirm and contextual variations give rise to a number of inhibitors that influence the extent of adoption and deployment of new technologies [54]. Based on the severity of these inhibitors, organizational responses to the technology could vary. At the extremes, firms may decide either not to adopt the new technology or to radically overhaul their business processes to assimilate the new technology. Some firms could adopt the technology in selected processes on an experimental basis. Further, the speed with which firms adopt and assimilate the new technology could also vary. The severity of inhibitors faced by a firm could greatly influence the organizational response to the new technology and its deployment [76], [138]. Thus, it becomes important to identify these inhibitors, understand the roles they play and develop appropriate mitigation tactics. Our paper is directed towards this goal.

We use the theoretical framework proposed by Tornatzky and Fleischer [131] as our foundation. According to Tornatzky and Fleischer, technology deployment in a firm is influenced by three aspects pertaining to the firm’s context – *technological*

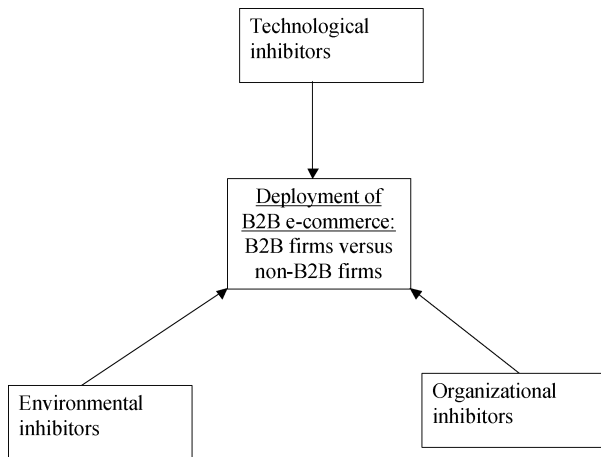


Fig. 1. General conceptual framework.

*context, organizational context* and the *environmental context*. The technological context refers to both internal and external technologies relevant to the firm, and associated characteristics. The organizational context refers to firm characteristics including strategies, policies, structure and cultural aspects. The environmental context refers to the external arena where the firm conducts its business. It includes the competitive, legal and regulatory atmosphere and the market in which a firm operates. The *Technology-Organization-Environment* (TOE) framework has been successfully used by many IS researchers as these three contexts capture the key elements that determine technology deployment. For example, the TOE framework was used by Iacovou *et al.* [66] to examine EDI adoption; by Chau and Tam [26] to examine open systems adoption; and by Teo, Tan and Buk [128] to examine Internet adoption. Further, in a meta-analysis of research on IT implementation, Premkumar [102] found consistent empirical support for the TOE framework although specific factors examined within the three TOE contexts may vary across different studies. Drawing upon the TOE framework, our conceptual model is presented in Fig. 1.

1) *Technological Context*: The technological context essentially describes the new technology to be adopted, internal technological environment, external technologies and their key characteristics. Scholars have documented a number of technological factors that influence a firm's decision to implement new technologies. Table I(a) presents a list of key technological inhibitors. A flexible, scalable IT infrastructure is essential to implement web based B2B systems [134]. An expansive IT infrastructure provides a technological base on which a firm could build its B2B e-commerce. A firm's database and telecommunication resources also determine its ability to develop and deploy interorganizational applications [104]. Firms that have been able to standardize their IT infrastructure and applications through enterprise systems have been found to more easily deploy B2B applications [15]. However, in some cases, a firm's historical legacy in technology deployment could impede its B2B implementation. Integrating proprietary systems with new Web-based applications has been a major concern for several corporations [31], [35]. Moreover, firms that have relied on traditional technologies and legacy applications might not possess adequate

technological expertise for deploying B2B e-commerce [51], [138].

In the case of B2B e-commerce, the new systems need to be integrated not only with existing systems, but also with those of business partners, customers, and suppliers [106]. B2B technology decisions need to take into account the technological sophistication and IT infrastructure of business partners with whom B2B electronic transactions need to be conducted [30]. Such technological issues could often discourage a firm from engaging in B2B e-commerce.

In this study, we compare firms that deploy B2B e-commerce (B2B firms) with those that do not (non-B2B firms). Conceptually, we can postulate that the severity of inhibitors for firms that do not deploy B2B e-commerce is greater than those that do. The rationale is that there are strong inhibitors holding back firms which have not deployed B2B e-commerce. In contrast, firms that do deploy B2B e-commerce are likely to have found ways to mitigate its effects. Given our earlier arguments about potential technological inhibitors, we propose that:

*Hypothesis 1a*: The severity of technological inhibitors for B2B firms is lower than that for non-B2B firms.

2) *Organizational Context*: Organizational context embodies a set of firm-related characteristics that either constrain or facilitate diffusion and infusion of a particular technology. Tornatzky and Fleischer [131] note that the firm itself is a "rich source" of formal and informal structures, processes, attitudes and cultural traits that influence the technology deployment process.

Table I(b) presents a list of key organizational inhibitors. There is a good body of research that documents the importance of top management support and managerial attitudes for effective adoption and deployment of new technologies [6], [52]. In the context of e-commerce, Chatterjee *et al.* [25] found top management championship to be a key factor affecting the deployment of web technologies. Apart from top management support, effective B2B e-commerce deployment also requires the support and active engagement of functional leadership. B2B e-commerce transcends organizational functions and firm boundaries and, thus, requires strong cross-functional co-operation [48]. Increased cross-functional integration has been found to enhance B2B application deployment [31].

Effective deployment of B2B e-commerce is also contingent upon careful planning that is guided by an overall strategic vision for e-commerce. Lack of a clear vision and plan could impede B2B initiatives [57]. Undertaking B2B e-commerce also requires significant changes in the interfirm and intrafirm business processes. Scholars advocate process-based approaches for managing workflow changes when deploying B2B e-commerce [85]. Since B2B e-commerce often demands significant changes in the way in which a firm interacts with business partners, large scale B2B projects require significant shifts in organizational mindsets [113], cultural orientations [57], and structural configurations [68]. Studies on IOS implementation [9], [53] and B2B e-commerce [31], [68] have empirically documented the impact of organization structure and culture on systems deployment.

Undertaking B2B e-commerce projects entails significant commitment of organizational resources such as capital, managerial expertise and human resources. While financial resource-

TABLE I  
(a) POTENTIAL INHIBITORS FROM TECHNOLOGICAL CONTEXT

Technological Inhibitors	References from traditional IS/IOS/EDI literature	References from E-commerce literature
Lack of adequate IT infrastructure (applications, databases, telecommunications etc.) in the firm	[18], [52], [54], [103], [104], [108]	[2], [15], [36], [75], [99], [119], [120], [138]
Limitations posed by existing database infrastructure in the firm	[52], [54], [104], [108]	[15], [120]
Limitations posed by current telecom infrastructure in the firm	[5], [52], [54], [103], [104]	[63], [99], [117], [118]
Unresolved security, encryption and authentication issues	[5], [103]	[32], [45], [75], [99], [116], [118]
Inadequate mechanisms for protecting data and information in EC transactions	[103]	[30], [34], [41], [117], [137]
Lack of adequate payment systems for conducting financial transactions with business customers and suppliers	[5]	[34], [41]
Lack of robust, stable and standardized infrastructure	[5]	[32], [46], [64], [79], [117]
Lack of inter-operability between new e-commerce applications and legacy systems	[69]	[31], [32], [35], [45], [114]
Difficulties in integrating e-commerce applications with existing applications and systems	[69], [103], [106]	[2], [24], [31], [35], [45]
Lack of interoperability between e-commerce applications and those of business partners (suppliers, customers etc)	[5], [103], [106]	[2], [30], [32], [75], [85]
Difficulties in keeping IT staff adequately trained on up-to-date e-commerce technologies	[14], [54]	[3], [34], [101], [116]
Not enough time to develop new skills	[54]	[24], [101], [114], [138]
Lack of adequate IT/e-commerce expertise in the firm	[18], [110]	[51], [57], [138]

es have been a significant barrier for many organizations [118], difficulties in demonstrating a clear cost-benefit relationship have also impeded many firms from commencing B2B projects [5], [34]. In some cases, B2B efforts get diffused within other corporate initiatives due to the lack of a dedicated task force or a designated executive to coordinate the B2B efforts [113], [130].

