

Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology

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ble. To investigate this issue, three major factors are identified that influence the EDI adoption practices of small firms. These factors are: organizational readiness (because of the low levels of IT sophistication and resource availability of small firms), external pressures to adopt (because of the weak market positions of small firms and the network nature of the technology), and perceived benefits (because of the limited impact that IT has on small firms due to under-utilization and lack of integration). By combining the anticipated effects of these factors, we developed a framework of EDI adoption by small businesses. The applicability of this framework is empirically demonstrated using the results of seven case studies. Finally, recommendations are made for the development of successful EDI partner expansion plans. These include the development of a long-term EDI partner expansion plan from the very beginning, the individual assessment of each partner's EDI preparedness level, and the selection of appropriate influence tactics to expedite adoption by small partners. Specifically, it is suggested that EDI initiators pursue promotional efforts to improve partners' perceptions of EDI benefits, provide financial and technological assistance to partners with low organizational readiness, and carefully select and enact influence strategies to reduce resistance.

Keywords: Electronic data interchange, interorganizational systems, small business, electronic commerce

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Abstract

Many EDI researchers and practitioners have recognized the importance of high penetration levels for the success of EDI. Unfortunately, such penetration is partly impeded by the resistance of small companies to become EDI capa-

Electronic Data Interchange (EDI) can only be of full benefit to systems initiators and adopters through widespread adoption of the technology. Widespread adoption is required to (1) transact with a substantial EDI network of business partners, and (2) eliminate the costs for maintaining parallel, non-EDI systems that are used in transacting with non-EDI-capable partners. As

Introduction

a critical mass of firms become EDI-capable, the costs of trade transactions will decrease for EDI users, who will be able to more efficiently process the majority, if not all, of their purchases, sales, and payments via EDI (Bouchard, 1993; Lytle, 1988; McCusker, 1993).

One major impediment to this level of adoption is the inability of EDI initiators to motivate their business partners to adopt the technology. This is especially true for small enterprises that are reluctant to join the EDI community (Ahlin, 1991; Banerjee and Golhar, 1994; Smith, 1990). The lack of EDI capability of small organizations is critical because of the important role they play in the economy.¹ To address this issue, many large organizations, industry associations, and governmental units have recently launched EDI partner expansion plans. However, many practitioners have argued that "expanding trading partners seems more difficult than implementing EDI in the first place" (Stelzer, 1993, p. 43). Because of the importance of high adoption levels, this reluctance of smaller partners to become EDI-capable deserves serious attention.

Thus, this article addresses two issues: (1) What are the major factors that influence the adoption and impact of EDI in the small business context, and (2) how can EDI systems initiators assist in expediting the adoption process of their small partners?

To examine these issues, we reviewed past conceptual and empirical research on EDI adoption and impact, formulated a small business-focused EDI-adoption framework, and tested its validity with seven case studies. A summary of the literature review, a description of the model of EDI adoption by small businesses, an overview of our research methodology, a summary of the empirical findings, a list of recommendations to EDI initiators, and a description of suggestions for future research comprise this article.

Literature Review

Electronic data interchange

EDIs are co-operative interorganizational systems (IOS) that allow trading partners to

exchange structured business information electronically between separate computer applications (Swatman and Swatman, 1992). IOSs are telecommunication-based computer systems that are used by two or more organizations to support the sharing of data, and sometimes applications, among users in different organizations (Barrett and Konsynski, 1982; Cash, 1985). For an IOS to be classified as EDI, it must possess four essential features (Pfeiffer, 1992):

1. It must have *at least two organizations* in a business relationship as users;
2. Data processing tasks pertaining to a transaction at both (all) organizations must be supported by *independent application systems*; (This property is unique to EDI; other IOSs are based on a single application system that is used by multiple users.)
3. The integrity of the data exchange between application systems of trading partners must be guaranteed by *agreements concerning data coding and formatting rules*; and
4. Data exchange between the application systems must be accomplished via *telecommunication links*.

EDI adoption

Most of the past EDI studies have used the diffusion of innovations theory (Rogers, 1983) to identify attributes of the innovation (the EDI systems) that influence its adoption. Among the most commonly investigated EDI characteristics that promote the adoption of the technology are: *relative advantage* (i.e., perceived EDI benefits and impact), *compatibility* (both technical and organizational), and *trialability* (e.g., pilot tests, prototypes, etc.).² Perceived relative advantage of EDI is the only variable that has been consistently identified as one of the most critical adoption factors and as the most important factor for information technology (IT) growth in small firms (Cragg and King, 1993). Therefore, **perceived EDI benefits** were included in our framework as one of the main explanatory factors for EDI adoption.

Several factors that inhibit EDI adoptions were also identified. Among these are the cost and complexity of the technology, the need to change internal systems, a lack of technological skills, and a lack of system integration (Pfeiffer, 1992; Saunders and Clark, 1992). We expect these inhibitors to play a big role in the context of small organizations, where resources and computer sophistication are limited (Swatman and Swatman, 1991). Indeed, empirical findings suggest that economic costs and lack of technical knowledge are two of the most important factors that hinder IT growth in small organizations (Cragg and King, 1993). Therefore, **EDI organizational readiness**, defined as the availability of the needed organizational resources for adoption, is another factor in this study.

Clearly, many factors influence the adoption of EDI.³ But, since these factors have generally been identified through studies of large organizations, their applicability to small business is questionable. Smaller organizations have been shown to have different technology adoption patterns than large ones.⁴ Furthermore, most of the previous studies failed to recognize that EDI is a network interorganizational system in which interdependencies, power of the EDI initiator, and trust toward the partners become critical issues.⁵

Pressure from trading partners who are EDI initiators plays a critical role in EDI adoption by small firms (Hart and Saunders, 1994; Swatman and Swatman, 1991; Webster, 1994). Research suggests that a firm's decision to adopt EDI "is primarily based on what [its] business partners are doing and not on the characteristics of EDI" (Bouchard, 1993, p. 366). Indeed, more than 70 percent of the respondents in recent surveys identified customer pressure/mandate as one of the primary reasons for adopting EDI.⁶ Hence, external pressure to adopt EDI is an additional factor in our framework.

A Model of EDI Adoption by Small Businesses

Based on a review of the literature on EDI adoption and small business IT, three factors — (1) perceived benefits of EDI, (2) organizational readiness, and (3) external pressure — were identified as the main reasons that could explain the EDI adoption behavior of small firms and the expected impact of the technology. The relationships of these factors with the process of EDI adoption and integration, and impact are shown in Figure 1.

