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**ELECTRONIC DATA INTERCHANGE:
AN ASSESSMENT OF THE FACTORS LEADING TO EDI ADOPTION**

David Elbaz

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of
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Presented in Partial Fulfilment of the Requirements
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ABSTRACT

Electronic Data Interchange: An Assessment of the Factors Leading to EDI Adoption.

David Elbaz

Electronic Data Interchange (EDI) is a revolutionary way to conduct business. The electronic exchange of information between business partners can have a significant impact on the performance and profitability of businesses. However, despite the numerous potential advantages EDI can provide, only fraction of the market is using EDI. The current study attempts to find the explanation for this phenomenon. Thus, which factors are affecting the decision to adopt EDI?

This study is based on Iacovou *et al.*(1995) research where seven cases of EDI adoption were studied. Iacovou *et al.*(1995) identified three major variables affecting the adoption of EDI: perceived benefits, external pressure and organisational readiness.

The current study modified Iacovou *et al.* 's (1995) model by introducing the awareness variable. This study also changed the organisational readiness variable to financial strength and technology used. The current study was conducted using questionnaires that were sent to 1000 businesses in different industries in Quebec. A sample size of 149 companies was used to test the revised model.

The results suggest that there is some relationship between EDI adoption and awareness, financial strength and technology used. Furthermore, this study suggests also a strong relationship between EDI adoption and pressure from important partner.

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1 INTRODUCTION

The increasing importance of emerging information technologies has prompted many researches to examine the process of technology adoption. Various studies have been looking at different elements that may have been affecting organisations' decision to adopt new technology. However, the process of new technology adoption in businesses still requires further study. Understanding the adoption process fully will enable interest groups such as technology developers to better achieve their business goals.

Furthermore, users of programs such as Electronic Data Interchange (EDI) will be able to increase the number of their online partners. Thus, maximising the number of users as well as the benefits gained from using the technology.

The objectives of this paper are to identify the factors that facilitate the adoption of new technology and particularly of EDI, to find the level of EDI integration in organisation, the distribution of EDI users in the industries and finally to find ways to increase the number of EDI users. These objectives will be attained by first reviewing the available literature on the topic. Then, an empirical study using questionnaires will examine the factors that may be affecting the decision to adopt new technology.

This paper will begin by explaining what is EDI and what are the benefits and problems EDI users may experience. Then, a literature review of previous studies published on the subject will be presented. Following the literature review, the significant findings from all the studies will be summarised into a proposed research model. The third part of this paper will detail the research method and procedures. The results and analysis section will follow describing the input we received from the

questionnaires. These results will be further discussed and analysed in the discussion section. The last part of the paper will conclude the study and the findings.

1.1 What is Electronic Data Interchange?

Electronic Data Interchange (EDI) refers to the electronic transfer of information between computers of trading partners using an agreed standard to structure the transaction or message data. The documents that trading partners send to each other, such as purchase orders, order confirmations, bills of lading, invoices, and advanced shipment notices, are converted to a format that can be readable by the partners' computer. These messages can be interpreted, processed and transmitted directly, using compatible data communication protocols via a communications network (Huan, 1996).

The idea behind EDI is very simple. Most companies are using computers for keeping records and for correspondence. The information is entered to the computer then printed out and either stored or sent to business partners using mail or fax. EDI enables these companies to transfer this information directly from their computer to the computers of their customers, suppliers, banks or others (Anonymous, 1995).

There are several ways businesses can exchange electronic information. One method is the transfer over regular telephone lines. Similar to a regular telephone or fax call, the user dial-up, connect and transmit. A variation of this method is the use of private or leased telecommunication links between trading partners. In this method data can be transferred faster because the line is dedicated and no dialling is required.

In practice, however, most businesses have more than one trading partner and establishing separate point-to-point links with each partner is usually not manageable.

The solution is the Value Added Network (VAN). With a VAN, a company can send electronic messages at any time to any trading partner. The messages are transferred to the recipients' "mailbox" in the VAN's computer system. Messages can be retrieved at any time simply by dialling to the VAN and transferring the data (Anonymous, 1995). However, VANs are still relatively expensive, EDI transmissions may cost up to 25 cents per 1,000 characters (Harler, 1996).

In the past few years, a new way to transmit EDI over the Internet has been developed. Using the Internet, instead of private lines, for transmission of EDI could reduce up to 90% of a company's EDI bills (Weisul, 1996).

1.1.1 Benefits of EDI

EDI technology offers exciting opportunities for a wide variety of users and the benefits drawn from EDI can be dramatic. This section will focus on these benefits.

Immediate benefits that can be derived from EDI include improved accuracy, reduced payroll costs, reduced cycle times, standardised forms, lower processing cost and substantial time savings (Prewitt, 1996; Carty, 1996). As a result users enjoy increased productivity, better control of information, faster response time, increased sales, closer ties with customers, and quicker payments for goods sold (Anonymous, 1995).

Using EDI standardised electronic documents can replace hard-copy documents such as invoices, orders, and shipping notices. Therefore, a tremendous volume of transactions can be handled without manual processing. In addition, because EDI enables companies to use fewer people to process these transactions, the cost per transaction is

much lower. Sending documents electronically also improves the timeliness and accuracy of information (Schrifer, 1996).

A survey covering Australia, Belgium, Canada and the US, indicated several benefits that 149 businesses achieved after installing EDI (Anonymous, 1995). The participants were asked to indicate the effect of EDI on their businesses in terms of financial results, business operation, market share, and customer relationships. In each of these areas, they were asked to indicate whether there was an improvement, no change or deterioration due to EDI. The results represented in Figure 1 show that large number of respondents indicated that EDI had a positive impact on their businesses.

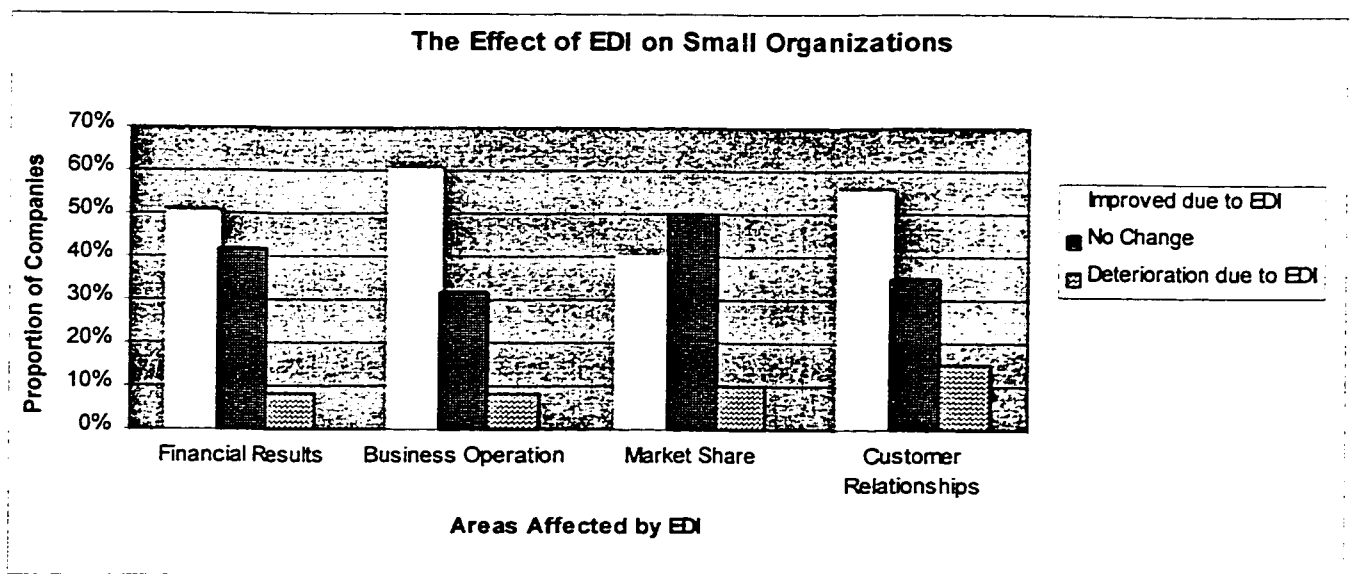


Figure 1 The Effect of EDI on Small Organisations Source: The why guide for small and medium-sized enterprises. EDI World Institute, 1995, pp. 1-19.

To sum up, the above suggest that EDI has a positive impact on businesses. EDI improved companies' business process, market position, customers' relations and financial results. However, to be able to maximise these benefits, several major problems must be addressed. The next section will describe these problems and possible solutions.