Firms adopting and deploying B2B e-commerce (B2B firms) need to overcome several inhibitors stemming from the organizational context. We expect significant differences in the severity of organizational inhibitors between B2B firms and non-B2B firms. Specifically, we expect the severity of organizational inhibitors to be higher in non-B2B firms as these firms have been grappling with issues that hamper B2B e-commerce deployment. It follows that:

*Hypothesis 1b:* The severity of organizational inhibitors for B2B firms is lower than that for non-B2B firms.

3) *Environmental Context:* Environmental context refers to the external landscape in which a firm operates and a set of related factors that are likely to affect the firm behavior [131]. It includes the competitive environment which encompasses a firm's customers, suppliers and business partners, and legal, regulatory and social environments that could potentially influence the firm behavior. A large body of research on contingency theory focuses on the relationship between the external environment and organizational actions. Several studies have empirically documented the impact of the external environment on technology adoption and assimilation in organizations.

A list of potential inhibitors from the environmental context is presented in Table I(c). A large body of research has documented the influence of a firm's competitive environment (comprising its customers, suppliers, competitors and business partners) on its technology deployment processes. Deployment of any interorganizational system, including Web-based B2B e-commerce, involves electronically connecting two or more firms. Therefore, the readiness and capabilities of partner organizations are likely to influence a firm's system deployment process. Premkumar *et al.* [105] found customer support and competitive pressure to be critical determinants of EDI deployment. Hart and Saunders [61] argue that a business partner's influence and readiness are significant factors in the EDI adoption decision. Barua *et al.* [11] empirically found customer and supplier readiness to enhance e-business capabilities that ultimately led to improved operational and financial performance.

Potential impacts of legal, regulatory and social environments on Web technology deployment have also been noted in the literature. Kshetri and Dholakia [79] found legal and regulatory environment to influence B2B e-commerce decisions. If a firm's B2B partnerships could extend geographically across the globe, international trade regulations could influence B2B deployment decisions. Gibbs *et al.* [47] found state policies, legal issues, and international trade regulations to significantly influence e-commerce diffusion.

Firms considering B2B e-commerce may have little control over larger legal or regulatory environments. If these environments pose significant constraints, firms might curtail or shed

TABLE I (Continued.)  
(b) POTENTIAL INHIBITORS FROM ORGANIZATIONAL CONTEXT

Organizational Inhibitors	References from traditional IS/IOS/EDI literature	References from E-commerce literature
Lack of top management support	[5], [52], [104], [105], [110]	[99], [45], [118], [119]
Lack of top management leadership	[6], [54], [105], [108],	[24], [25], [57]
Lack of top management understanding about potential benefits and issues (related to B2B EC)	[6], [54], [104]	[25], [32], [36], [114]
Difficulties in making organizational and management changes.	[39], [54], [103]	[24], [28], [32], [35], [46], [57], [113], [130]
Difficulties in making changes to current corporate culture	[10], [88]	[32], [57], [114]
Difficulties in making changes to existing organizational structure	[5], [8], [9], [53], [89], [124]	[31], [46], [57], [68] [113], [114]
Difficulties in re-designing the business processes.	[5], [39],[123], [53], [54], [58], [124]	[3], [11], [24],[28], [31], [34], [35], [63], [68], [75], [85], [107],
Lack of strategic vision for e-commerce.	[5], [6], [95]	[34], [41], [45], [113], [114]
Lack of strategic plan for e-commerce	[52], [54], [110]	[57]
Lack of alignment of e-commerce plans and corporate plans	[76], [110], [111]	[17], [99]
Lack of proven, accepted business models for e-commerce*		[32], [35], [36], [89] [130], [138]
Difficulties in managing the conflicts between current marketing and business channels and new channels via internet*		[114], [133]
Lack of support from functional managers	[5], [54], [58], [95]	[48], [113], [114], [138]
Lack of champion	[5], [52], [95], [105]	[119]
Difficulties in gaining cross-functional co-operation	[5], [54], [58]	[48], [57], [101]
Inadequate support from other departments	[5], [54], [58]	[48], [101], [114]
Lack of adequate commitment of resources (finance, human resources etc)*	[66], [110]	[15], [63], [75], [117], [118], [120]
Difficulties in financially justifying e-commerce investments and benefits	[106], [110]	[25], [24], [41], [114], [107]
Problems in measuring benefits of e-commerce efforts	[5], [54]	[34], [57], [114]
Lack of appropriate methodology	[54]	[75], [114]
Inadequate training on e-commerce for organizational staff	[5], [98]	[24], [28], [99], [101], [113], [138]
Lack of external consultant support	[44], [54], [129], [135]	[37], [115], [116]
Lack of dedicated team, or decision maker for e-commerce	[54]	[25], [114], [113], [116]
Internal fear of opening corporate systems to suppliers and customers	[61], [62]	[17], [32], [137]
Lack of communication among the organizational members*	[94]	[41], [101], [113]
Too much time involved in e-commerce efforts*	[54]	[116], [75]

\* Items dropped during factor analyses

their B2B e-commerce activities. However, B2B firms might enjoy relatively better degree of influence in their competitive environment. Larger firms could even deploy coercive tactics to engage their suppliers and partners in B2B e-commerce networks [62]. Hence we expect B2B firms to have relatively lower severity of inhibitors as compared to non-B2B firms.

*Hypothesis 1c:* The severity of external environmental inhibitors for B2B firms is lower than that for non-B2B firms.

4) *B2B Versus Non-B2B Firms in Their Perceptions of Inhibitors:* Although there are several issues inhibiting the deployment of B2B e-commerce, the severity of these inhibitors is likely to vary among firms. Depending on their resource base, technological endowments, functional and process capabilities and competence, firms are likely to sense and respond to these

inhibitors in different ways. Researchers have found significant differences in the organizational perceptions of inhibitors between firms that have adopted and deployed an innovation as compared to those that have not. For instance, Grover *et al.* [54] found BPR-adopters to perceive a different set of inhibitors than nonadopters. In another study, Grover [52] found firms deploying customer-based IOS systems to significantly differ from nonimplementers. Similar differences have been reported in the context of EDI as well. In the context of B2B, it is plausible that the B2B firms and the non-B2B firms view the inhibitors differently with some being more important for one group compared to the other group. Hence, we hypothesize that:

*Hypothesis 2:* The key inhibitors for B2B firms are significantly different from non-B2B firms.