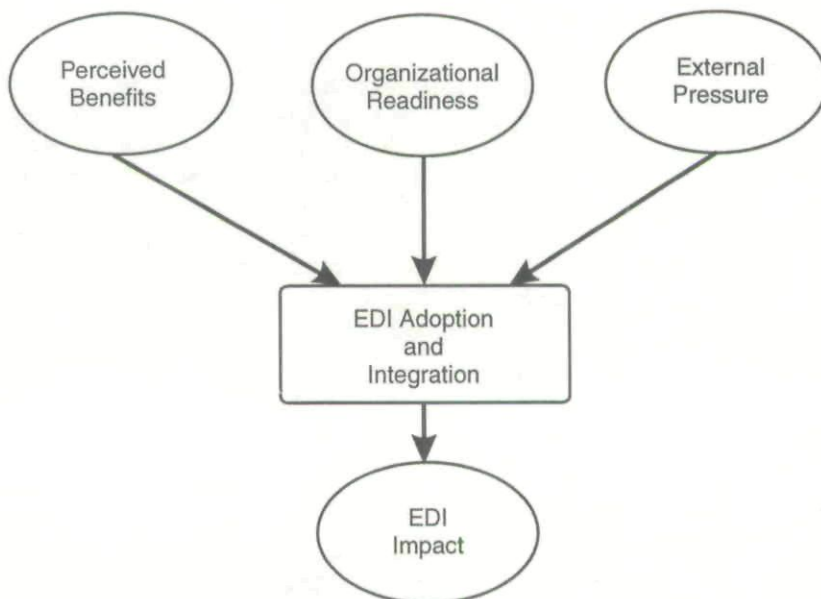


Figure 1. Proposed Small Business EDI Adoption Model

EDI adoption and integration

EDI adoption is the process during which a firm becomes capable of transacting via EDI, usually through a front-end, PC-based EDI server. This is the first step of EDI integration. Although adoption and integration can be undertaken at the same time, EDI integration is the process during which a firm alters its business practices and applications so that they interface with its EDI applications. For the purposes of this study, integration is considered bi-dimensional. *Internal integration* refers to the variety of applications interconnected through EDI, such as order-entry, invoicing, billing, and payment transfer, and *external integration* refers to the number of trading partners, such as suppliers, customers, governmental units, and financial institutions with which the firm can transact business through EDI (Bergeron and Raymond, 1992).

EDI impact

Impact refers to the *actual* benefits adopters receive from utilizing EDI. To estimate the expected impact of the technology, the level of system integration is used as a surrogate measure. We assume that the integration level of EDI is positively related to the benefits an adopter can receive given its EDI capability (Benbasat, et al., 1993; Bergeron and Raymond, 1992; Bouchard, 1993). Usually, non-integrated EDI systems will offer adopters direct benefits only, such as reduced transaction costs and higher information quality. Integrated systems, on the other hand, will offer both high direct benefits and the ability to take advantage of indirect benefits, such as increased operational efficiency, better customer service, and improved interfirm relationships. This more complete integration, which requires interorganizational design and policies, is essential to achieve the performance improvements and full beneficial impact of EDI (Clark and Stoddard, 1994).

Perceived EDI benefits

Many practitioners and researchers have attempted to identify the potential advantages that EDI technology has to offer.⁷ These can be grouped into two categories (Pfeiffer, 1992), roughly equivalent to the two levels of integration noted above. The first group is *direct benefits*. These are mostly operational savings related to the internal efficiency of the organization. The second group is *indirect benefits or opportunities*, which refer to the impact of EDI on the business processes and relationships. These are mostly tactical and competitive advantages. A list of the two types of benefits is presented in Table 1.

Although direct benefits can include large financial savings, much of the attention on EDI has focused on its impact on business operations. EDI offers several opportunities that can turn into organizational advantages if they are combined with an appropriate business strategy and reengineering of business processes (Clark and Stoddard, 1994; Swatman, et al., 1993). This means that EDI is ideally best integrated with the core business of the organization, since higher levels of integration lead to higher expected benefits.

Perceived EDI benefits refer to the level of recognition of the relative advantage that EDI technology can provide the organization.⁸ Higher managerial understanding of the relative advantage of EDI (i.e., direct and indirect benefits) increases the likelihood of the allocation of the managerial, financial, and technological resources necessary to implement an integrated EDI system (Benbasat, et al., 1993). Therefore, we anticipate that *small firms with management that recognizes the benefits of EDI will be more likely to adopt EDI and enjoy higher impacts than those whose management has a lower level of recognition of the perceived benefits.*

Organizational readiness for EDI

Organizational readiness refers to the level of (1) financial and (2) technological resources of the firm. This factor was considered because small firms tend to lack the resources that are

Table 1. List of Benefits Accrued to EDI Users*

Benefits	Reasons
Direct Benefits:	
Reduced transaction costs	Elimination of paperwork; labor savings
Improved cash flow	Faster processing and exchange of information
Reduced inventory levels	Shorter order cycle; reduced ordering costs
Higher information quality	Increased timeliness, accuracy, and accessibility of information
Indirect Benefits (Opportunities):	
Increased operational efficiency	Improved internal operations due to time and cost reduction and better information management
Better customer service	Shorter lead times; more timely information about transaction status
Improved trading partner relationships	Enhanced trust through increased sharing of information; elimination of nuisance factors (e.g., errors in orders); increased ability to participate in Just-In-Time programs
Increased ability to compete	Increased ability to reach new markets; increased ability to provide better service at a lower cost

*Based on a list of benefits in Pfeiffer (1992).

necessary for EDI and other IT investments (Bouchard, 1993; Saunders and Clark, 1992). Furthermore, the relatively low computerization level of the operations of small firms makes the integration of sophisticated information systems (such as EDI) difficult, necessitating costly expenditures (i.e., capital, people, and technology). Because small organizations tend to lack such resources, their ability to receive all strategic benefits of the technology is usually limited.

Financial readiness refers to financial resources available for EDI to pay for installation costs, implementation of any subsequent enhancements, and ongoing expenses during usage (such as communication charges, usage fees, etc.). Although the cost of EDI adoption can be limited to a few hundred dollars (for EDI software running on a front end, independent personal computer), the cost of integration may run over \$10,000 (Bouchard, 1993). Because integration is necessary for successful EDI investments, one can easily see the importance of financial resources. Usually, small firms with

available financial resources will be better equipped to implement integrated EDI systems. Consequently, firms that can afford more costly, integrated EDI projects are more likely to enjoy higher benefits from the use of such systems.