1.1.2 Problems Faced by EDI Users

In order to achieve the full benefit of EDI, security, standards and legal issues have to be resolved. Security includes privacy, authentication, integrity, and non repudiation of electronic transmission. The lack of security may lead to legal problems such as liability in the case of information that was tampered with. Another unsettling aspect is the lack of global standards of EDI in different industries and countries.

The following paragraphs will describe in detail each of these problems and possible solutions.

1.1.2.1 Security

When using a public medium such as a VAN or the Internet for transmitting EDI data, one must consider that sophisticated hackers or criminals can intercept and alter information. Data interception and manipulation, denial of service, ID interception, data misrouting, data duplication, and rejection are part of the potential risks (Jilovec, 1996).

Four factors stalled EDI in the past. The first is privacy, which refers to the assurance that a transaction is private between sender and receiver. The second is authentication, which refers to verification of both the sender and receiver identities. The third is integrity, which refers to the assurance that the transaction received is identical to the one that was sent. The fourth is non-repudiation, which is the proof that a transaction actually took place between the parties (Carty, 1996).

A simple access code (password) is not enough in an era when hacking has become a sport nor is it sufficient to encrypt the information that is exchanged over the Internet. Encryption protects the integrity of the message, but does nothing to verify the identity of the sender (Carty, 1996). Several techniques were developed in order to give

answers to the security problems. The following is a description of several known security schemes available in the market.

Digital certificates

A Digital Certificate is a document which gives the partners the assurance that the Web site is legitimate and not an impostor's. The secure server you order from has a Digital Certificate embedded in the binary. This certificate contains information about who owns the certificate (company name, domain name, contact address, etc) as well as information about the issuing authority.

Hashing

A unique shortened version of a message used as a "fingerprint" of a larger message. For example, one type of Hash could be summing up the ASCII values of all characters in the message.

Digital signatures

This is an additional security for the hash technique, the encryption of a Hash message. If the message is changed in any way, the Hash results will also change, indicating that the message has been tempered with. Since it is also encrypted using a public key, only the receiver with the proper private key can decrypt the message.

Certificate authority (CA)

A certificate authority is a trusted third party that generates digital certificates, thus, vouching for the identity of the public key holder.

Secure electronic transaction (SET)

A secure electronic transaction is a protocol for electronic commerce used to secure credit card transactions developed by MasterCard and Visa (Carty, 1996). The

SET protocol is an advance over other Internet security technologies due to its use of digital certificates and encryption technology which enable consumers and merchants to verify the authenticity of the parties involved in a card transaction across the Internet.

Templar, a software product from Premenos Corp. is one example of these technologies. Templar serves as the agent for encryption and authentication of EDI data. It may be used point-to-point over the Internet or to switch EDI transactions between a public VAN and an Internet service provider (messmer 1996; Jilovec 1996). Chase Manhattan Bank is using the Templar combined with the message authentication system that Chase already uses (Reinbach, 1996).

1.1.2.2 Standards

Companies using EDI must agree upon common data format standards for transmission of electronic business documents. Data standards enable companies to format the same data, formerly distributed on paper into electronic documents with a defined structure. The agreeable standard format on the two or more parties allows their computers to read, write and transmit information. (Anonymous, 1993).

Many companies already have their own proprietary data format for inter-company electronic communication. However, EDI formats differ not only from industry to industry, but also among firms in the same industry (Huan, 1996). A variety of industry-specific standards have been developed. Some popular examples are: UCS (uniform communication standard) for the retailing industry; WINS (warehouse information network standard) for the warehousing industry; TDCC (transportation data coordinating committee) for the transportation industry, CIDX (chemical industry data exchange) for the chemical industry; VICS (voluntary inter-industry communication

standard) for general merchandisers, and EDX (electrical data exchange) for the electrical industry (Anonymous, 1993).

With an increasing number of global trading partners, many companies realise that they need international EDI standards. Without global standards, it would not be possible to implement a world wide commonplace transfer of business information (Pacio III, 1997). Most US companies subscribe to the ANSI X.12 standard, while most companies in Europe and Asia subscribe to UN/EDIFACT. As a result, there is an increasing demand for EDI software packages with the flexibility to be able to transform one standard message to another (Huan, 1996).

The success of EDI application depends on the creation of industry-wide standards, high EDI technical levels, reliable VANs and thorough EDI regulations. Trading partners will be more inclined to use EDI once the standards are developed (Huan, 1996).

1.1.2.3 Legal Aspects of EDI

EDI has raised a number of legal issues for parties contemplating its use. The most common issue raised is that of security and protection from alteration of data as discussed earlier. This possibility, in the context of commercial communications, has resulted in fears that commercial information such as contract papers, regulatory filings, or credit card numbers can be altered, forged, or stolen. From a legal perspective, such security schemes may be harmful since it is difficult to establish who is liable when information is tampered with.

A proposed solution to those cases where a legal dispute arises as to the authenticity or accuracy of a document, is that absolute 'hard' authentication of a

transaction or its originator is often unnecessary. Circumstantial factors such as delivery and receipt of the goods or services, course of dealing, or telephone records may be adequate to authenticate the transaction. Such proof is equally applicable to EDI transactions (Montana, 1996).

The above problems are not easy to solve, they will require further studies to find complete and safe solutions. However, these improvements are essential in order to encourage potential users to adopt the technology. Otherwise, the growth of EDI use may be slower than hoped.

1.2 Motivation for this study

In order to be able to fully realise the benefits of EDI, the majority of every industry members should be involved in EDI (Puccio III, 1997). In addition, with the globalisation of world markets, EDI has become an efficient and a needed means for competing locally and internationally (Mooney *et al.* 1996). However, according to a study by Dianne (1996), only 5% of Canadian businesses are using EDI and the adoption process of EDI is still very slow. Therefore, it is important to find ways so that businesses can embrace EDI technology to compete successfully in what has now become a global economy.

The findings of the present study will help EDI users and interested organisations to identify the factors affecting the adoption of EDI. Moreover, the findings will provide a representation of the distribution of the EDI users in different industries.

These findings will enable potential users to become aware of the benefits of EDI, thereby, enlarging the base of potential EDI users and maximising the benefits that can be

gained by using EDI (Puccio III, 1997). In addition, it will help the users and interested organisations to identify the necessary actions that are needed to increase the number of EDI users. By increasing the number of EDI users, more business transactions will take place over the EDI enabling businesses to compete more efficiently in the global market. As a result, improving the overall economy.

1.3 Objectives of the Study

This study has four objectives. They are:

- A. To identify the major factors influencing the adoption of EDI. Thus, which variables are affecting the adoption decision and can we manipulate these variables to bring more businesses to adopt EDI.
- B. To identify the distribution of EDI users in the different industries. Therefore, finding whether there are certain industries that are more or less susceptible to adoption of EDI.
- C. To explore ways to increase the use of EDI. Identifying the factors that most commonly affect the adoption decision and identifying the distribution of users as well their pattern of EDI use, will enable us to propose ways to increase the number of EDI users.
- D. To examine the level of EDI integration within the businesses that adopted EDI. Thus, is EDI internally integrated with other system within the organisation or is it merely a communication tool such as fax. Also, is it externally integrated with other organisation or is it used with only one main business partner

1.4 The Research

The current study is a replication of a case study by Iacovou *et al.* (1995), who studied the EDI adoption model on seven companies. Iacovou *et al.* suggested that there are three major variables affecting the adoption of EDI: perceived benefits, external pressure and organisational readiness.

The current study introduced the awareness variable in addition to the three variables in Iacovou *et al.*'s model. This study was conducted using questionnaires that were sent to 1000 businesses in different industries in Quebec. A sample size of 149 companies was used to test the revised model.

2 LITERATURE REVIEW

The following section will describe four classical models of adoption of new technology as well as several recent studies that investigated the adoption process. Then, Iacovou *et al.*'s model of EDI adoption will be reviewed in detail.

2.1 THEORIES OF THE TECHNOLOGY ADOPTION

Four early studies of technology adoption suggested that the objective is reached after the adopting firm moves through three stages: cognitive, affective, and behavioural stages (Strong, 1925; Rogers, 1962; Lavidge and Steiner, 1961; Kotler, 1984). These studies, which will be described below, suggest that the adoption process commence with a cognitive stage where the firm is exposed to the technology. After being aware of the technology, the firm moves into the second stage, the affective stage where the firm develops an opinion about the technology. If the opinion is favourable, then it will move to the last stage, the behavioural stage, and adopt the technology.