TABLE I (Continued.)  
(c) POTENTIAL INHIBITORS FROM ENVIRONMENTAL CONTEXT

Environmental Inhibitors	References from traditional IS/IOS/EDI literature	References from E-commerce literature
Complex legal issues (liability, contracts) involved in conducting electronic transactions with business partners	[5], [69], [70]	[13], [30], [34], [47], [79]
Lack of international access and trade barriers to do e-commerce across national borders	[5], [69]	[32], [36], [41], [47], [114]
Inconsistent taxation laws related to e-commerce		[30], [34], [41], [47], [67]
Lack of clear legal environment for conducting e-commerce	[5], [69]	[13], [30], [32], [34], [36], [41], [47], [63], [75], [79]
Uncertain response of customers	[4], [33], [52], [62], [105]	[11], [24], [31], [119], [42], [138]
Uncertain response of suppliers	[4], [33], [62], [103]	[11], [42], [46]
Uncertain response of other business partners	[4], [5], [33], [80], [81], [66], [103], [104], [105]	[3], [11], [32], [35], [42], [84], [137], [138]

### III. METHOD

#### A. Instrument

An extensive review of prior literature on the aforementioned areas was carried out to identify a comprehensive list of potential inhibitors that affect the deployment of B2B e-commerce applications. We also scanned the popular press and practitioner literature on e-commerce to identify potential inhibitors for B2B e-commerce applications. Our specific sources include academic research, practitioner-oriented articles in business press, published interviews with executives, surveys by consultants and IT market research firms, anecdotal case studies, and other organizational stories of B2B e-commerce application deployment. This exercise resulted in a list of potential inhibitors for the deployment of B2B e-commerce. The list was tested with six academic experts and iterative refinements were made. This step helped in identifying similar and redundant items for grouping and pruning purposes. Subsequently, the list was pretested with eight senior IT managers who had considerable experience in B2B e-commerce. Interviews were carried out with these senior IT managers to gather their opinions on problems inhibiting the deployment of B2B e-commerce. They were asked to delete, add and refine the list. The list of items was expanded, refined, and iteratively validated based on the feedback of respondents. This resulted in a final pool of 46 items representing problems faced in the deployment of B2B e-commerce [see Table I(b)–(c) for the list of inhibitors].

In order to ensure that our respondents correctly understood the meaning of B2B e-commerce application, we provided them with our definition in the cover letter as an *information system based on Web-technologies that is used by a firm for conducting business transactions with its suppliers, customers, or other partner firms*. We also encouraged respondents to provide us with a brief description of the system they deployed. This description of the system helped us in ascertaining that the details provided were in accordance with our research purposes.

In the survey, we asked respondents to indicate the extent to which their firms had deployed B2B e-commerce applications. The respondents were asked to indicate: 1) if there was no consideration of such applications; 2) if there were discussions initiated, but no further action taken about them; 3) if there was

some consideration of applications, but with no specific decision being made; 4) if there was a specific decision made to deploy such applications and implementation was in progress; 5) if the firm had deployed applications and was currently using one or more of them. This approach is similar to prior studies from the traditional IOS literature [52]. We presented our list of inhibitors and solicited the significance of each item. Based on their organizational context and experience, respondents were requested to rate the severity of each of the inhibitors on a seven-point scale where 1 = not a problem, and 7 = extreme problem. Our approach to measuring the severity of inhibitors is consistent with similar studies (e.g., [54]).

#### B. Sample and Procedures

Based on the suggestion of Huber and Power [65] to seek responses from the individual most knowledgeable about the issue of interest especially in single informant survey studies, we chose the most senior IT executive to be the target respondent for our survey. A cover letter was sent along with the survey, providing the respondents with a brief idea about the study and assuring confidentiality about the data they provided. We also gave respondents the option of not identifying their names, contact details or the identity of their organization.

Our research intent was to study and understand B2B e-commerce inhibitors in established brick-and-mortar organizations. Therefore, pure-play Internet firms (*dot-coms*), B2B exchanges and portals were excluded at the outset. To identify potential participants for our study, we used a database comprising the ACR (Applied Computer Research) directory of top computer executives in North America and the senior IT executives of organizations on the Toronto Stock Exchange's Listed Company Directory. From this pool, a total of 1200 organizations were randomly selected to receive the survey. Two follow-up reminders in the form of fax/mailings or telephone calls were carried out to increase the response rate. A total of 249 usable responses were obtained. This represents a response rate of 20.75% that compares well with similar studies in MIS research. To assess nonresponse bias, we compared the early respondents with late respondents based on the revenue and the industry categories. The logic of this comparison is that the late respondents tend to

TABLE II  
DEMOGRAPHIC PROFILE

Industry Type	Number	%
Manufacturing/engineering related	45	18.1
Chemicals	8	3.2
Finance / banking/insurance-related	27	10.8
Computer/IT-related	16	6.4
Medical/healthcare related	8	3.2
Oil/gas/energy	9	3.6
Business services	22	8.8
Real estate/property	9	3.6
Publishing/information/news related	6	2.4
Transportation / logistics related	14	5.6
Retailing/wholesale/trading related	28	11.2
Hotel/travel/tourism-related	10	4.0
Others	33	13.3
NA	14	5.6
Total	249	100.0
<i>Annual revenue level</i>		
< 1 million	1	0.4
1.1-5 million	11	4.4
5.1-10 million	25	10.0
10.1-50 million	69	27.7
50.1-100 million	65	26.1
> 100 million	76	30.5
NA	2	0.8
Total	249	100.0

closely resemble the nonrespondents [73]. No significant differences were found; hence, nonresponse bias was not a concern.

#### IV. RESULTS

##### A. Demographic Profile

The demographic profile of respondents in terms of their industry and revenue levels is shown in Table II. The industry distribution indicates that our sample had a fairly, heterogeneous and distributed group of respondents belonging to both manufacturing and service sectors. Further, about 30% of respondents had annual revenues exceeding \$100 million, and another 54% had revenues between \$10-\$100 million. This also represents a fairly diverse mixture of respondent firms.

Out of 249 valid, usable responses received, 137 firms (55.0%) were using one or more e-commerce applications while 48 firms (19.3%) were in the process of deploying such systems (Table III). Only four firms (1.6%) had not considered any e-commerce applications while 60 firms (24.1%) had considered them, but had either not taken any action about deployment or had not made a decision about deployment yet. For further analysis, we grouped the first three categories in Table III as *non-B2B* firms (i.e., firms who have not deployed B2B e-commerce applications) and the remainder as *B2B* firms (i.e., firms who are currently implementing or have deployed B2B e-commerce applications). Our approach is consistent with prior studies that have used a similar scheme for classifying adopters and nonadopters (e.g., [52]). We had a total of 185 (74.3%) B2B and 64 (25.7%) non-B2B firms.

Of the 185 B2B firms, 115 firms had provided a brief description of their B2B deployment. Some firms had even deployed multiple B2B applications. Thus, about 62% of the B2B firms in our sample provided us with some kind of details regarding their B2B initiatives. A screening of these descriptions helped us ascertain that the responses we had received are in tune with our research goals. Other firms might have chosen not

TABLE III  
DEPLOYMENT OF WEB-BASED B2B E-COMMERCE

Deployment	Number	%
No consideration of any e-commerce applications	4	1.6
Some discussion on e-commerce applications, but no further action	20	8.0
Some consideration but no decision to have e-commerce applications yet	40	16.1
Decision to have e-commerce applications made and implementation is in progress	48	19.3
We currently use one or more e-commerce applications	137	55.0

to describe their B2B applications for reasons such as confidentiality and so on. Examples of B2B systems mentioned by respondents include B2B system for orders, billing and payments, B2B system for used-machinery, Web system for collaborative product design with partners, Web based extranet for order and sales information exchange and processing, B2B system for contract management with suppliers, and B2B system for corporate insurance agreements.