The second dimension of organizational readiness—technological readiness—is concerned with the level of sophistication of IT usage and IT management in an organization. Sophisticated firms usually are less likely to feel intimidated by the technology, possess a superior corporate view of data as an integral part of overall information management, and have access to the required technological resources (i.e., hardware, expertise, and a competent project leader) (Pare and Raymond, 1991). We expect that these properties of sophisticated firms will expedite EDI adoption. Moreover, firms with highly integrated, computerized processes are better prepared to undertake integrated EDI projects, which increase the impact of the technology and provide greater benefits. In summary, we anticipate that *small*

firms with higher organizational readiness for EDI will be more likely to be adopters and more likely to enjoy higher benefits than firms with low levels of readiness.

External pressure to adopt EDI

External pressure to adopt refers to influences from the organizational environment. The two main sources of external pressure to adopt are (1) competitive pressure, and more importantly, (2) imposition by trading partners, such as when U.S. car manufacturers required their suppliers to use EDI in their transactions with them. Competitive pressure refers to the level of EDI capability of the firm's industry and, most importantly, to that of its competitors. As more competitors and trading partners become EDI-capable, small firms are more inclined to adopt EDI in order to maintain their own competitive position.

Imposition from trading partners is expected to be one of the most critical factors for EDI adoption by small firms; as the weaker partners in interorganizational relationships, small businesses are extremely susceptible to impositions by their larger partners (Saunders and Hart, 1993). Such impositions are especially prevalent in the case of EDI because of its network nature.

The pressure exercised by trading partners is a function of two factors: the potential power of the imposing partner and its chosen influence strategy (Provan, 1980). Not surprisingly, requests from powerful partners (e.g., ones that consume a large proportion of sales or generate a large portion of the small firm's profits) to become EDI-capable are expected to be more influential in the adoption decision of small firms than similar requests from less powerful partners.

A powerful partner may pursue three different strategies to induce a small partner to adopt EDI.⁹ In the first type of strategy—*recommendations*—large firms use information to alter their smaller trading partners' general perceptions of how their organizations might more effectively operate via the use of EDI. In con-

trast, the other two strategies require compliance from the smaller firms. *Promises* include all tactics that suggest that the larger firm will provide the smaller partner with a specified reward (such as discounts for EDI-transacted goods, subsidized adoption and usage, etc.) if it becomes EDI-capable. *Threats*, on the other hand, refer to actions that convey the larger firm's intentions to apply negative sanction (such as discontinuance of the partnership) should the smaller company fail to become EDI-capable. Such threats have been invoked by large automobile manufacturers and department store chains in recent years (Brent, 1994).

Because of the importance of external integration in EDI networks, one expects small organizations to be more vulnerable to competitive pressures and more likely to comply with demands of their trading partners than larger firms (Pfeffer and Salancik, 1978). Thus, we expect that *small firms that encounter pressure either by their partners or from the competition will adopt EDI more frequently than those that do not encounter such pressure.*

As outlined in Table 2, we expect perceived benefits and organizational readiness to influence both the adoption and integration (and thus impact) of EDI. External pressure, on the other hand, is expected to play a critical role in the adoption decision, but not in integration.

Research Methodology

To investigate the effects of the three main factors, an empirical study of seven companies was undertaken during the Summer of 1993.¹⁰

Sample

All seven organizations in our sample are suppliers to the British Columbia (BC) government, which is currently pursuing an EDI initiative. These companies were selected from a list of provincial government suppliers with less than

Table 2. Summary of Concepts, Variables, and Expected Relationships

Concept	Variables	Expected Effect
EDI Adoption EDI Integration EDI Impact Perceived Benefits	Capability to transact via EDI Internal integration External integration Actual direct and indirect benefits received Awareness of direct benefits Awareness of indirect benefits	Positively related to adoption, integration, and impact
Organizational Readiness	Financial resources Technological resources	Positively related to adoption, integration, and impact
External Pressure	Competitive pressure Imposition by partners	Positively related to adoption

200 employees; the list was provided by the BC Purchasing Commission (BCPC).¹¹ These BC government suppliers are currently the target of an EDI implementation plan as part of the BC Buy Smart project, a major initiative undertaken by the government in an attempt to streamline and computerize its purchasing function. The EDI project is currently in development and scheduled to become functional by 1996. Although an attempt was made to identify small companies that were EDI-capable and include them in the sample, only two of the seven were EDI-capable. This lack of small EDI-capable companies further supports the initial arguments about the reluctance of small firms to adopt EDI.

After the seven companies were identified as potential candidates, high-level managers (owners, vice presidents, or other top-level managers) were asked to participate in the study. All of them agreed to participate. A summary description of these companies is presented in Table 3.

Data collection

The main data collection method was face-to-face, structured interviews with managers of the small organizations. However, when necessary, telephone interviews with other executives in the

firms were conducted to supplement the information gathered during the personal interviews. Three firms also provided a copy of their financial statements. All interviews were tape recorded, and all sessions were transcribed before the data were analyzed. To enhance the validity of the answers, summaries of the major findings of each interview were verified by the participants after the end of each interview session. Furthermore, to ensure consistency and reliability, structured interview guides were used for all interviews. Two forms of the interview guide were developed—one for non-EDI-capable and one for EDI-capable firms.¹² The interview guides included several open format questions to allow the participants flexibility in their responses.