The Awareness, Interest, Desire and Action Model (AIDA)(Strong, 1925) summarises these stages of technology adoption. According to the AIDA Model the firm first becomes aware of the technology then this awareness leads to interest. The interest in the technology fuels a desire for the benefits that the technology may provide, which finally leads to the adoption of the technology.

Similar stages were described in three other models: the Hierarchy-of-Effects model (Lavidge and Steiner, 1961) the Innovation Adoption Model (IAM) (Rogers, 1962) and the Communications Model (Kotler, 1984) These three models like the AIDA model, have similar stages in which the business will go through before adopting a new

technology. According to these models, businesses' familiarity and attitudes toward new technology affect the process of adopting the technology.

Many recent studies analysed each step of the adoption process described above. Williams and Rao (1998) used the four classic adoption models to study the adoption of Automatic Equipment Identification (AEI) in North American railroads. They found that although awareness and understanding of the technology's existence was necessary to the adoption process it was not significant to the process. West (1994) on the other hand, asserted that lack of awareness of the broad business impact of EDI is one of the company's pitfalls preventing them from adopting the technology. According to West, successful implementation of EDI requires that the company understand what EDI is and what it can do for the company. Furthermore, West asserts that lower level management should also be aware of the technology since they are the ones that can understand the real advantage of this technology.

The effect of awareness or knowledge of the technology on the adoption process was also studied by Rupnik and Zupancic (1995). They studied the adoption and use of CASE tools in Eastern European countries. Their results indicated that lack of management knowledge and skills seems to be the major reason why system developers do not adopt CASE tools, are slow to adopt or just use part of them. Attewel (1992) also suggested that many organisations would defer adoption until the knowledge barrier has been sufficiently lowered. Attewel who studied the spread of technological innovations (INS) concluded that firms delay in-house adoption of complex technology until they obtain sufficient technical know-how to implement and operate it successfully.

Finally, Abdul-Gader *et al.* (1995) who studied the factors leading to alienation from new technology, asserted that technology alienation affect negatively the purchase decision of new technology. They conclude that awareness or knowledge of the technology as well as some experience with new technology are less likely to be a factor in new technology alienation.

The above studies support the assertion that knowledge or awareness of a new technology may be a major factor in the adoption process. During the past few years many empirical studies have been conducted to examine which other factors influence the adoption decision of new technology.

Prekumar *et al.*(1997) asserted that there are three broad categories that affect the decision to adopt EDI: Environmental, Organisational and Innovation Characteristics. Premkumar *et al.*'s found that external environmental forces were predominantly instrumental in motivating firms to adopt EDI. Business competitive pressure driven by customers' demands and competitors' actions seems to be the primary factors to influence many firms to adopt EDI. Moreover, non-adopters indicated that customer pressure would be a primary reason for them to adopt EDI. The next most important factor was found to be customer support for adopting new technology. Small firms are often intimidated by new technology and look for external support to implement it. Among the organisational factors, Premkumar *et al.* found top management support and organisational size to be important. Implementation of new technology requires large investment and it is a strategic decision to many firms. The lack of management support makes it difficult if not impossible to execute any strategic decision. The organisation's size was also found to be significant as it is that they have the required resources for that.

Moreover, they are more likely to have the business relations. Finally, none of the innovation attributes were found to be important in this study. This is inconsistent with the traditional innovation adoption studies. The author's explanation is that the difference is due to the type of technology. Unlike the traditional adoption literature, EDI adoption is affected mainly by external competition.

Vincent and Guynes (1997) who studied the adoption decision of Integrated Services Digital Network (ISDN) asserted that organisational strategies, structure, or context facilitate the adoption decision of ISDN. After surveying thousand companies they concluded that organisational strategies such as training and support designed to expand diffusion of an information technology, control actions strategies designed to control diffusion availability of slack resources, and organisational size can significantly impact ISDN's adoption decision. Openness of organisation, which is the degree to which members of system are linked to others who are external to the system, was also significant in influencing the adoption of ISDN.

Davis *et al.* (1989) studied the effect of user perception on the acceptance and use of software, developed a technology acceptance model (TAM). According to TAM, there are two main factors that are the significantly involved in the decision to use computer system. They are Perceived usefulness, the user's perception of the potential of these systems to improve job performance, and Perceived ease of use, the extent to which the user expects a system or software to be easy to use and learn. Davis (1989) found a high correlation between usefulness and predicted usage, also between ease of use with predicted usage. In another study, Davis (1989, 1993) found a stronger relationships between usefulness and actual and predicted usage than the relationship between ease of

use and usage. He also found a high correlation between ease of use and usefulness. Davis interpreted his results as usefulness affect directly the intention to use the system while ease of use affect it indirectly through usefulness.

Daugherty *et al.* (1995) studied the effect of select contextual and structural dimensions on the adoption of Electronic Data Interchange (EDI). They surveyed 183 manufacturing organisations from broad range of industries, with no differentiation in the rank of the respondents within the organisation. Daugherty *et al.* (1995) concluded that in context there was a significant relationship between EDI adoption and firm size as evidenced by number of factories. However, they did not find significant relationships between the number of employees and warehouses to EDI adoption. .

Daugherty *et al.* (1995) found also a significant relationship between formal benchmarking and EDI adoption. Benchmarking is formalised by external evaluation accomplished by compilation and comparison of relevant internal and external information. Finally, decentralisation and EDI adoption were also found to be positively related. EDI involvement was greater for firms in which the authority for EDI implementation is decentralised or delegated to lower levels within the organisations. Their results did not support the hypothesis that there is a relationship between EDI adoption and either specialisation of tasks and activities within the organisation or the use of integrative mechanisms.

Thong *et al.* (1995) studied the adoption of IT in small businesses, using questionnaires that were received from 172 small businesses. They proposed a model with two main classes of variables that are important in determining adoption of innovation: CEO characteristics and organisational characteristics. Thong *et al.*

concluded that size is the most significant determinants of the decision to adopt IT in small businesses. Businesses that are larger in size are more likely to adopt IT. In addition to business size, the authors concluded that individual characteristics are important determinants to the decision to adopt IT. It is likely that the less innovative CEO will look for other solution that are less radical and therefore less risky. They also concluded that small businesses with CEOs who have a positive attitude towards adoption of IT are more likely to adopt IT. Finally, CEOs who are more knowledgeable about IT are more likely to adopt IT. Thong *et al.* however, found no support to the hypothesis that competitiveness of the environment and information intensity have any significant direct effect on the decision of small businesses to adopt IT.

From the above studies we can learn that the adoption decision may be affected by many variables from within the organisation or its environment. A case study by Iacovou *et al.* (1995) attempted to research some of the variables indicated above. Their study formed the basis of the current study and therefore will be described in detail next.

2.2 EDI ADOPTION MODEL

In this section, a model of EDI adoption and integration will be reviewed. The model was developed by Iacovou, Benbasat and Dexter (1995) and was tested empirically by these authors. They investigated the variables that affect the adoption and integration of EDI by small businesses, as well as, the impact of EDI on these businesses.

Iacovou *et al.* defined EDI adoption as the process during which a firm becomes capable of transacting via EDI, usually through a front-end PC-based EDI server. Integration of EDI has two dimensions, internal and external. Internal integration refers

to the variety of applications interconnected through EDI, such as order entry, invoicing, billing, and payment transfer. External integration refers to the number of trading partners such as suppliers, customers etc. EDI impact refers to the actual benefits EDI adopters receive from utilising EDI. Iacovou *et al.*'s model includes three factors that affect the adoption and integration of EDI (see Figure 2): Organisational Readiness, External Pressure and Perceived Benefits. These factors will be discussed next.