##### B. Factor Analysis and Reliability Assessment

An exploratory factor analysis using principal component analysis with varimax rotation was carried out on the total sample. This has an advantage over individual factor analysis for B2B and non-B2B firms in that the ratio of sample size to number of items is increased, thereby leading to lesser tendency of producing spurious results. Further, this procedure makes it easier to compare between B2B and non-B2B firms since the same key dimensions were used. A similar procedure has been adopted by Moore and Benbasat [92] and King and Teo [76] who examined adopters and nonadopters of information technology.

Consistent with King and Teo's work, the results of each factor analysis were evaluated based on two criteria: 1) only items with at least 0.50 were retained; 2) items with loadings of less than 0.50 on all dimensions or with loadings greater than 0.50 on two or more dimensions were dropped. After six rounds of factor analysis on the initial 46 items, we have 41 items loading on 10 factors and accounting for 78% of the variance (Table IV).

Reliability assessment using Cronbach's alpha was carried out on each dimension. The results indicate that nine out of ten dimensions have values above the threshold of 0.70 suggested by Nunnally [96]. The last dimension (F10) comprises two items and has a Cronbach's alpha value of 0.61 which may be adequate for exploratory research. We decided to retain this dimension as it relates to the important issue of cost-benefit assessment of e-commerce initiatives.

##### C. Dimensions of Inhibitors

Table IV shows the factor structure with the names of the factor being subjectively inferred from the nature of the grouped items, as is commonly done with such results. The first underlying dimension (F1), called "Difficulties in Organizational Change," comprises items that pertain to the difficulties in making organizational and managerial changes. Past research has shown that changes in corporate culture, organizational structure and redesigning business processes are issues that firms grapple with when implementing radical IT-based

TABLE IV  
KEY DIMENSIONS, ITEMS, AND LOADINGS

Key dimensions and items	Loadings
<b>F1. Difficulties in Organizational Change (Organizational Context)</b> (Eigenvalue=11.0, Var = 26.8%, $\hat{\alpha}$ =0.90)	
Difficulties in making organizational and management changes	0.78
Difficulties in making changes to current corporate culture.	0.82
Difficulties in making changes to existing organizational structure.	0.87
Difficulties in redesigning the business processes for e-commerce	0.79
Lack of support from functional managers.	0.74
Lack of champion.	0.64
Difficulties in gaining cross-functional cooperation.	0.73
Inadequate support from other departments.	0.78
<b>F2. Problems in Project Management (Organizational Context)</b> (Eigenvalue=5.4, Var = 13.3%, $\hat{\alpha}$ =0.83)	
Lack of appropriate methodology.	0.78
Inadequate training on e-commerce for organizational staff.	0.81
Not enough time to develop new skills.	0.81
Lack of external consultant support.	0.69
Lack of dedicated team or decision maker for e-commerce.	0.66
Difficulties in keeping IT staff adequately trained on up-to-date e-commerce technologies.	0.74
<b>F3. Unresolved Technical Issues (Technological Context)</b> (Eigenvalue=3.2, Var = 7.8%, $\hat{\alpha}$ =0.89)	
Unresolved security, encryption and authentication issues.	0.89
Inadequate mechanisms for protecting data and information in e-commerce transactions.	0.90
Lack of adequate payment systems for conducting financial transactions with business customers and suppliers.	0.86
Lack of robust and stable infrastructure.	0.84
<b>F4. Unresolved Legal Issues (Environmental Context)</b> (Eigenvalue=2.7, Var = 6.5%, $\hat{\alpha}$ =0.85)	
Complex legal issues (liability, contracts) involved in conducting electronic transactions with business partners.	0.87
Lack of international access and trade barriers to do e-commerce across national borders.	0.87
Inconsistent taxation laws related to e-commerce.	0.89
Lack of clear legal environment for conducting e-commerce.	0.81
<b>F5. Lack of Top Management Support (Organizational Context)</b> (Eigenvalue=2.4, Var = 6.0%, $\hat{\alpha}$ =0.94)	
Lack of top management support.	0.81
Lack of top management leadership.	0.82
Lack of top management understanding about potential benefits and issues related to e-commerce.	0.81
<b>F6. Lack of E-Commerce Strategy (Organizational Context)</b> (Eigenvalue=2.0, Var = 4.9%, $\hat{\alpha}$ =0.97)	
Lack of strategic vision for e-commerce.	0.75
Lack of strategic plan for e-commerce.	0.79
Lack of alignment of e-commerce plans and corporate plans.	0.71
<b>F7. Lack of IT Expertise and Infrastructure (Technological Context)</b> (Eigenvalue=1.6, Var = 4.0%, $\hat{\alpha}$ =0.81)	
Lack of adequate IT/e-commerce expertise in the firm.	0.63
Lack of adequate IT infrastructure (applications, databases, telecommunications, etc.) in the firm.	0.83
Limitations posed by existing database infrastructure in the firm.	0.80
Limitations posed by current telecom infrastructure in the firm.	0.71
<b>F8. Fear and Uncertainty (Environmental Context)</b> (Eigenvalue=1.3, Var = 3.2%, $\hat{\alpha}$ =0.78)	
Internal fear of opening corporate systems to suppliers and customers	0.64
Uncertain response of customers.	0.80
Uncertain response of suppliers.	0.81
Uncertain response of business partners.	0.88
<b>F9. Lack of Interoperability (Technological Context)</b> (Eigenvalue=1.2, Var = 3.0%, $\hat{\alpha}$ =0.76)	
Lack of interoperability between new e-commerce applications and legacy systems.	0.80
Difficulties in integrating e-commerce applications with existing applications and systems.	0.82
Lack of interoperability between e-commerce applications and those of business partners (suppliers, customers, etc.).	0.66
<b>F10. Difficulties in Cost-Benefit Assessment (Organizational Context)</b> (Eigenvalue=1.1, Var = 2.8%, $\hat{\alpha}$ =0.61)	
Difficulties in financially justifying e-commerce investments and benefits.	0.66
Problems in measuring benefits of e-commerce efforts.	0.85

changes [59]. In addition, the problem is often compounded when there is a lack of champion for the change effort [12].

The second dimension (F2) consists of items related to "Problems in Project Management." Various authors have emphasized



the need for proper project management in order to ensure that IT projects are delivered on time and within budget. Problems in project management can result from the lack of appropriate methodology, skilled staff, training, dedicated team and external consultant support [109], [111].

The third dimension (F3) consists of items that may not be within the firm's control. We named this factor as "Unresolved Technical Issues." This includes items such as security, encryption, authentication, payment and infrastructure issues. The lack of standards in these areas among different firms and countries may inhibit deployment since e-commerce tends to include interorganizational and cross-border data flows and transactions.

The fourth dimension (F4) is made up of items pertaining to "Unresolved Legal Issues" for e-commerce, taxation laws and trade barriers to e-commerce. To conduct global e-commerce, firms need to familiarize themselves with variations of e-commerce laws among different countries that may impact their businesses and customers [43], [93].