Empirical Findings

Categories of EDI adopters

The relative proportions of organizational readiness, external pressure, and perceived benefits in a firm influence different levels of EDI adoption and impact for the organization. Thus, we combined the anticipated effects of each factor to formulate a framework to serve as an EDI

Table 3. Description of the Organizations in the Sample

Firm	1	2	3	4	5	6	7
Industry	Business commun., video and print production	Office furniture sales; mostly contract sales	Processing and wholesale of fresh food and vegetables	Industrial cleaning and sanitizing chemicals manufacturing	Commercial printing	Recycling of industrial waste	Engineering/ manufact. of low technology products
Sales in 1992 (CDN\$ millions)	1.4	10	18.5	20	N/A	0.4	0.3
Employees	12	105	110	45	175	6	1 & 3 part-time
Environment							
Competitors	About 7; all small firms	Many; large and small firms	One large firm and few small ones	Very few large firms	Many large and small firms; both local and abroad	One large and two small firms	Very large firms
Customers	Large private and governmental corporations	4,000 customers; large and small firms	Large supermarket chains and small restaurants	Many; mostly large firms	200 customers; large and small firms; paper distributors;	350 customers	Few; very large corporations
Suppliers	Large equipment suppliers; talented artists	Few large firms; one supplies 60% of products	Few large multinational firms and many local producers	Large chemical distributors	Mostly large	Very few	Very few, large multinational corporations
EDI-Capable	No	Yes	No	Yes	No	No	No

adoption/impact typology for small businesses (see Table 4). We investigated the proposed model by classifying each of the organizations in our sample according to this framework (see Table 5). This section describes and illustrates each organizational type from Table 4 as it applies to the case study organizations. Then, a fuller discussion of the effects of the factors is offered.

Unprepared Adopters

Unprepared adopters are firms that are pressured into adopting EDI by their trading partners. Even though these firms are aware of the potential benefits of the technology, they do not possess the necessary financial resources and/or technical expertise to integrate the EDI

Table 4. Framework of EDI Adoption by Small Businesses

Organization		Perceived Benefits	Organizational Readiness	External Pressure	Expected Impact
1	Unprepared Adopter	High	Low	High	Low
2	Ready Adopter	High	High	High	High
3	Coerced Adopter	Low	Low	High	Low
4	Unmotivated Adopter	Low	High	High	Low
5	EDI Initiator	High	High	Low	High
6a	Non-Adopter	High	Low	Low	N/A
6b	Non-Adopter	Low	Low	Low	N/A
6c	Non-Adopter	Low	High	Low	N/A

Table 5. Summarized Case Descriptions

Firm	1	2	3	4	5	6	7
EDI-capable	No	Yes	No	Yes	No	No	No
Expected Integration Level*	Low	High	Low	High	Low	Low	Low
External Pressure	High	High	High	Low	High	High	High
Perceived Benefits	Low	High	Low	High	Low	Low	High
Organizational Readiness	High	High	Low	High	High	Low	Low
Dependency on BC Government	Low	Low	High	Low	Low	High	High
Willingness to Adopt BC Buy Smart	Low	High	High	High	Low	High	High

* The entry for firm 2 indicates the current integration level of its EDI applications; for the rest of the firms, it indicates expected levels.

system into their operations (i.e., they lack organizational readiness). In the case of adoption due to imposition by a trading partner, EDI may help to enhance the trading relationship, but it will not significantly improve the internal processes of the adopter firm because low readiness indicates a lack of needed resources to develop an integrated EDI system that would provide high benefits.

One organization in our sample (firm 7) is likely to become an unprepared adopter if it attempts to adopt EDI without any assistance. Firm 7 is a low-technology engineering firm run by one person. Its level of IT sophistication is very low. It owns two personal computers and no facsimile, all of its operations are manual (except for the use of a simple accounting program), and the owner has very little computer experience. It has limited financial resources; its annual sales are \$250,000, and its working capital is about \$15,000. Even though the owner recognized several benefits that EDI can offer to her organization (such as time and cost savings), she indicated that a lack of resources restrains her firm's ability to become EDI-capable. Despite the lack of these resources, the owner has expressed a strong willingness to become EDI-capable as part of the BC Buy Smart project because she thinks that an EDI partnership will improve her trading relationship with the government. This relationship is very important for the survival of her firm because it is currently trying to sign a new, major contract with the BC government, the largest of its seven clients.

Ready Adopters

Ready adopters represent those organizations that, although pressured into an EDI relationship, are prepared for it. They usually have the necessary resources to develop integrated EDI systems that will interface with their existing computer applications. Management of ready adopter firms has recognized the relative advantages of EDI and is willing to allocate the required resources and support the adoption of EDI in the organization. This, in turn, would suggest the eventual implementation of an integrated EDI system with many benefits.

Firm 2, an office furniture retailer, is a ready adopter. It had a high level of preparedness before adopting an EDI system; it owned a mainframe, had many personal computers, and employed an MIS staff of five. Overall, its operations were highly computerized and integrated. This high level of IT sophistication was augmented by support subsidies from the trading partner that initiated the EDI adoption. This trading partner, which supplies 60 percent of firm 2's purchases, was wholly responsible for the EDI installation, maintenance, and staff training. The high level of organizational readiness of firm 2 enabled the implementation of a highly integrated system. Characteristically, this system included software that transformed the salespeople's layout designs into orders that were then transmitted via EDI. According to the respondent, this integrated system reduced the need for order entry clerks, eliminated errors, and significantly improved customer service. Having recognized the large benefits that EDI can offer, the management is currently attempting to establish EDI partnerships with its other suppliers and customers. In our opinion, high levels of preparedness and awareness of benefits account for the willingness of this firm to participate in the BC Buy Smart project, despite its extremely low dependency on government business (less than three percent of its sales are made to the BC government).

Coerced Adopters

Coerced adopters are small firms that are pressured into adopting EDI without having recognized the need for it and without owning the necessary resources to integrate the technology. Even though coerced adopters are not fully aware of the potential impact of the technology, they adopt EDI to sustain the business relationship with the imposing trading partner. However, it is very common that coerced, small adopters can afford only a stand-alone personal computer as an EDI server. In such cases, the EDI system is no more beneficial than a fax or e-mail-based system. Consequently, the potential efficiency of EDI does not materialize.

Two companies in our sample, firms 3 and 6, lack necessary resources to adopt but are highly dependent on the BC government. These firms are likely to become coerced adopters who would not realize the full benefits of the technology unless the BC government provided them with technical training and support (to increase their readiness) and education (to stimulate their awareness of the benefits). Firm 3, with annual sales of \$18.5 million and 110 employees, is a wholesaler and processor of fresh food and vegetables. Its level of computerization is very low; it has no MIS staff and owns only two personal computers and a mini-computer used exclusively for bookkeeping and word processing. The senior manager of the firm sees little advantage to EDI adoption (other than increased transaction speed and elimination of paperwork). However, due to his firm's high dependency (20 percent of its sales are made to the government), he is willing to make the firm EDI-capable to maintain the working relationship with the government.