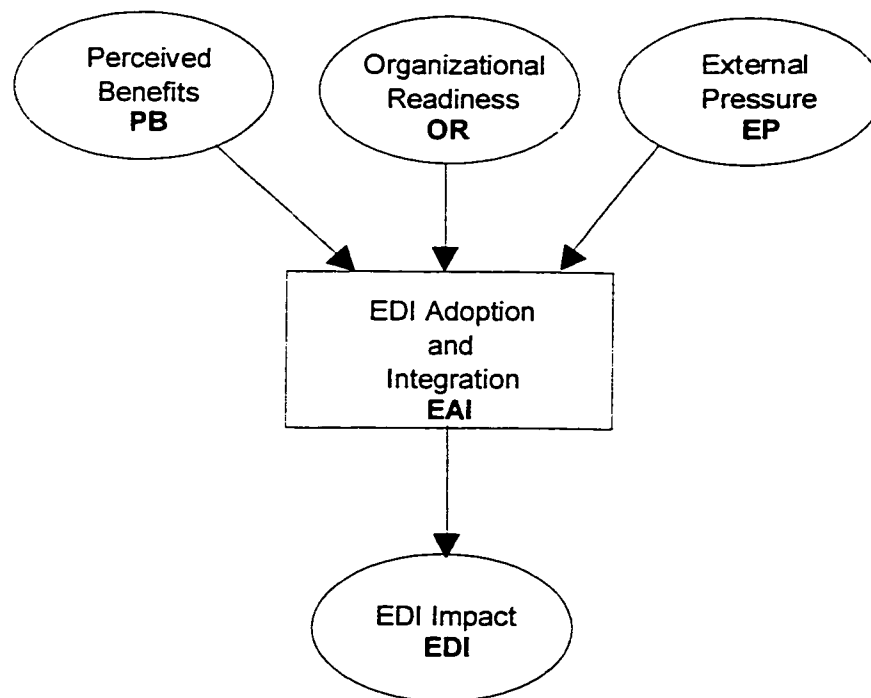


Figure 2 EDI adoption model. Source: Iacovou, C., L; Benbasat, I; Dexter, A. S, " Electronic data interchange and small organisations: Adoption and impact of technology", MIS Quarterly, December 1995, Vol. 19, No. 4 pp. 465-485;

2.2.1 Organisational Readiness

Organisational Readiness refers to the level of financial and technological resources of the firm. Technological Readiness is concerned with the high level of sophistication of information technology (IT) usage and IT management in an

organisation. Iacovou *et al.* indicated that the relatively low computerisation level of the operations of small businesses makes the integration of sophisticated information systems such as EDI difficult. They also argue that more sophisticated firms are less likely to be intimidated by the technology, and therefore, are more likely to adopt EDI. In addition, Iacovou *et al.* expected that businesses with integrated and computerised processes would be more likely to adopt EDI and that EDI will have a greater impact on their business.

In terms of financial readiness, Iacovou *et al.* suggested that companies with financial resources are more likely to adopt EDI. The required initial investment as well as the on going maintenance cost will be less of a financial burden for companies that have the resources.

Iacovou *et al.* concluded that large size firms, which were measured by sales volume, were more likely to adopt EDI. However, they did not find a relationship between the number of employees and the adoption of EDI.

2.2.2 External Pressure

External Pressure refers to influences from the organisational environment. The two main sources of external pressure to adopt are competitive pressure and imposition by trading partners. Competitive pressure refers to the level of EDI capability of other firms in the industry. As more competitors and trading partners become EDI-capable, small firms are more pressurised to adopt EDI in order to maintain their own competitive position.

Iacovou *et al.* expected that imposition from trading partners would be one of the most critical factors for EDI adoption by small firms. Since small businesses are the

weaker partners in inter-organisational relationships, they are extremely vulnerable to impositions by their larger partners.

A powerful partner can use three different strategies to make a small partner adopt EDI. The first type of strategy is recommendations. Large firms use information to change the general perceptions of their small partners. Thus, they inform the small partner on the advantages they can achieve by using EDI. The second strategy is promises which include all tactics suggesting that the larger firm will provide the smaller partner with a specified reward (such as discounts for EDI-transacted goods, subsidised adoption and usage, etc.) if it becomes EDI-capable. The last strategy is the use of threats, where the larger firm threatens to apply sanctions (such as the termination of the partnership) should the smaller company fail to become EDI-capable.

2.2.3 Perceived Benefits

Perceived Benefits refer to the level of recognition of the relative advantage that EDI technology can provide to the business. These can be grouped into two categories: direct and indirect benefits. Direct benefits are mostly operational savings related to the internal efficiency of the business such as reduced transaction costs, improved cash flow, reduced inventory levels and higher information quality. Indirect benefits or opportunities refer to the impact of EDI on the business processes and relationships. They include increased operational efficiency, better customer service, improved trading partners' relationships and increased ability to compete.

Perceived EDI benefits refer also to the level of recognition of the relative advantage that EDI technology can provide to the business. 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. Therefore, Iacovou *et al.* anticipated that small firms with management that recognises the benefits of EDI would be more likely to adopt EDI. Thus, enjoy a higher return than those whose management has a lower level of recognition of the perceived benefits.

In order to test the model, Iacovou *et al.* studied seven businesses that are all suppliers to the British Columbia government. These businesses differ in size, sales volume, number of employees, and type of industries. Two of the companies used EDI in their business operations. The data was collected using interviews with high level managers (owners, vice presidents, etc.) of the businesses.

The result of Iacovou *et al.*'s research led to the conclusion that the major reason that small businesses adopted EDI is external pressure from trading partners. In addition, they concluded that companies that are forced to adopt EDI would benefit fully from the system only if they are willing and capable to invest the resources to integrate the system within their operations. Thus, high organisation readiness and awareness are required for integrating the system.

The current study will examine the variables that were tested in Iacovou *et al.*'s model. However, by increasing the sample size, the current study will enable us to evaluate more effectively Iacovou *et al.*'s findings that were based on a small number of companies. Iacovou *et al.*'s findings may have been different had they investigated the same type of companies in different industries or different organisation settings. In addition, other variables that were not studied may have been the factor in the adoption

decision. Therefore, larger sample may minimise the risk that the results are due to factors other than the ones tested. Furthermore, companies from several industries should be studied in order to evaluate the effect of different environments on the adoption of EDI.

Iacovou *et al.*'s study did not include the awareness variable, which may be a significant factor in the adoption process of EDI. As mentioned earlier in the classical theories, awareness is the first step in the adoption process of new technology. Small companies need to know about the technology's existence in order to be able to evaluate it effectively. The current study will analyse whether the lack of knowledge is a significant factor affecting the adoption decision.

3 RESEARCH MODEL

3.1 RESEARCH QUESTION

From the literature review section we identified several factors that may affect the decision to adopt EDI. The current study will examine several of these variables and try to find which of these variables are affecting the decision to adopt EDI? As mentioned earlier, the current study is based on the Iacovou *et al.*'s (1995) study. Therefore, this study will examine whether Iacovou *et al.*'s findings can be supported. The current study will also examine the awareness variable, which was not examined in Iacovou *et al.*'s model. Thus, the research question is:

Do knowledge of EDI, perceived benefits, technology used, financial strength, and external pressure are affecting the decision to adopt EDI?

3.2 RESEARCH MODEL

This section will outline the revised model used in the current study. As shown in Figure 3, the proposed model is combined of four major variables that influence the decision to adopt EDI. The variables are awareness (AW), Perceived Benefits (PB), Technological Used (TU), Financial Strength (FS), and external pressure (EP). As described below, the assumption is that each of these variables positively affects the adoption decision and integration of EDI.

First variable is awareness where the lack of knowledge of EDI may be an obstacle for EDI adoption. Second variable is the perceived benefits where the benefits the organisation expects to gain from the system should be the drive behind the adoption decision. Financial strength is the ability of the organisation to afford the cash outlay

involved with the implementation of EDI. Technology used is the hardware and software used in the organisation which may imply the sophistication and the technological capabilities and the ability to adopt new and sophisticated system. The last variable is external pressure which is the forces external to the organisations influencing them to adopt EDI. Each of these variables and our propositions are described in greater detail below.