The fifth dimension (F5) consists of items relating to the "Lack of Top Management Support." Previous research has frequently emphasized the importance of top management support, commitment and leadership in any development and implementation process e.g., total quality management [16], statistical process control [60], CASE tools [97], and expert systems [55]. Further, top management understanding about IT and support for IT investments are also important for aligning business and IS initiatives [125].

The sixth dimension (F6) is named "Lack of E-Commerce Strategy" and relates to the lack of a strategic vision and plan for e-commerce as well as the lack of alignment of e-commerce plans with corporate plans. The importance of strategic vision and plan as well as business-IT alignment have been emphasized in past literature (e.g., [127]). Basically, the vision and plan provide focus to e-commerce initiatives while alignment helps to ensure that e-commerce initiatives support business goals.

The seventh dimension (F7) includes items relating to "Lack of IT Expertise and Infrastructure." Teo and Ang [126] found that the lack of IT expertise is one of the major problems encountered in IS planning. Without such expertise, it is difficult for the firm to embark on e-commerce initiatives. In a similar vein, Weill and Vitale [134] emphasized the importance of adequate IT infrastructure (applications, databases, telecommunications, etc.) in order to deploy IT and e-business effectively.

The eighth dimension (F8) relates to "Fear and Uncertainty" regarding e-commerce initiatives. Since e-commerce commonly spans organizational boundaries, there is fear of opening corporate systems to suppliers and customers. Further, there may be uncertainty about buy-in from business partners and customers. Without strong partnership, investments in e-commerce may become a "white elephant" where partners chose not to do business with the firm or chose to do business in the traditional way.

The ninth dimension (F9) is called "Lack of Interoperability" as it comprises items that capture the difficulties in integrating e-commerce applications with the firm's existing systems as well as with the systems of business partners. Without interoperability of systems, the full benefits of e-commerce in terms of enhancing efficiency and reducing cost are difficult to achieve. In fact, the lack of IT integration has been cited as the chief

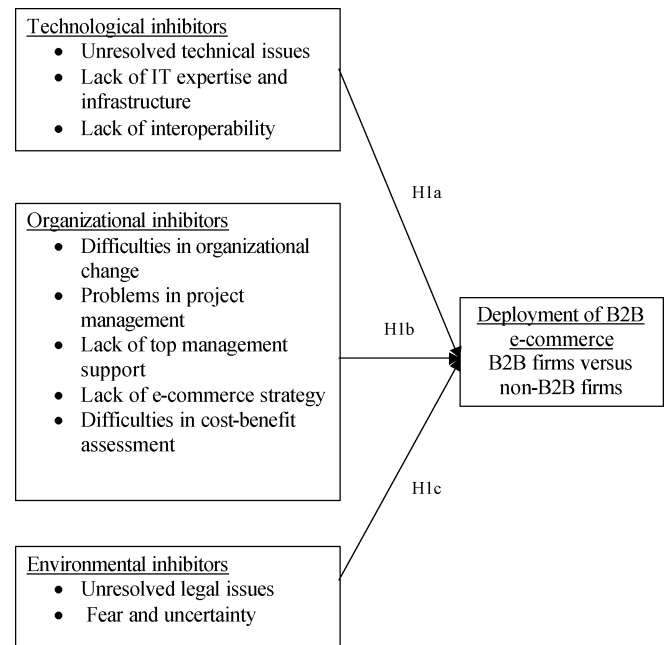


Fig. 2. Research model.

reason why many B2B projects fail to deliver the benefits users expect [91].

The last dimension (F10) relates to the "Difficulties of Cost-Benefit Assessment" of e-commerce initiatives. Researchers have frequently debated the productivity paradox where investments in IT do not seem to impact the firm's bottom-line (e.g., [19], [20], and [121]). Given that e-commerce via the Internet is relatively new and that it normally transcends organizational boundaries, problems in assessing its benefits arise especially when most firms are interested in "hard" data such as revenue growth or profitability rather than "soft" data such as impact on customer satisfaction. Further, Meehan [91] reported that an inability to measure the performance of B2B applications designed to connect multiple trading partners is a big factor in the low success rate of B2B efforts.

In summary, factor analysis helped us aggregate the 46 inhibitors and combine them into 10 dimensions. We mapped these ten dimensions derived from data analysis to the three broad categories of inhibitors outlined (Fig. 2).

#### D. Intercorrelations

The correlation matrix of the various dimensions is shown in Table V. The table shows that the various dimensions are correlated with each other. This is not surprising since the dimensions pertain to the various inhibitors for e-commerce deployment. Note that the problem of multicollinearity becomes serious when correlations among variables exceed 0.80 [56]. Since none of the correlations are above 0.80, multicollinearity is not a problem.

In order to compare differences in perceptions between B2B and non-B2B firms, both independent sample t-test and discriminant analysis were carried out. The independent sample t-test enables us to test H1 (a, b and c) by comparing the severity of

TABLE V  
CORRELATION MATRIX

	OCHG	PMGT	EENV	LEGL	TMGT	STRG	EINF	FEUC	IOPE	CBA
OCHG	1.000									
PMGT	0.244***	1.000								
EENV	0.093	0.336***	1.000							
LEGL	0.111	0.241***	0.242***	1.000						
TMGT	0.456***	0.312***	0.302***	0.163*	1.000					
STRG	0.427***	0.345***	0.275***	0.102	0.625***	1.000				
EINF	0.391***	0.371***	0.404***	0.082	0.377***	0.401***	1.000			
FEUC	0.441***	-0.019	-0.023	0.116	0.136*	0.151*	0.167**	1.000		
IOPE	0.472***	0.186**	0.207**	-0.001	0.240***	0.221***	0.425***	0.412***	1.000	
CBA	0.164**	0.191**	0.058	0.003	0.283***	0.387***	0.157*	0.144**	0.196**	1.000

\* p<0.05, \*\*p<0.01, \*\*\*p<0.001

OCHG=Difficulties in Organizational Change, PMGT=Problems in Project Management, EENV=Unresolved Technical Issues, LEGL=Unresolved Legal Issues, TMGT=Lack of Top Management Support, STRG=Lack of E-Commerce Strategy, EINF=Lack of IT Expertise and Infrastructure, FEUC=Fear and Uncertainty, IOPE=Lack of Interoperability, CBA=Difficulties in Cost-Benefit Assessment

TABLE VI  
INDEPENDENT SAMPLES t-TEST

Dimensions	B2B firms	Non-B2B firms	t-test
	Mean (SD)	Mean (SD)	
<b>Technological Context</b>			
Lack of Interoperability	4.20 (1.33)	4.52 (1.15)	-1.70
Lack of IT Expertise and Infrastructure	3.29 (1.18)	3.66 (1.20)	-2.19*
Unresolved Technical Issues	2.90 (1.23)	3.56 (1.35)	-3.61***
<b>Organizational Context</b>			
Difficulties in Organizational Change	4.18 (1.09)	4.24 (1.07)	-0.37
Problems in Project Management	3.73 (1.10)	4.08 (0.93)	-2.51*
Difficulties in Cost-Benefit Assessment	3.52 (1.41)	4.19 (1.50)	-3.21**
Lack of E-Commerce Strategy	3.47 (1.54)	4.21 (1.59)	-3.31**
Lack of Top Management Support	2.92 (1.34)	4.66 (1.52)	-8.61***
<b>Environmental Context</b>			
Unresolved Legal Issues	2.63 (1.09)	2.89 (1.22)	-1.57
Fear and Uncertainty	3.71 (1.15)	3.80 (0.91)	-0.57

\* p<0.05, \*\* p<0.01, \*\*\*p<0.001

each inhibiting factor between B2B firms and non-B2B firms. In contrast, the discriminant analysis (used to test H2) is a multivariate technique that enables us to assess which inhibitors are more important to B2B firms compared to non-B2B firms and vice versa, taking into account all the factors as a whole.