Firm 6, a recycler of industrial waste, is also willing to become EDI-capable to gain better access to governmental business despite the firm's low levels of readiness. The firm owns only three personal computers, which are mainly used for word processing and record keeping, and none of its six employees has received formal computer training. The financial resources of the company are also limited; its annual sales are \$400,000, and its working capital is about \$40,000. Nevertheless, the firm is willing to adopt EDI to improve its sales to the government (which are expected to triple in the next five years).

The respondents from both of these firms indicated that, because of their limited resources, they intend to use a personal computer as an EDI server to receive and send messages but will process the printed EDI messages manually. Unfortunately, as indicated above, such a configuration limits the benefits of the technology and lowers its positive impact on the operations of the organization.

Unmotivated Adopters

Unmotivated adopters are firms that have been pressured into EDI, but still have not recognized the need for it. Even though they possess the necessary resources to create an integrated system, they have not recognized the relative advantage of the technology and thus are not willing to spend the resources to enhance their EDI investments. Therefore, the actual impact of the technology in these organizations is limited.

Firm 1, a video and print production company, and firm 5, a commercial printing firm, are likely to become such unmotivated adopters if the BC government requires them to become EDI-capable. Both of them are highly computerized and own local area networks. Their computerized applications are integrated, and both use outside consultants to assist them with their systems. However, the respondents from both firms indicated that their companies see very few advantages in EDI. Firm 1's manager expressed a fear about the "levelling effect" of EDI that could allow other smaller companies to obtain some of the government's business because of lower prices. This respondent said that his firm competes on quality and long-term partner relationships, something he believes can be undermined by the lack of personal contact in EDI relationships. He perceived low benefits from EDI; indeed, he indicated that it would be "a pain in the neck to implement," and its costs would be higher than any benefits.

It is important to note that both of these firms' sales to the government are relatively small, accounting for less than eight percent of their business, and neither of them expect these figures to increase in the future. Because of this low dependency and the low awareness of EDI benefits, these firms are not willing to become EDI-capable unless required to do so. Even though strong pressures from the BC government could potentially lead to EDI adoption by these firms, unless an effort is made to increase the firms' awareness of the advantages of EDI and encourage the allocation of the necessary resources for integration, the impact of EDI will be limited.

EDI Initiators

EDI initiators are organizations that have recognized the need for EDI, possess the necessary financial resources, have reached a high level of IT sophistication, and have not been pressured by external factors into adopting EDI. In many cases, these firms implement integrated EDI systems as part of a larger business reengineering initiative. Such initiators should be treated as innovators and should expect high returns on their EDI investments (after the system has been integrated into their business processes) because of the indirect advantages they stand to gain. EDI initiators are extremely rare in the small firm population because of the relatively large investment necessary for EDI initiation.

Firm 4 in our sample, however, is such an innovator. It is an industrial cleaner and chemical manufacturer with \$20 million annual sales. The management of the firm has recognized the many benefits that EDI can offer to the company. The firm's vice president believes, in addition to saving costs, EDI will increase the bargaining power of his firm and will allow the company "to grow with its customers" and tap into the government business market. The ability of the company to become EDI-capable was largely facilitated by its high computer sophistication and the proactive stand of its MIS team. The project champion, the vice president of finance, has played a critical role in materializing this initiative. Also, outside consultants have been hired to supplement the skills of the in-house MIS team. Although the project is still under development, its impact on the operations of the organization is expected to be significant.

Non-Adopters

Lastly, non-adopters are firms that do not intend to become EDI-capable. These firms usually do not face high external pressure to adopt EDI capabilities. In the absence of external pressure, the only mix of factors that leads to adoption by an organization is a combination of both high organizational readiness and high perception of benefits. The lack of either will hinder adoption. To assist these non-adopter firms to become

EDI-capable, several strategies are suggested in the last section of this article.

Effects of the three explanatory factors

Perceived Benefits

Several observations can be made comparing the current adopters (firms 2 and 4) to non-adopters (firms 1, 3, 5, 6 and 7). First, the recognition of perceived benefits of EDI varies significantly between the two groups. When discussing the advantages of the technology all *non-EDI adopters* primarily focused on efficiency (i.e., direct) benefits, indicating that there is a perception of low competitive advantage in adopting EDI. Only EDI-capable participants identified non-efficiency benefits of the technology. Respondents from non-EDI-capable firms also mentioned time, paper, and cost savings as the primary motivation for EDI adoption. On the other hand, respondents from EDI-capable firms mentioned as significant benefits the potential of EDI to transform interfirm relationships, to allow entry into new and remote markets, and to enable organizational and structural change. This suggests a significant lack of awareness about non-direct EDI benefits prior to adoption and, hence, a need for greater promotional efforts to increase awareness. Furthermore, the lack of EDI capability is not perceived as a competitive disadvantage among the firms in our sample, primarily because the vast majority of their direct competitors (usually other local small firms) are equally, or even less, EDI-capable.

Our results indicate a positive relationship between perceived benefits and adoption. In five out of the seven cases, perceived benefits were congruent with the adoption decision (in the other two, dependency on partner was named). The findings also suggest that perceived benefits must indeed influence the integration level of EDI. All four firms in the sample that have low awareness of the benefits do not plan to integrate EDI in the near future. Of the three firms with high awareness, one has already developed an integrated EDI system, another plans an integrated adoption, and the third is not planning integration due to a lack of the necessary resources (organizational readiness).

Organizational Readiness

The majority of the respondents expressed concerns about the cost of the investment and lack of know-how. Furthermore, all firms with low readiness (firms 3, 6, and 7) indicated a desire to receive technical assistance from the BC government in implementing EDI. This finding illustrates the importance of using subsidies to increase the EDI readiness of small businesses.

Our findings indicate that the relationship between organizational readiness and adoption is not very strong. Specifically, two of the firms with high organizational readiness are not likely to adopt immediately, while two of the low-readiness businesses are willing to become EDI-capable. (This paradoxical finding can be explained by the partner dependency effects for these four firms.) Organizational readiness also has an unclear relationship with potential integration; none of the three firms with low readiness expect to integrate their EDI systems. Only two of the four firms with high readiness, the current adopters, are willing to undertake integration of the systems. This suggests that organizational readiness may be needed for integration; however, high readiness does not necessarily lead to high integration.