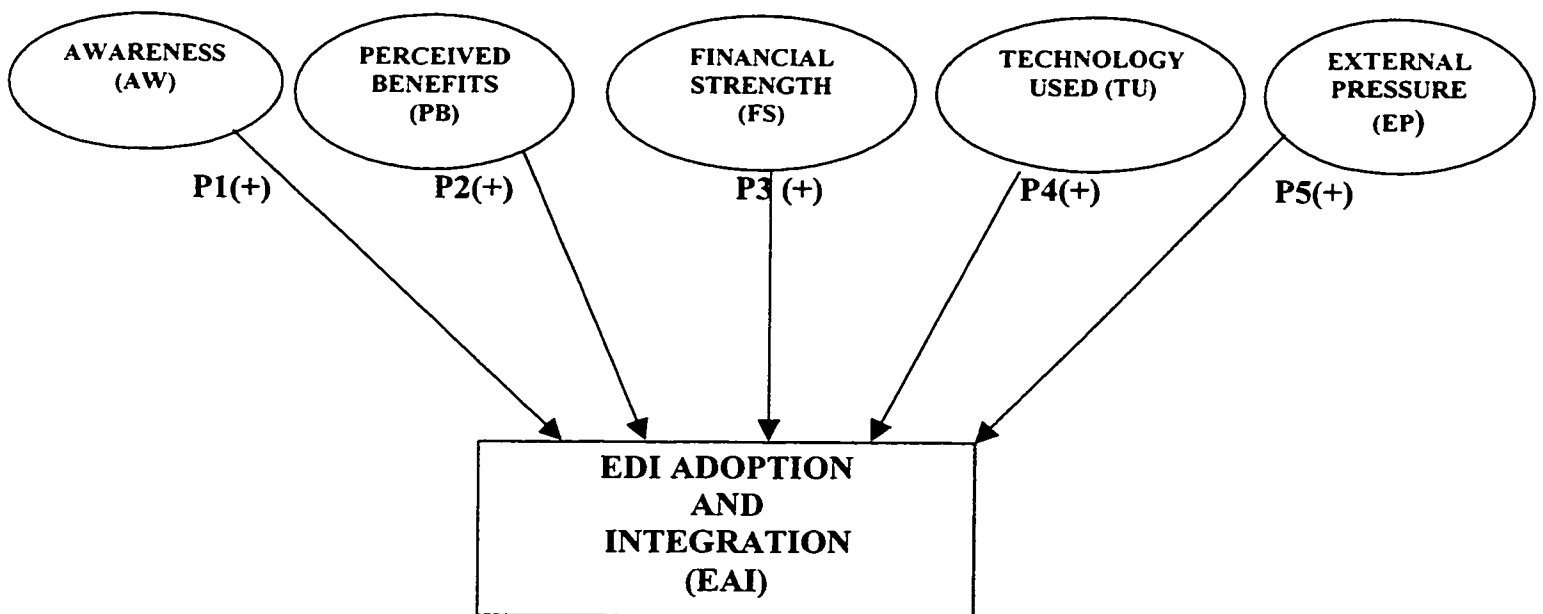


Figure 3 The revised EDI adoption model

The first variable of the model is awareness, which is the level of EDI knowledge. As described in the early studies (Strong, 1925; Rogers, 1962; Lavidge and Steiner, 1961) as well as in later studies (Kotler, 1984; Attewel 1992; West, 1994; Rupnik and Zupancic,1995; Abdul-Gader *et al.*, 1995;Rao,1998), awareness and understanding of new technology is a prerequisite to the adoption process. We assert that large number of

organisations are not aware of this technology or have insufficient information about the technology. Therefore, they will not adopt the technology due to lack of knowledge.

P1: Lack or limited knowledge of EDI may halt the adoption of process.

The second variable of the model is perceived benefits. It is the level of recognition of the relative advantage that the technology can provide the business. 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 (Iacovou's *et al.*, 1995; davis, 1989; Thong *et al.*, 1995; Premkumar *et al.*, 1997). Therefore, the higher the expected benefits from using EDI, the higher the probability that the company will adopt it. We assert that the decision to adopt EDI should be motivated by the expected benefits from using the system.

P2: Higher perceived benefits from using EDI would encourage the adoption of EDI.

The third variable of the model is financial strength. Because large size firms have the financial resources, they can afford the initial investment as well as the on going maintenance cost of EDI. Therefore, they are more likely to adopt EDI (Iacovou *et al.*, 1995; Thong *et al.*, 1995; Daugherty *et al.* 1995; Premkumar *et al.*, 1997). We assert that companies with financial resources are more likely to adopt EDI.

P3: Financially secured companies are more likely to adopt EDI.

The fourth variable is technological use. Low computerisation level of businesses makes the integration of sophisticated information systems such as EDI difficult. In addition, more sophisticated firms are less likely to be intimidated by sophisticated technology, and therefore, are more likely to adopt EDI (Iacovou *et al.*, 1995; Thong *et al.*, 1995). Therefore, we assert that usage of sophisticated of technology will facilitate the adoption of EDI.

P4: Companies using more sophisticated hardware and software are better prepared to adopt EDI.

The last variable is external pressure. The decision to adopt EDI may be strongly motivated by partners, suppliers or customers. Imposition from trading partners would be one of the most critical factors for EDI adoption by small firms. Since small businesses are the weaker partners in inter-organisational relationships, they are extremely vulnerable to impositions by their larger partners (Iacovou *et al.*, 1995; Thong *et al.*, 1995; Premkumar *et al.*, 1997). Therefore, we assert that pressure from external organisations may be a significant factor leading to adoption of EDI.

P5: Strong external pressure from important partner will seriously affect companies' decision to adopt EDI.

The current study will examine whether Iacovou *et al.*'s findings can be supported using the modified model shown in Figure 3. The modified model will be studied on a larger sample size, using questionnaires that will be sent to businesses in Québec.

3.3 OPERATIONALISATION OF VARIABLES

The first variable, awareness, was measured using three categories. Respondents had to indicate one of the following categories of EDI knowledge. (See the second part question # 2 in Exhibit 1)

1. do not know what EDI is,
2. have some knowledge of EDI, and
3. know what EDI is.

Category one had no knowledge of EDI and therefore were not asked any further questions about EDI. The businesses in the second category had only some knowledge of EDI and were asked additional questions relating to EDI. The last group had a full knowledge of EDI.

The second variable of the model is Perceived Benefits where we measured the perceived or actual benefits from using EDI. On scale from 1 to 5, where 1 is not at all and 5 is very much, respondents were asked to indicate the benefits they expect or currently receive from using EDI. Clearly, the higher the ranking of each benefit the more valuable it is to the respondents. (See question # 8 in Exhibit 1) The list of the perceived benefits was taken from the Iacovou *et al.* (1995) study, they are:

- Saving on time
- Reduction of cost of labour
- Saving on paper
- Lower error rate in data entry
- Higher operation efficiency
- New business connections
- Better customer service
- Lower inventory cost
- Ability to lower price to customers
- Faster information processing
- Reduce ordering costs
- Better access to information, and
- Better relations with other companies

Note that respondents who do not know what EDI is, could not answer this section.

Thus, large number of potential users are unable to evaluate the benefits that could be derived from EDI simply because they do not know about its existence.

The third variable of the model is Financial Strength. Respondents were asked to indicate the number of employees and the annual sales of the company (see question # 16 & 17 in Exhibit 1). Previous studies (Iacovou *et al.*, 1995; Daugherty *et al.*, 1995; Thong *et al.*, 1995), also measured the financial strength of the company using the number of employees and sales volume.

The fourth variable is Technological Use in which the types of hardware and software used was studied. Respondents were asked to indicate what type of hardware they are using (i.e. P.C., minicomputer or Mainframe) (see question # 1A in Exhibit 1) and what type of software (i.e. accounting packages, word processing etc.) (See question # 1B in Exhibit 1). We assert that more types of hardware used in an organisation indicate a better technological sophistication. In addition, organisations that use more types of software are better equipped to handle new and advanced technology. The hardware results were coded 1 per entry therefore, if a company had all the hardware types they scored 3. In the software section responses were coded 1 for each entry and the accumulated number of software used indicated the level of software. Thus a company that uses all types of software scored 8. Therefore, a company that scores 3 on the hardware and 8 on the software is the most sophisticated company technology wise.

The Last variable is external pressure. EDI users were asked several questions concerning pressure from external forces. They were asked to indicate on a scale from 1 to 5, where 1 is not at all and 5 is very much, what was the effect of these forces on their

decision to adopt EDI (see question # 7 in Exhibit 1). Companies that indicated 5 or 4 were strongly affected by external pressure when adopting EDI. In this category we asked several question

To examine the internal and external integration of EDI, we asked EDI users which systems are connected to the EDI. Internal integration refers to the systems within the organisation such as: order entry, Invoicing, inventory, and payment transfer. External integration refers to the organisations outside the company that are connected to the EDI system. The company is more integrated as more systems are connected to the EDI.

4 METHODOLOGY

4.1 RESEARCH METHOD

Since this study necessitates contact with many businesses across wide geographic area, we have decided to use mail type survey. There are several advantages to use this survey method. First, it provides contact with many organisations relatively easy. Second, it costs less compare to other possible data collection methods. Third, this method permits the respondents to stay anonymous while providing us with sensitive information, which may not have been provided using other methods.

The importance of reaching as many companies as possible is to twofold. First, it increases the probability that the results are due to factors tested in the study and not other side effects. Furthermore, this enabled companies from different industries to participate in the study. Thus, providing information on the effect of their environments on the adoption of EDI.

4.2 SAMPLE SELECTION

The sample was selected from two databases. Seven hundred and fifty companies were selected randomly from the Centre de Recherche Industrielle du Québec (CRIQ) database, which contain several thousands of companies. In addition, the entire 250 companies from the database of the EDI Institute of Québec were selected. The reason for using two databases is to compare the responses of the “knowledgeable” population (EDI sample) to the general population (CRIQ sample). Consequent to our design, questionnaires were sent to 1000 companies in Québec. The questionnaires were addressed to owners and high-ranking executives in the organisations.