### E. Independent Samples t-Test

Table VI shows the independent sample t-test between B2B and non-B2B groups. For each context, the factors are ranked from highest to lowest scores in the column for B2B firms. Since respondents were asked to rate the inhibitors on a 7-point scale from (1) not a problem to (7) extreme problem, the mean scores indicate that all dimensions are inhibitors to some extent. In general, the mean scores for non-B2B firms are higher than B2B firms, thereby indicating that non-B2B firms anticipate more problems in trying to deploy Web-based B2B e-commerce. Specifically, two out of three constructs comprising technological context, and four out of five constructs comprising organizational context were significant, thereby providing general support for H1a and H1b. However, there were no significant differences for the two constructs comprising the environmental context. Hence, H1c was not supported. Further, these results indicate that technological and organizational factors pose more inhibiting effects than environmental ones. This is consistent with Teo, Tan and Buk's [128] study which found that organizational and technological factors, rather than environmental factors, play a significant role in facilitating Internet adoption. As indicated by the low mean scores, both B2B firms as well as non-B2B firms do not seem to perceive "Unresolved Legal

Issues" to be a major inhibitor to B2B e-commerce. Though considerable "Fear and Uncertainty" about customers, business partners and suppliers exists, these concerns are shared by both B2B and non-B2B firms. The perceived severity of uncertainty from business partners does not seem to significantly differ between the two groups.

For B2B firms, there are only two factors with mean values that were greater than 4.0, namely, "Lack of Interoperability" and "Difficulties in Organizational Change." Though B2B firms have managed to engage in B2B projects, they seem to be grappling with integration problems and change management. These concerns seem to be shared by non-B2B firms as well. The mean scores of non-B2B firms for "Lack of Interoperability" and "Difficulties in Organizational Change" are higher than those of B2B firms, though there is no significant difference between the two groups on the mean scores. For non-B2B firms, in addition to the two factors, other important factors (mean > 4.0) include "Lack of Top Management Support," "Lack of E-Commerce Strategy," "Difficulties of Cost-Benefit Assessment," and "Problems in Project Management."

Interestingly, the top most factor inhibiting e-commerce deployment in non-B2B firms is related to the lack of top management support (mean = 4.66) for e-commerce. In contrast, B2B firms do not face this problem as indicated by the relatively low score. Two closely related problems in non-B2B firms concern the lack of e-commerce strategy (mean = 4.21) and having difficulties in justifying B2B e-commerce investments (mean = 4.19). An unenthusiastic top management might result in poor vision or a complete lack of strategy for B2B e-com-

TABLE VII  
DISCRIMINANT ANALYSIS

Key dimensions	Structure correlations
<u>Technological Context</u>	
Unresolved Technical Issues	0.34
Lack of IT Expertise and Infrastructure	0.21
Lack of Interoperability	0.16
<u>Organizational Context</u>	
Difficulties in Organizational Change	0.04
Problems in Project Management	0.22
Lack of Top Management Support	0.82
Lack of E-Commerce Strategy	0.32
Difficulties in Cost-Benefit Assessment	0.31
<u>Environmental Context</u>	
Unresolved Legal Issues	0.15
Fear and Uncertainty	0.01
Eigenvalue	0.45
Canonical correlation	0.56
Wilks' lambda	0.69
Chi-square	89.4
Significance	0.000
Percentage (%) classified correctly	
B2B firms	77.3
Non-B2B firms	71.9
Total	75.9

\*  $p < 0.05$ 

merce. Without a formal e-commerce strategy, cost-benefit analysis for B2B e-commerce deployment is difficult as there are no clear goals to be achieved or strategy to be implemented. Further, problems with interoperability in terms of linking B2B systems with existing systems (mean = 4.52) and the lack of support for various organizational changes required for e-commerce deployment (mean = 4.24) are also important problems in non-B2B firms. Changes in organization structure, culture and integration of systems are essential if the firm intends to reap maximum benefits from Web-based B2B e-commerce. In addition, various drawbacks related to project management such as the lack of methodology and training also act as important inhibitors for non-B2B firms. Without skilled staff and proper methodology, the e-commerce initiative is less likely to take off.

The results of the t-test show that the scores for non-B2B firms in terms of the Lack of Top Management Support, Unresolved Technical Issues, Lack of E-commerce Strategy, Difficulties in Cost-benefit Assessment, Problems in Project Management, and Lack of IT Expertise and Infrastructure are significantly higher than that for B2B firms. It is apparent that in addition to the factors discussed above, the lack of external standards for security, payment, etc. coupled with the internal lack of IT expertise and flexible infrastructure make it difficult for non-B2B firms to deploy B2B e-commerce.

In summary, a key problem for non-B2B firms seems related to the lack of direction and involvement from top management. One possibility is that top management in non-B2B firms might not be entirely convinced that they have the resources to deploy B2B e-commerce. For example, two of the problems listed are "Unresolved Technical Issues" and "Lack of IT Expertise and Infrastructure." Curiously, the difference between B2B and

non-B2B firms with regard to the "Lack of IT Expertise and Infrastructure" is relatively small (albeit significant) when compared to the difference with regard to "Unresolved Technical Issues." One potential explanation is that IT Executives might overestimate the capabilities their firms have to deal with the technology; however, when confronted with unresolved technical problems, which require a set of skills and technologies not possessed by the firm, the inadequacy of the firm to deal with B2B implementation becomes more evident. So, it is possible that top management is being prudent in not allowing an under-qualified IT department without a good grasp of security issues, payment schemes, and overall infrastructure outside the firm, to pursue an option that might be destined to failure.

#### F. Discriminant Analysis

Discriminant analysis was carried out to identify key inhibitors differentiating between B2B and non-B2B firms. It is a logical and efficient way to examine which factors have higher discriminating power in the presence of other factors. It also helps us prioritize the inhibiting factors in terms of their severity. Table VII shows the structure correlations (or discriminant loadings) rather than standardized discriminant coefficients since they are usually considered more valid in determining the power of each discriminant variable [77]. The significance of the discriminant function in differentiating between the two groups is measured by Wilks' lambda and chi-square statistics. Both these measures test the hypothesis that there is no difference in the group means of the population.

In order to estimate the effectiveness of the discriminant function as a predicted model, we need to examine its classification accuracy. Table VII shows that the total classification accuracy

is 75.9%. The chance accuracy can be computed by the formula  $p^2 + (1 - p)^2$ , where  $p$  is the proportion of the sample in the first group. In our case,  $p = 0.74$  giving a chance accuracy of 61.5% which is less than our discriminant model. Consistent with Premkumar and Ramamurthy's [104] work, we can test whether the classification ability of our model is better than the chance model by computing the t-statistic as follows:

$$t = \frac{(p - k)}{\left(\text{sqrt}\left(\frac{k(1-k)}{n}\right)\right)}$$

where

- $p$  proportion correctly classified;
- $k$  chance accuracy;
- $n$  sample size;

The t-value of 32.4 was found to be significant at  $p < 0.05$ , thereby indicating that the classification ability of our model is significantly better than the chance model. Hence, the results of discriminant analysis support H2 that the key inhibitors for B2B firms and non-B2B firms are different.