Although firm size was not included in our model, we looked closely at the relationship between size and adoption behavior. In terms of sales volume, it appears that the current adopters are, on average, larger than non-adopters. This is not surprising because size, especially in financial measures, should indicate the resources available to the firm. And according to our assumptions, the higher the level of resources, the more likely the firm will be an adopter. In terms of number of employees, however, it seems that there is no relationship between firm size and EDI adoption. In fact, the average size of the firms in our sample that are willing to adopt is smaller than those of firms that are reluctant to become EDI-capable. (This finding should be interpreted very carefully due to the small sample size and the large variation within the sample.)

External Pressure to Adopt

It seems that the strongest explanatory variable influencing small firms to adopt EDI is the external pressure from EDI initiators. With the exception of the two current adopters, the value of perceived dependency on the BC government perfectly corresponds to the likelihood of adoption. Firms that are highly dependent on BC government (firms 3, 6, 7) are very willing to adopt EDI; firms that are less dependent on BC government for their sales are reluctant to adopt the system. This indicates that partner imposition is one of the most critical adoption factors in the context of small organizations. The fact that current adopters are willing to adopt the BC Buy Smart system, despite their low dependency on the government, supports our earlier arguments about the non-specificity of EDI investments and the expected gains from external integration.

EDI integration and impact

Considering that the impact of EDI technology is largely determined by its level of integration within business processes and with other computer applications, two observations arise about its potential impact on small organizations. First, it seems that small firms are reluctant to integrate EDI with other applications (i.e., there is low internal integration), mainly because most of their operations are not computerized. All of the *non-adopters* in our sample plan to run the EDI applications on a stand-alone personal computer and then print out the EDI messages for manual processing. Interestingly, the two current adopters are willing to integrate EDI with other systems. This suggests that integration is perceived as a second stage in adoption, rather than a concurrent one.

Second, the data indicates that both high perceived benefits and high organizational readiness are needed for the development of the highly integrated EDI systems that usually result in greater benefits. High impact is achieved by *EDI initiators* because they own the necessary resources for the development of an integrated system; high impact by *ready adopters* is realized mainly because their organizational readi-

ness is significantly increased by partner subsidies and support. In our sample, firm 2's systems are highly integrated and, as the respondent indicated, "EDI has changed the way the company does business." Systems development, software updates, and staff training were provided by the *EDI initiator*, and the adoption was highly supported by top management. Other incentives (e.g., allocation of credit points for use) were also used to induce adoption. On the other hand, the other adopter in the sample (firm 4), is currently developing its own system. Although there are plans for internal integration in the future, the EDI application is not currently integrated with other computer applications in the organization.

The respondent from firm 2 pointed out several indirect benefits of EDI that were enjoyed in the company, while the participant from firm 4 focused most of his comments about the impact of the technology on issues associated with efficiency and ability to trade with larger firms (i.e., external integration). The participant from firm 2 also reported that several organizational changes occurred as a result of EDI adoption, such as the ability of salespeople to directly

track and modify an order without the assistance of an order entry clerk (i.e., internal integration). This finding supports our conjecture that the impact of the technology is indeed directly affected by its level of integration, which in turn can be greatly enhanced by outside assistance, such as subsidised adoption from the system initiator.

Summary

This empirical investigation suggests that a major reason that small companies become EDI-capable is due to external pressure, especially from trading partners (for a summary of the findings, please refer to Table 6). Small organizations that are pressured into adopting EDI will reap limited benefits unless they are willing and capable of investing the resources necessary to integrate the system within their operations. Therefore, both high organizational readiness and an awareness of the benefits (which induces the allocation of the available resources) are required for integrated, high-impact EDI systems. Based on our findings, it

Table 6. Summary of Key Findings

Factor	Findings
Perceived Benefits	Pre-adoption awareness of EDI benefits is low. There is a need for promotion to increase awareness. The relationship between perceived benefits and EDI adoption and integration is moderate.
Organizational Readiness	The overall readiness of small organizations is not high enough for adoption. There is an additional need for financial, technological, and managerial assistance. The relationship between readiness and integration is moderate. The influence of readiness on adoption is weak.
External Pressure	The relationship between dependency and adoption is strong.
EDI Integration	Both organizational readiness and perceived benefits are required for highly integrated systems. Small firms are reluctant to integrate EDI into their operations (because it is too costly). Subsidies from EDI partners/initiators greatly enhance the integration (and thus impact) of the technology.

appears that a large number of small organizations tend to lack the needed high organizational readiness and perceived benefits that are required for integrated, high-impact systems. The case results also indicate that the use of subsidies, promotional efforts, and other influence tactics can reduce the liabilities caused by the low levels of these factors and lead to faster and more integrated adoption.

Recommendations to EDI Initiators

Unquestionably, there is a need for a methodological approach in facilitating EDI adoption by small partners. We suggest the following steps for EDI initiators such as organizations, industry associations, and governmental bodies to assist them in preparing their partner expansion plans.

Step 1—Planning: Develop a long-term plan that covers the adoption of small partners from the very beginning. The faster the adoption by a few small partners, the higher the likelihood that other small partners will imitate this behavior in order to retain their competitive position and to protect their business with the EDI initiator. Unfortunately, many initiators tend to focus on large partners only and ignore the small ones during the early stages of their EDI partner expansion plans. This isolation of smaller partners during the initial stages conveys the idea that the relationships with the smaller partners are not very important and that the main reason the initiator wants the small partners to become EDI-capable (after all of its larger partners are EDI-capable) is so that it enjoys higher benefits. In addition, lack of EDI capability among the small business population reduces the perceptions of competitive necessity for EDI, reducing any external competitive pressure for adoption. Early involvement of small partners can eliminate these misconceptions and better educate the small firms about the potential impact of EDI on their businesses, which in turn would lead to faster EDI adoption by small organizations.

Step 2—Partner Assessment: Assess the EDI preparedness status of each small partner. Both the available resources and awareness of EDI benefits of each potential EDI partner must be carefully considered, because high levels of both organizational readiness and perceived benefits are required for the development of integrated, high-impact systems. To estimate the partners' organizational readiness levels, IT sophistication and slack indicators can be used; to measure their levels of perceived benefits, interviews with key decision makers should be conducted (using the measures presented in this article). These two measures should be used to estimate the preparedness level of each potential partner so that an effective influence strategy and subsidy scheme can be chosen to induce successful EDI adoption.