4.3 THE QUESTIONNAIRE

Fourteen questions were included in four separate sections (See exhibit 1). The first section was designed to determine the type of computer hardware and software used by the companies in order to determine the company's technological usage. Respondents were asked whether they have knowledge of EDI. Depending on their answer, they are directed to one of the following three sections. The second section is addressed to those companies that use EDI, and is designed to investigate the reasons for EDI adoption and the extent of its internal and external integration. The third section inquires about the perceived benefits of EDI by non-users and the actual benefits of EDI by users of EDI. The last section is answered by all respondents and includes general information about the company and its environment.

The different sections of the questionnaire were evaluated according to a scale described in details in the code book in exhibit 2 and in the section of operationalisation of variables. Generally, questions in the questionnaire, which required yes or no answers, were coded as 2 or 1, respectively.

In the first section of the questionnaire, which was designed to measure the technological usage, respondents were asked to indicate the hardware and software they use. In the hardware section, respondents were asked to indicate the type of hardware they use (PC, minicomputer or mainframe) (see question # 1A in Exhibit 1). Then, respondents were asked to indicate the computer application they use (see question # 1B in Exhibit 1).

The last part of section 1 inquires about the reasons the respondents do not use EDI. We asked if they had the opportunity, would they install EDI? (see question # 3 in

Exhibit 1). Respondents were given five reasons to choose as many as they need to explain why they do not use EDI (see question # 4 in Exhibit 1). They were also provided the opportunity to add other reasons.

In section 2, EDI users were asked questions concerning the integration of the EDI with other systems. First, questions were concerning the internal integration, i.e., other systems within the organisation that are connected to their EDI system (see question # 5 in Exhibit 1). When appropriate, they were also asked to indicate why these systems are not connected to the EDI. The next part of section 2 inquires about the external integration, i.e., to which external organisations are connected to the EDI system (see question # 6 in Exhibit 1).

The last part of section 2 inquires about the reasons the respondents adopted EDI. The respondents were given several possible reasons and were asked to rate them from 1 to 5, where 1 is "do not affect their decision at all" and 5 is "affected their decision very much" (see question # 7 in Exhibit 1).

Section 3 of the questionnaire measured the perceived benefits from the use of EDI by non-EDI users and the current benefits obtained by users from using the system (see question # 8 in Exhibit 1). The same scale from 1 to 5 was used to find how respondents view the benefits from the use of EDI.

In the last section of the questionnaire, respondents were asked to describe their environment in terms of Industry, suppliers, customers, competition, number of employees, and annual sales. (see questions # 9-14 in Exhibit 1)

5 ANALYSIS AND RESULTS

According to the research model presented in Figure 3, five variables could affect the decision to adopt EDI, they are awareness, perceived benefits, financial strength, technology used, and external pressure. In this section we will study each of these variables to explore possible relationship between these variable and the decision to adopt EDI.

5.1 SAMPLE DEMOGRAPHICS

At the end of the data-gathering phase, which lasted approximately three months, 149 responses were received. The first mailing of 400 envelopes was sent on March 17, 1997. Additional 100 envelopes were sent on the 20th of March and on the 24th of March the 360 envelopes were sent. The last mailing of 140 envelopes was sent on May 1st 1997. The first responses arrived on March 25th and the last one arrived on May 27th. The majority of the responses (55%) arrived between the 3rd of April to the 10th of April.

Of the total 149 responses received, ninety-three responses were from the CRIQ sample and 56 from the EDI sample. Thus, the response rate of the two groups combined, after taking into account the returns of 26 undeliverables, is 15.30%. Therefore, the analysis was based on a sample size of 149 observations.

Table 1 presents the number of employees in the two samples. From Table 1 we can see that the number of employees in the EDI sample is significantly higher ($t = -2.78$ & $p = 0.007$) than that of the CRIQ sample (see Table 1). This indicates that businesses in the two samples are not equal in size as measured by number of employees.

Table 1 Employees in EDI and CRIQ samples

	<i>CRIQ</i>	<i>EDI</i>
	N=93	N=56
Mean	135.60	672.80
Standard Deviation	844.44	1250.25
Minimum	1	3
Maximum	8000	6000
t Statistic	-2.78	
P value two-tail	0.007	

Table 2 illustrates the annual sales of the businesses for each sample. The annual sales of the businesses in the EDI sample are relatively higher than the CRIQ sample, though not significantly ($p < .08$) (see Table 2). Again we see that the businesses from the EDI sample are larger than the CRIQ sample, as measured by annual sales and number of employees. However, the difference in size between the two samples will not affect the results of this study, because, the analysis of the data is not based on the difference between the two databases.

Table 2 Annual sales in the different samples

	<i>CRIQ</i>	<i>EDI</i>
	N=81	N=44
Mean	\$ 9.8 Mill.	\$ 635 Mill.
Standard Deviation	\$ 24.9 Mill.	\$ 2,292Mill.
Minimum	\$ 2,000	\$ 35,000
Maximum	\$ 200 Mill.	\$ 15,000 Mill.
t Statistics	-1.81	
P value two-tail	0.08	

Table 3 presents the results of usage of computers, minicomputers, and mainframes by the two samples. The table also presents the level of EDI usage and the level of EDI knowledge in the CRIQ sample. Note that 36.56% of the CRIQ sample did not know what EDI is, and 16.13% had only some knowledge on EDI. Overall, we could suggest that, the EDI sample is more advanced in terms of the use of technology and EDI.

Table 3 Technology use in the two samples

	EDI		CRIQ	
	Number	Percentage	Number	Percentage
	n=56	100%	n=93	100%
Using EDI	36	64.28%	16	17.20%
Using computers	56	100%	78	83.87%
Using minicomputers	37	66.07%	19	20.43%
Using mainframes	8	14.28%	5	5.38%
Do not know what EDI is	**"N/A"	"N/A"	34	36.56%
Have some Knowledge	"N/A"	"N/A"	15	16.13%
Know what EDI is	"N/A"	"N/A"	28	30.11%

* Since these are members of the EDI institute, we thought it is safe to assume that they all know what EDI is.

The two samples were grouped together and then divided into two groups, EDI users, and non-EDI users. Before further investigating the data of the two new groups, we eliminated the organisations that are too large. Therefore, organisations with sales or number of employees with two standard deviations higher or lower from the mean were eliminated. To be able to efficiently identify the outliers, the data was standardised by transformation to Z scores. Totals of six outliers were found: four EDI users and two non-EDI users, all were omitted from the sample.

In order to identify the distribution of EDI users in the different industries, respondents were asked to indicate the type of industry they operate in. Table 4 presents the distribution of EDI users and non-EDI users in the different industries according to the SIC classification. From Table 4 we can learn that the distribution of EDI users is mainly in the manufacturing industry.

Table 4 Distribution of EDI users and Non-EDI users in the industries

	EDI Users		Non-EDI Users	
	Number	Percentage	Number	Percentage
	n=56	100%	n=93	100%
Manufacturing	31	55.35%	54	58.06%
Transportation & Public Utilities	14	25.00%	12	12.09%
Wholesale Trade	0	0.0%	3	3.23%
Agriculture, Forestry, & Fishing	0	0.0%	2	2.15%
Retail	2	3.57%	6	6.45%
Constructions	1	1.78%	6	6.45%
Service	0	0.0%	1	1.07%
Other	1	1.78%	1	1.07%
*Total	49	100%	85	100.00%

* The difference between the sample size and total number is due to missing data.

The above section described the characteristics of our sample, the sample selection and the questionnaire. In the next section, the results will be presented and analysed.

5.2 AWARENESS

As described earlier, there are three levels of awareness: the group that knows what EDI is, the group that has limited knowledge of EDI and the group that has no knowledge of EDI. The results indicate that 25% of the total sample, had no knowledge of EDI, 19% had only limited knowledge of EDI and 56% knew what EDI is. This suggests that 44% of the organisations may not have the adequate knowledge to initiate the adoption process.

Since the awareness variable was not addressed in the base model of Iacovou *et al.*(1995), we have decided to elaborate our analysis on this variable. We examined the number of employees, annual sales, perceived benefits, and use of hardware and software

of the three groups. Table 5, depict the number of employees and annual sales for the three groups of awareness. As we can see from the Table 5, the companies that are aware of EDI have significantly more employees and annual sales than the companies that have limited knowledge or have no knowledge of EDI. Moreover, it is also evident that there is no significant difference between the number of employees and number of sales between the companies that have limited knowledge to the companies that have no knowledge of EDI.