In interpreting the discriminant analysis results, the general guideline is that values of structural correlations above 0.30 are satisfactory and acceptable [82]. Four variables: Unresolved Technical Issues, Lack of Top Management Support, Lack of E-Commerce Strategy, and Difficulties in Cost-Benefit Assessment are above the cutoff values. Note that these four factors were also significant for the univariate t-tests carried out as reported earlier. The order of importance of the four factors (Lack of Top Management Support, Unresolved Technical Issues, Lack of E-commerce Strategy, Difficulties in Cost-benefit Assessment) is also consistent with the results for the univariate t-test.

*Industry and Size Effects:* On the advice of a reviewer, we examined industry and size effects on the severity of inhibitors. Previous studies on IOS, EDI and e-commerce have noted significant effects of industry and firm size on systems adoption, assimilation and usage [66], [105], [138]. To assess industry and firm size effects, we examined if the severity of inhibitors differed across industries and across large and small firms. We used analysis of variance (ANOVA) to compare the four main industries in our sample, namely: manufacturing, finance, business services and retail. ANOVA was followed by pair-wise comparisons based on Tukey tests which show that the manufacturing industry has greater severity of inhibitors than the finance industry in terms of "Lack of E-Commerce Strategy" ( $F = 2.83$ ,  $p < 0.05$ ). Further, the manufacturing industry also has higher inhibitor scores than the retail industry in terms of "Difficulties in Cost-Benefit Assessment" ( $F = 4.21$ ,  $p < 0.01$ ). In contrast, the business services industry has higher inhibiting scores than the finance industry in terms of the "Lack of Top Management Support" ( $F = 3.84$ ,  $p < 0.05$ ). Overall, our results suggest that there are some variations in inhibitors among different industries, with manufacturing firms facing higher levels of inhibitors as compared to other firms. However, note that only three of the pair-wise comparisons for four industries (out of a

total of 60 possible comparisons) were statistically significant ( $p < 0.05$ ).

We also compared small firms (revenue  $< 10$  m) and large firms (revenue  $> 100$  m) on all the inhibitors using t-test. The rationale is to compare the two extremes of firm size as commonly done in previous research (e.g., [7] and [132]). We found only two significant inhibitors, namely "Difficulties in Organizational Change" ( $t = 2.06$ ,  $p < 0.05$ ) and "Unresolved Legal Issues" ( $t = 2.20$ ,  $p < 0.05$ ). Large firms face greater problems with organizational change than small firms. This is perhaps expected as large firms often find it more difficult to implement change efforts due to the large scale of operations and their increased organizational complexity. Further, due to their scale of operations which may be regional or global, large firms are also more concerned about various legal issues pertaining to e-commerce compared to small firms.

## V. DISCUSSION

Our results indicate that organizational and technological inhibitors are more severe than environmental inhibitors in inhibiting the deployment of B2B e-commerce. Overall, the results support H1a, H1b, and H2, but not H1c. Our analysis also helps understand the top inhibitors in B2B firms as well as in non-B2B firms. It appears that a key reason why non-B2B firms do not deploy Web-based B2B e-commerce applications is the lack of top management support, and their lack of understanding of potential benefits and drawbacks relating to B2B e-commerce. Top management support implies active participation, championship and involvement in e-commerce efforts. Some of the ways in which this is done includes providing leadership, sitting on the steering committee, and spending time with those who are actively involved in the planning process for e-commerce initiatives. However, all too often such participation is delegated to those who are not in a position to make crucial decisions involving resource allocation. Either top management does not appreciate the impact that e-commerce applications have on the outcome of the company's total performance, or it does not deem it sufficiently important enough to warrant direct executive involvement. If active top management involvement is lacking, a less than enthusiastic atmosphere is likely to permeate the working environment of the e-commerce planning team. Our discussion of this finding with senior IT executives suggests that the over-exuberance about the potential impact of e-commerce during the "dot-com" days, led the top management of many firms to be wary about the credibility of B2B e-commerce initiatives. Perceiving these to be risky projects, many of them may not have provided full support to the B2B projects.

It is probable that this problem occurs because top management has not been adequately briefed regarding the scope of the B2B e-commerce initiatives, the resources involved, and the importance that B2B e-commerce has on the total bottom-line performance of the firm. Some CIOs often term this the "training-upwards" requirement, in the sense that it is critical for IT managers to ensure that the top management team of their organization is trained adequately about new technologies before it is tasked with making strategic decisions pertaining to investing in these technologies. Thus, top management needs to have a clear

understanding of the potential benefits and drawbacks relating to e-commerce. If top management understanding is lacking, then an essential task is to ensure that top management knows first-hand the scope and nature of proposed e-commerce initiatives. Senior IS executives should brief top management on how the proposed e-commerce efforts support business goals and are in alignment with the business plan. All too often, senior IS executives fail to win top management support because their technical jargon is not understood by top management. A key implication of the results is that IS executives should bear in mind that top management is not interested in the technical problems relating to e-commerce systems, but rather in knowing how cost-benefit can be justified and how e-commerce can help enhance the company's competitive position and improve the bottom-line at the strategic level.

The second important inhibitor discriminating between B2B and non-B2B firms focuses on unresolved technical issues. As e-commerce typically involves interorganizational and cross-border data flows, there are a multitude of complex unresolved problems as different organizations and countries have adopted different technical systems and practices. Important drawbacks that remain unresolved include encryption, authentication, payment systems, and data and system security. Our discussion of the results with senior IT managers suggests that the multitude of solutions available to resolve technical problems often confuses potential B2B firms as they are aware of plausible exaggerations by IT vendors marketing these systems. Further, news reports of hackers breaking into Web-based systems serve to discourage firms from deploying e-commerce. Other problems such as the lack of a robust and stable infrastructure for e-commerce that can assure protection and cope with denial-of-service attacks also serve to discourage firms from deploying otherwise critical e-commerce applications. Hence, some firms may be adopting a wait-and-see attitude, hoping that such problems will be resolved before they are willing to commit resources to B2B e-commerce.

The lack of a clear e-commerce strategy and vision is the third important inhibitor discriminating between B2B and non-B2B firms. Amongst non-B2B firms, this could arise from a lack of understanding of the potential impact of e-commerce on the firm and the industry. For example, several IT executives in large corporations have suggested that the old methods of strategy formulation and technology visioning, which are borrowed from other areas, do not work well in relation to e-commerce business model visioning and strategy [1]. It may be possible that B2B firms may be more adept at this than non-B2B firms. A key solution is to educate top management on how e-commerce is affecting various related firms and industries and how e-commerce business models can be leveraged to streamline business operations. Another possible solution is to bring in knowledgeable and competent external consultants who are able to assist with the e-commerce strategy and visioning. In a study focusing on the reasons why many IT departments in large organizations fared poorly in deploying e-commerce, Dhaliwal [38] suggested that senior IT executives need to cultivate intrapreneurship within the IT unit so that the unit maintains a proactive stance vis-à-vis new technology visioning and strategy formulation.