Step 3—Enactment of Influence Strategy: Choose and implement an appropriate subsidy and influence strategy for each partner. The objective of these strategies is twofold: to assist the smaller partner in implementing an integrated system (so that it receives high benefits) and to facilitate faster diffusion of EDI (so that the initiator can achieve high external integration). Three main aspects should be considered when formulating expansion plans: financial and technological assistance, promotion efforts, and coercive tactics. As the case studies indicate, these actions can alter the effect of the three explanatory factors and facilitate a more successful implementation of EDI. The effects of each strategy are illustrated in our modified EDI adoption model shown in Figure 2.

First, financial and technical assistance can be used to alleviate problems of organizational readiness. Initiators can offer technical subsidies such as training and on-site assistance during the development and maintenance of the systems to augment the resources of smaller partners that lack the expertise required for EDI projects. Economic support such as discounted software, hardware, and training may also be needed to overcome resistance because of lack of financial resources and to facilitate the development of internally integrated systems, leading to high benefits for the adopters. This approach

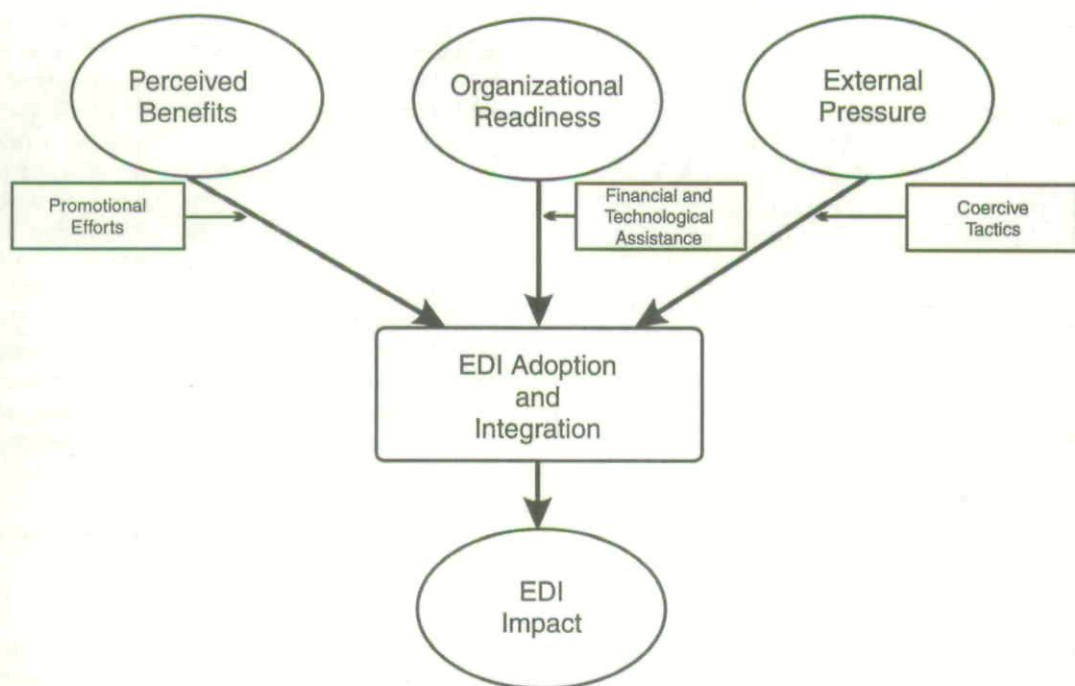


Figure 2. Revised Small Business EDI Adoption Model

has been used by Sears, which offered full EDI software costing \$3000 and training to its suppliers as an incentive to adopt EDI (Fitzgerald, 1990). We specifically recommend heavier subsidization during the early stages of the expansion plan, potentially leading to a "critical-mass" effect and facilitating faster adoption.

Second, the use of promotional efforts and non-coercive influence tactics is suggested for partners with levels of awareness of EDI benefits. In many cases, diffusion of EDI, and IT in general, is delayed because the managers of small organizations fail to perceive the benefits that the technology has to offer to their business operations. To overcome this problem, EDI initiators are encouraged to pursue a recommendation strategy that actively communicates the benefits of the technology through promotional seminars, presentations, and on-site visits. Such tactics have been recently utilized by many larger retailers as part of their EDI expansion plans (Booker and Fitzgerald, 1990). Promises, which are strategies that offer rewards to adopters, are also appropriate for firms with low awareness. Such strategies usu-

ally include discounted prices for EDI transacted goods and other rewards (such as the credit point system for EDI transacted goods that is used by the supplier of firm 2's EDI system). These incentives are usually very effective in increasing the perceived (and subsequently actual) EDI benefits, leading to a more rapid adoption.

So far, only non-coercive influence strategies have been discussed. These are preferred because they seek to expedite adoption while aiming to augment the resources of the small firms (to ensure integration and high benefits for the small adopters). However, several organizations, such as U.S. automobile manufacturers, have lately pursued coercive tactics as part of their EDI expansion plans (Helper, 1991). In general, the use of such threats, especially without subsidies, should be avoided for two main reasons. First, under conditions of low dependency, there is a danger that the level of cooperation and trust in trading relationships will be compromised as a result of the imposition. Second, unless the small partners possess both high readiness and awareness levels to

become ready adopters, threats will usually result in non-integrated systems with very low impact for the unprepared, coerced, and unmotivated adopters.

In summary, the careful assessment of preparedness of each small partner and subsequent selection of subsidies and influence tactics are critical for the success of an EDI partner expansion plan. The framework presented in this article can be used to develop individual subsidy plans tailored to suit the needs of each potential partner. In general, the appropriate selection of subsidies and influence tactics will induce a faster and more successful adoption of EDI by small organizations and will lead to significant gains for both the EDI initiator and its small partners.

Suggestions for Future Research

As part of this study, we developed and tested a simple framework that categorizes EDI adopters and non-adopters into a typology and predicts the expected impact of this technology. Two of the main strengths of this model are its parsimony and the derivation of its factors from previous conceptual and empirical research.

Although our case-based investigation of the model has provided preliminary findings on the adoption and impact of EDI on small organizations, further research is needed to complete our understanding of this subject. We believe that our model and hypotheses can form the basis of larger scale studies to (1) examine the validity and applicability of the model, and (2) improve and refine it.