TABLE 5 Comparison of Sales and Employees between the three groups.

	Employees			Sales		
	<i>Aware</i>	<i>Some Knowledge</i>	<i>Not Aware</i>	<i>Aware</i>	<i>Some Knowledge</i>	<i>Not aware</i>
Mean	319.53	42.0	12.09	\$365,187,539	\$7,933,695	\$1,223,833
Standard Deviation	582	56	25	1,889,380,419	10,390,674	1,370,136
Observations	75	25	33	63	23	30
Percentage	56%	19%	25%	54%	20%	26%
Tukey (some knowledge)	0.004	1		0.020	1	
Tukey (Not Aware)	0	0.914	1	0.0006	0.990	1

We also compared the perceived benefits of the group that know what EDI is to the group that has limited knowledge of EDI. The group that has no knowledge of EDI was not incorporated in this analysis since they do not know what benefits they can obtain from using EDI. As we can see from Table 6, when comparing each of the perceived benefit, lower error rate is the only benefit that is weighted significantly more important by the knowledgeable group compare to the second group.

Table 6 Analysis of perceived benefits between the knowledgeable and limited-knowledge groups.

SUMMARY Groups	Know what EDI is		Have limited knowledge of EDI		Mean
	Average	Variance	Average	Variance	P value
Save time	3.53	1.04	3.30	1.58	0.40
Reduce labour cost	2.71	1.56	2.57	1.71	0.61
Save on paper	2.97	1.54	2.95	1.85	0.92
Lower error rate	3.89	1.17	3.13	2.03	0.00
Higher operation efficiency	3.58	0.84	3.23	1.42	0.13
New business connections	2.51	1.4	2.55	1.88	0.95
Better customer service	3.36	1.30	3.30	1.58	0.78
Lower inventory cost	2.24	1.33	2.30	1.68	0.91
Lower price for customer	2.14	1.54	1.91	1.04	0.40
Faster information processing	3.96	0.86	3.73	1.73	0.39
Reduce ordering costs	3.18	1.73	2.73	2.11	0.16
Better access to information	3.35	1.30	3.30	1.86	0.80
Better relations with other companies	3.19	1.26	3.18	1.68	0.93
MEAN (all as one factor)	3.04	0.55	2.69	0.80	0.06

The overalls mean of the responses however, is significantly different between the two groups. The group that knows what EDI is indicated the perceived benefits significantly more than the group that has only limited knowledge of EDI. Moreover, if we incorporate into this table the group that has no knowledge of EDI as a group with no perceived benefits, the difference between the means will be even more apparent.

Next we examined the technology used by the three groups, to examine whether there is any relationship between awareness and the hardware and the software. From Table 7, we can see that the group that knows what EDI is uses significantly more software applications than the other two groups. In addition, the group that has limited knowledge of EDI is also using significantly more software applications than the group that has no knowledge of EDI.

Table 7 Comparison of Software applications usage between the three groups.

	<i>Aware</i>	<i>Some Knowledge</i>	<i>Not Aware</i>
Mean	0.79	0.63	0.47
Standard Deviation	0.19	0.26	0.31
Observations	82	25	34
Percentage	58%	18%	24%
Tukey (some Knowledge)	0.049	1	
Tukey (Not Aware)	0	0.011	1

Table 8 presents the hardware used by the three groups. From Table 8 we can see again that the companies that are aware of EDI use more hardware than the other two groups. However, there is no significant difference between the group with limited knowledge and the group that has no knowledge of EDI. These results are in line with the findings in Table 5 where we found that the number of employees and the annual sales of the three groups is significantly different.

Table 8 Comparison of Hardware Usage Between the three Groups

	<i>Aware</i>	<i>Some Knowledge</i>	<i>Not Aware</i>
Mean	1.65	1.24	1.06
Standard Deviation	0.57	0.72	0.78
Observations	82	25	34
Percentage	58%	18%	24%
Tukey (some knowledge)	0.016	1	
Tukey (Not Aware)	0	0.891	1

To sum up the results of the first section, we found that companies that are aware of EDI have significantly more employees and annual sales than the companies that have limited knowledge or have no knowledge of EDI. We also found that the group that knows what EDI is has slightly better overall perceived benefits and uses significantly more hardware and software. The most important finding however, is the distribution of knowledgeable vs. non-knowledgeable respondents. We found that almost half of the

sample did not have sufficient knowledge of EDI. Lack of knowledge may hinder the process of EDI adoption. These findings should be analysed further to study whether the lack of knowledge does affect the adoption of EDI.

5.3 PERCEIVED BENEFITS

The second proposition states that the level of perceived benefits will affect the decision to adopt EDI. Therefore, we compared the level of perceived benefits between the non-EDI users to the actual benefits of the current users. This is different from Table 6 where we compared the level of perceived benefits between the group that know what EDI is to the group that has limited knowledge of EDI. As we can see from Table 9, only few of the benefits were significantly different between the EDI users and non-users. These benefits include save on paper, lower inventory cost, reduce ordering cost and better access to information. However, unlike our expectations that EDI users will view their actual benefits more than the non-EDI users, the results indicate that the latter perceive the benefits from using EDI more than current EDI users. Moreover, although not significant, the overall benefits were also higher for the non-users compare to the users.

The results suggest that unlike the second proposition, higher perceived benefits are not necessarily associated with the adoption of EDI. However, because the companies that have no knowledge of EDI do not know the benefits they can gain from EDI, they were not included in this analysis. Incorporating these companies in the above analysis may change the results significantly.

Table 9 Analysis of perceived vs. actual benefits between the EDI users and Non-EDI users.

SUMMARY Groups	EDI users		Non-EDI users		P value
	Average	Variance	Average	Variance	
Save time	3.44	1.62	3.53	0.77	0.70
Reduce labour cost	2.78	1.68	2.60	1.50	0.48
Save on paper	2.75	1.54	3.22	1.57	0.07
Lower error rate	3.78	1.59	3.69	1.29	0.72
Higher operation efficiency	3.33	1.05	3.61	0.96	0.17
New business connections	2.38	1.47	2.66	1.65	0.27
Better customer service	3.24	1.42	3.46	1.27	0.35
Lower inventory cost	1.98	1.25	2.51	1.41	0.02
Lower price for customer	1.98	1.46	2.25	1.45	0.27
Faster information processing	3.73	1.56	4.06	0.62	0.12
Reduce ordering costs	2.8	1.98	3.36	1.54	0.04
Better access to information	3.04	1.59	3.63	1.11	0.01
Better relations with other companies	3.04	1.27	3.36	1.31	0.18
MEAN (all as one factor)	2.84	0.67	3.08	0.54	0.12

5.4 FINANCIAL STRENGTH

The third proposition states that the financial strength of the organisation will facilitate the decision to adopt EDI. We analysed the financial strength of organisation based on the annual sales and number of employees. The number of employees in businesses that use EDI were compared to businesses that do not use EDI. From Table 10 we can learn that EDI users have significantly more employees than non-EDI users.

Table 10 Employees in the users and non-EDI users organisations

	EDI Users	Non-EDI Users
	n=46	n=93
Mean	471.10	41.32
Standard Deviation	707.96	60.82
Minimum	1	1
Maximum	3500	294
t Statistics		4.11
p two-tail		0.001

We also compared the annual sales of these two groups to study their financial capabilities. Table 11 depicts that EDI users have significantly higher annual sales than non-EDI users.

Table 11 Comparison of the annual sales between EDI users and non-EDI users

	EDI Users n=42	Non-EDI Users N=79
Mean	\$ 244.9 Mill.	\$ 10 Mill.
Standard Deviation	\$ 573.3 Mill.	\$ 21 Mill.
Minimum	\$ 2000	\$ 10000
Maximum	\$ 3,500 Mill.	\$ 140 Mill.
t Statistics		2.65
P(T<=t) two-tail		0.01

Tables 10 and 11 indicate that businesses that use EDI have significantly more employees and sales volume than businesses that do not use EDI. This suggests that financial strength may facilitate the adoption of EDI. Businesses that have higher sales and number of employees can probably better afford this technology. Moreover, it is more likely that their large business operation creates the need for EDI.

5.5 TECHNOLOGY USED

The fourth proposition states that companies that are using more sophisticated hardware and software are more likely to adopt EDI. Therefore, we compared the use of hardware and software used by the EDI users and non-users. Table 12 presents the hardware used by the two groups.