Without a clear e-commerce strategy, it is also difficult to align e-commerce plans with business plans. This in turn makes it difficult to secure the necessary resources for e-commerce initiatives. Another possible reason for the lack of alignment of e-commerce plans with business plans may be the unavailability of business goals and strategies to e-commerce planners. Top management may view business goals and strategies as being highly confidential, and if they do not view e-commerce as important, they may not make business plans available to e-commerce planners. The solution is to educate business management on the potential of e-commerce as well as to build up the credibility of the e-commerce team. It is only when business management is convinced of the ability of e-commerce to contribute positively to the achievement of business goals that partnership between business and e-commerce planners can effectively take place.

The difficulty of cost-benefit assessment for e-commerce efforts is the fourth significant factor discriminating between B2B and non-B2B firms. This result is consistent with Chau and Hui's [27] findings that perceived direct benefits and perceived costs are positively and negatively associated with EDI adoption respectively. Interestingly, they found that perceived indirect benefits do not significantly affect the likelihood of EDI adoption. Extended to the case of B2B e-commerce, this suggests that top management is interested in direct rather than indirect benefits from e-commerce investments. It may also be the case that given the interorganizational nature of B2B e-commerce, it may be much more difficult to estimate the potential costs and benefits of e-commerce. It may be important for organizations taking on such initiatives to ensure that they have the requisite supply chain estimation skills in place before starting on B2B projects.

Hence, despite the literature on the positive impact of e-commerce on organizational competitiveness [49], [83] and its value to customers [74], many chief executive officers still question the business value of e-commerce investments. One way to resolve the problem of assessment of the impact of e-commerce is to forge consensus on the criteria used to assess each e-commerce application. Each of these criteria can then be given different weights depending on their importance. By demonstrating that e-commerce can have diverse benefits and keeping top management informed about success stories of e-commerce deployment and impact, it becomes easier to obtain support and involvement of top management in e-commerce initiatives.

## VI. LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

There are several limitations of this study. First, the data gathered is cross-sectional which makes it difficult to imply causality among research constructs. Future research can use longitudinal techniques coupled with interviews. Second, we did not have a holdout sample to confirm the discriminant model. This might make the discriminant analysis results more tentative. However, since the discriminant analysis results are consistent with the univariate t-test, this problem may not be serious. Third, our study focussed on traditional brick-and-mortar firms and the inhibitors they face in deploying B2B systems. We did not focus on Internet-firms such as B2B

hubs, portals and exchanges and other pureplay B2B firms that might have an entirely different set of inhibitors. This offers a fruitful area for extending our research in the future. Fourth, as our study focuses on inhibitors, we did not assess the relative success and profitability of B2B e-commerce. Future research can compare inhibitors among firms with different levels of profitability and different degrees of B2B applications. Conceivably, firms that are doing well and/or with different degrees of B2B applications may view inhibitors differently from other firms. Future research could also examine inhibitors in Internet firms. Fifth, we did not distinguish between B2B for sales and procurement, but adopted a generic definition for B2B as we wanted to examine inhibitors related to B2B rather than specific to sales and/or procurement. Future research can examine inhibitors specific to such demand and supply chain management applications as this delineation of categories could affect the reasons for deploying B2B applications.

There are several other directions for future research that can be identified. First, it would be interesting to examine whether the underlying dimensions of inhibitors differ at different stages of e-commerce deployment. Second, while the emphasis of this study is on inhibitors, future research can also examine facilitators for the deployment of B2B e-commerce. Of particular interest would be hygiene factors, i.e., factors whose presence may not facilitate, but whose absence would seriously inhibit e-commerce efforts. In other words, the presence of some factors may be necessary, but insufficient for e-commerce deployment. Third, researchers may want to extend our study to other related areas of e-commerce to examine if the key dimensions of inhibitors are equally applicable to other e-commerce applications such as CRM. It is possible that different types of inhibitors may affect different types of systems to varying extents.

The results of the study also suggest that researchers need to continue focusing on developing robust managerial methods for assisting organizations in developing an e-commerce strategy and on the development of methods for supporting e-commerce cost-benefit analysis, given that these are key inhibitors. These areas should remain at the forefront of e-commerce research in the future.

## VII. CONCLUSION AND IMPLICATIONS

Our study contributes to the emerging body of literature on e-commerce in general, and to B2B e-commerce in particular by examining an extensive set of inhibitors (problems) in the deployment of B2B e-commerce. Previous research commonly focuses more on facilitators (or success factors) rather than inhibitors (e.g., Gregorio, Kassicieh, and De Gouvea [50] examined drivers for e-business activity). Our study represents an initial step towards understanding the inhibitors to the deployment of Web-based B2B applications in organizations. A study of inhibitors is important as their effects might be different from the facilitators of an innovation. For example, King and Teo [76] found that the presence or absence of a factor may have different effects in facilitating or inhibiting the strategic use of IT. In addition, Cenfetelli and Benbasat [23] suggested that failure to examine inhibitors may result in the omission of important factors that drive customers away from an online business channel.

Further, our research focuses on a current and important phenomenon of B2B e-commerce, and draws extensively from prior interorganizational and IT implementation literature to identify a large set of inhibitors using a generalized survey approach. Previous studies commonly use a small set of factors as inhibitors. As well, instead of focusing only on B2B firms (e.g., [104]), the study focused on both B2B and non-B2B firms.

The results also show that differences in the relative importance of key dimensions of inhibitors exist between B2B and non-B2B firms. An understanding of these differences can help to explain why some firms deploy Web-based B2B e-commerce while others do not. Such understanding is useful for both researchers and practitioners in identifying potentially important dimensions that may inhibit the deployment of e-commerce. Hence, executives in non-B2B firms interested in championing the use of the Web for B2B activities could pay more attention to resolving the four key dimensions of inhibitors found in this study. Further, the results also indicate that in general, the lack of appropriate organizational and technological contexts is more important than the lack of appropriate environmental context in inhibiting B2B e-commerce deployment.

In conclusion, the results suggest that senior IT and engineering management executives at firms wishing to deploy Web-based B2B e-commerce need to focus on gaining top management support and involvement for their initiatives. Without top management leadership and involvement in e-commerce efforts, it becomes difficult to leverage e-commerce especially when resources necessary for such initiatives are not forthcoming. Having an e-commerce vision and strategy is also critical to ensuring that e-commerce plans are aligned with business plans. It is only when vision and strategy are clear, then the linkage between impact of e-commerce and business goals can be better assessed. This linkage will consequently lead to more effective cost-benefit assessment for e-commerce efforts, thereby making it easier to justify e-commerce investments. In addition to these factors, other factors may also affect B2B e-commerce deployment. Policy makers should strive to create an environment conducive for e-commerce by agreeing on appropriate standards for security, encryption, authentication and payment systems. Without these, it will be difficult for firms, business partners and customers to use the system and have confidence in e-commerce.

The study also has implications for the vendors of B2B e-commerce solutions. It is important for them to ensure that their marketing efforts and materials are geared towards both senior IT/engineering management executives as well as top management. They also need to contextualize their products and solutions within the context of coherent organizational e-commerce strategies. To ensure that their products and services are associated with high rates of deployment over time, they must support their potential clients in efforts at putting in place viable e-commerce strategies before deployment is initiated. They may also want to provide senior IT/engineering management and business executives of their potential clients with clear information about the costs and benefits associated with their products and solutions as well as knowledge about industry best practices pertaining to e-commerce cost-benefit estimation.

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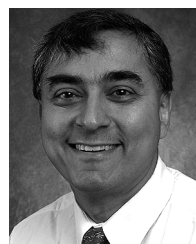


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