As with any other simple model, there is a danger that additional significant factors have not been included in the framework. Researchers who believe that additional variables play a critical role in the adoption and impact of EDI could use our constructs in their studies to better estimate the influence of each factor. Large-scale, longitudinal surveys can be especially appropriate for addressing this issue. Longitudinal investigations would allow researchers to mea-

sure the three explanatory factors *before* the adoption of EDI, observe the interventions by the EDI initiators, and, finally, more objectively assess the impact of EDI on the organizations. Such studies would reduce threats to the causal direction of the effects and, perhaps more importantly, would provide needed insights about the proposed relationship between EDI integration and impact.

For researchers who are indeed interested in pursuing empirical investigations such as surveys we recommend using our theory-based, previously validated measures. We also suggest that they endeavor to provide a more rigorous validation of three critical measures: EDI perceived benefits, integration, and impact.

Finally, we suggest that the model be applied in the context of larger organizations as well. Such empirical testing will allow students of EDI to identify necessary modifications to the model to enlarge its generalizability and isolate the differences in the factors that influence the adoption decisions of both small and large organizations. These differences are also relevant to MIS researchers who study small firms as a unique user group of information technology.

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Endnotes

¹ There are 13 million small firms in the U.S. creating 90 percent of the new jobs and contributing 38 percent of the total U.S. gross national product (Ojala, 1989). Small firms

play a comparable, critical role in the Canadian and other economies (Ibrahim and Goodwin, 1986).

² For example, see Emmelhainz (1988); Benjamin, et al. (1990); Reich and Benbasat (1990); Rogers (1990); Bergeron and Raymond (1992); O'Callaghan, et al. (1992); Pfeiffer (1992); Saunders and Clark (1992); Benbasat, et al. (1993); and Swatman and Swatman (1993).

³ For a list of these factors, see Bergeron and Raymond (1992); O'Callaghan, et al. (1992); Pfeiffer (1992); and Saunders and Clark (1992). Not surprisingly, Most of the previous research studies have focused on EDI system initiators and large organizations. These include: Emmelhainz (1988); Reich and Benbasat (1990); Kavan (1991); Benbasat, et al. (1993); Fowler, et al. (1993); and Swatman and Swatman (1993).

⁴ For example, see Rogers (1983); Massey (1986); Cragg and King (1993); and Benbasat, et al. (1993).

⁵ Due to the network nature of EDI, the benefits accrued by an EDI user are a function of both its own investment and the investments of its trading partners (Bergeron and Raymond, 1992; Bouchard, 1993). In other words, as more of its trading partners become EDI-capable, a firm receives higher benefits (due to its increased ability to transact via EDI with more of them). Therefore, interorganizational pressures play a critical role in the adoption of EDI because of the dependency of one's benefits on others' EDI investments.

⁶ See Kavan and Van Over (1990); Pfeiffer (1992); Bouchard (1993); and Saunders and Hart (1993).

⁷ For example, see Benjamin, et al. (1990); Emmelhainz (1990); Swatman and Swatman (1991); Bergeron and Raymond (1992); O'Callaghan, et al. (1992); Saunders and Clark (1992); and Nault, et al. (1993).

⁸ Perceived benefits refer to managers' perceptions before any EDI implementation. As our findings indicate, the list of anticipated benefits (provided by non-adopters) significantly differs from the list of obtained benefits (as described by adopters). This difference can be the result of two phenomena. Either the benefits of the technology are not widely known or visible, or adopters describe the benefits of their integrated systems, whereas non-adopters think of non-integrated systems when assessing the advantage of the technology.

⁹ These are based on Frazier and Summers' (1984) typology of interim influence strategies.

¹⁰ A multiple-case study approach was chosen for this study for several reasons. As the EDI survey literature indicates, little attention has been given to small firms, and there is no previous study that exclusively focuses on small business and EDI. Furthermore, it is evident that a complex organizational phenomenon such as the adoption of EDI could be better understood if the context of the action were also studied (Bonoma, 1985). The utilization of multiple cases would allow for cross case analysis, which could significantly enhance the investigation of the proposed framework (Benbasat, et al., 1987). Lastly, since the literature did not reveal a set of valid measures to assess the variables of interest, it was problematic to use survey techniques. To ensure that the case study yielded testable, rel-

evant, and valid results, we followed Eisenhardt's (1989) list of case implementation steps.

¹¹ The companies in our sample were selected because they vary on four organizational characteristics: industry affiliation, proportion of their sales to government, level of computer sophistication, and number of employees. This variation facilitated the investigation of the effects of these four factors on EDI adoption and impact.

¹² Copies of the interview guides can be found on the Internet's World Wide Web at the *MISQ Archivist* on the *MISQ Central* home page. The uniform resource locator of this site is <http://www.cox.smu.edu/mis/misq/central.html>. In preparing these guides, most variables were operationalized using previously validated measures. To assess the level of **perceived benefits**, executives of small partner firms were interviewed and asked to list the potential benefits of EDI to their organizations. A list of benefits, similar to Table 1, was also provided, and respondents were asked to rate the expected benefits. **Organizational readiness** was estimated using two measures. Indicators of high slack resources provided estimates of the level of availability of financial assets, allowing us to assess a firm's ability to pay for EDI-related costs. These included indicators such as quick, working capital/sales, and general and administrative expenses/sales ratios (Bourgeois, 1981; Singh, 1986), as well as other antecedents of slack (Sharfman, et al., 1988). Available technological resources were assessed using relevant items from a 35-item validated IT sophistication scale (Pare and Raymond, 1991). Regarding **external pressure**, to assess competitive pressure, two measures were used: the estimated proportion of a firm's competitors and partners that are EDI-capable, and perceptual measures about possible competitive disadvantage due to the lack of EDI-capability. To estimate the power of the trading partner (BC Government), we used net dependency measures such as the proportion of current sales, current profits, expected future sales, and expected future profits of the small firm that are attributed to sales to the trading partner, as well as the inverse of the total number of trading partners (Kale, 1989). The effects of the different influence tactics that could be used by EDI initiators to persuade their partners to adopt the technology were investigated using scenarios based on Frazier and Summer's (1984) typology. Concerning the dependent variables, **EDI adoption** was self-reported by the respondents, **integration** was investigated using Bergeron and Raymond's (1992) internal and external integration indicators, and **impact** was investigated based on the reported actual benefits of EDI capability. Although the majority of the questions focused on the main constructs of interest, a specific attempt was made to include open, probing questions to ensure that the respondents' perceptions and beliefs about any other relevant issues could also be identified. These open questions were based on the instrument used by Reich and Benbasat (1990).

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