Table 12 Hardware used EDI users vs. non-EDI users

	EDI Users		Non-EDI Users	
	Number	Percentage	Number	Percentage
	n = 56	100%	n = 93	100%
Using computers	56	100%	81	87.09%
Using minicomputers	32	57.14%	19	20.43%
Using mainframes	7	12.50%	6	6.45%
	Chi Square		7.37	
	At significance level of 0.05		Chi Square = 5.99	

From Table 12, we can learn that EDI users are better equipped in terms of hardware than non-EDI users. Fifty-seven percents of EDI-users are using minicomputer and 12.5% are using mainframe compare to 20.43% non-EDI users who are using minicomputer and 6.45% who use mainframe. The Chi-square test and the low p value support the above results.

To further analyse the technological use, the respondents were asked about the use of different computer applications. From Table 13, we can see that EDI users are using more computer applications than non-EDI users. This is more apparent as the computer applications become more sophisticated. Thus, the two groups are using almost equally common applications such as accounting and word processing, which are used by most businesses for their daily operations. However, programming applications, which are not commonly used by businesses and require more knowledgeable users, are used by EDI users more than by non-EDI users. In this case however, the chi-square does not indicate a significant difference between the two groups.

Table 13 Use of Computer Applications

	EDI Users		Non-EDI Users	
	Number	Percentage	Number	Percentage
	n =52	100%	N = 92	100%
Accounting	49	94.23%	83	90.22%
Word Processing	48	92.30%	81	88.04%
Billing	50	96.15%	77	83.69%
Order Entry	48	92.31%	56	77.64%
Inventory	42	80.77%	56	60.87%
Database	45	86.54%	65	41.30%
Payment Transfer	28	53.85%	18	19.56%
Programming	37	71.15%	37	40.22%
		Chi Square		12.29
		At significance level of 0.1		Chi Square = 12.02

Tables 12 and 13, suggest that EDI users are better equipped in terms of hardware and slightly better in terms of software. It can affect them in two ways: first, since EDI users are using such advanced technology they will not be reluctant to use new and advanced technology. Second, because they can afford this type of technology, they may be able also to afford the expense entail by using EDI. These results should be studied further to confirm whether they support the fourth proposition suggesting that technology use may facilitate the adoption of EDI.

5.6 EXTERNAL PRESSURE

The last proposition states that external pressure may affect the decision to adopt EDI. We asked **only** the EDI users how much the external pressure was a factor in their decision to adopt EDI. From Table 14 we can see that the mean response for external pressure from important partner is 4.21 out of 5. Thus, the respondents indicated that

pressure from important partner greatly affected their decision to adopt EDI. However, other variables in this category did not show as strong relationship with the decision to adopt EDI. Although only high mean does not indicate statistical significance, these results suggest that pressure from important partner might have led this sample to adopt EDI. This relationship will be explored further in the discussion section.

Table 14 External Pressure and EDI Adoption

	<i>Pressure from important partner</i>	<i>Pressure from competition</i>	<i>Need to improve performance</i>	<i>Increase business contacts</i>	<i>Better access to information</i>	<i>Total external pressure</i>
Mean	4.21	2.37	2.98	2.10	2.71	2.94
Median	5	3	3	2	3	3
Mode	5	1	4	1	1	3
Variance	1.36	1.54	1.77	1.07	2.06	0.68
N	43.00	41.00	41.00	40.00	41.00	43.00

To conclude this section, pressure from important partner may be an important factor in the decision to adopt EDI. The respondents however, did not indicate the other external pressure variables to be as important.

5.7 ADDITIONAL ANALYSIS

We further studied the environment of these organisations including the external and internal integration. We examined how well is EDI is integrated with other systems in the organisation such as inventory, invoicing etc. Also, how well the EDI is integrated with other systems outside the organisation such as banks, suppliers and customers.

We also asked the non-EDI users what are the reasons for not adopting the system. These results are presented in Annex 1.

6 OTHER FINDINGS

In this section we enquired about the reasons non-EDI users do not adopt EDI. We also examined the internal and external integration of companies.

To find the reasons for not adopting EDI, we asked non-EDI users who have knowledge of EDI, if they would install EDI if they had the opportunity. Table 15 summarises the results, 13 (22.8%) answered Yes, 33 (57.9%) answered Maybe and 10 (17.54%) answered No. Respondents were offered five possible reasons to choose from as to why they do not use EDI (see 15). They were asked to check all the reasons that may apply to their case. They were also given the opportunity to indicate other reasons. From Table 15 we can learn that knowledge, financial and technological resources, as well as lack of security may affect the decision to adopt EDI. However, it was commonly indicated that lack of interest by customers and suppliers might have a role in the fact that many do not adopt EDI.

The above results suggest that the proposition that lack of knowledge, financial resources and technology used may affect the decision to adopt EDI. This supports Puccio (1997) and Iacovou *et al.* (1995) assertion that to be able to realise the benefits of EDI, the majority of every industry should adopt EDI. Since having business using EDI necessitates an on line partners, it is important that more business will adopt EDI. In addition, wide spread EDI adoption will eliminate the need and cost involved with maintaining two systems for EDI and non-EDI partners.

Table 15 The reasons non-EDI users are not using EDI

What are the reasons you do not use EDI? (may choose more than one answer)	Would you install EDI, if you had the opportunity?						Total	
	Yes (n = 14)		Maybe (n = 33)		No (n = 10)		n=	
Not Interested	0	0% ~	6	18.2%	7	70%	13	23%
Do not have enough Knowledge	3	21.4%	10	30.3%	2	20%	15	26%
Do not have the financial	2	14.3%	12	36.4%	3	30%	17	30%
Do not have the tech.	2	14.3%	9	27.3%	4	40%	15	26%
Lack of security	0	0%	4	12.1%	2	20%	6	10%
Other	*2- Customers and suppliers do not require EDI.(14.3%)		8* - Customers & suppliers are not interested. (24.2%)		1*- Not required in the industry. (10%)		11	19%
	2 – Under review.(14.3 %)		2- Business volume doesn't justify it(6.1%)		1- Volume doesn't justify EDI (10%)		5	9%
	2 Priorities (14.3%)		2No immediate need.(6.1%)		1- Do not need it.(10%)		5	9%
	1- Waiting for a change in hard ware. (7.14%)						1	2%

* The numbers represent the frequency of each response.

~ The percentage represents the number of responses divided by n. The total percent does not equal 100% since more than one response may be indicated.

The last part of the analysis is the examination of the internal and external integration of EDI. Internal integration is the number of systems within the organisation that are connected to the EDI. External integration is the number of external businesses or organisations doing business over the EDI.

The results shown in Table 16, indicate that EDI is connected mainly to the order entry system (73%) and to the invoice system (61.54%). However, only 23.08% of the

respondents connect their EDI to the inventory system and 21.15% to the payment transfer system.

Table 16 Internal integration of EDI (n=52).

EDI connected to	Number	Percentage
Order entry system	38	73.08%
Invoice system	32	61.54%
Inventory system	12	23.08%
Payment transfer	11	21.15%

The above indicates that the level of internal integration is low. The respondents are using their EDI system for only one or two of the many possible functions within their organisation. To find the reason for this, we asked the respondents to explain why EDI is not connected to any of the other systems. The results were compiled and presented in Table 17. From Table 17, we can see that 40.38% of the respondents did not connect EDI to the other systems because they do not need it in their line of business. Also, 7.69% indicated that they do not have the financial and technological resources to do so. Respondents had also the opportunity to give other reasons why they did not connect the other systems to EDI. A very frequent response was that they would connect it in the future, a response that did not help us to understand the reasons.

Table 17 Reasons for not expanding the internal integration (n=52).

Reason not connected to EDI	Number	Percentage
Don't need it in my line of business	21	40.38%
Don't have financial resources	4	7.69%
Don't have technological capabilities	4	7.69%
Will connect it in the future	4	7.69%
Do not need it currently	2	3.85%
Priority.	1	1.92%

The above indicates that the main usage of EDI is with external sources without internal integration. For example, businesses may use EDI to invoice or to order goods, however, when the order is received the inventory is updated in a separate procedure. This clearly defeats the purpose of this type of system that supposed to eliminates or reduce the inefficiency of business practice. When we asked the reasons for the low level of internal integration, the most common response (40.38%) was “ don’t need it in my line of business” (see Table 17). This suggests that this answer is due to lack of knowledge on the part of the users. There is no logical explanation to justify that integrating EDI system with other internal systems is not needed. Particularly when we consider the fact that only 23.08% indicated that EDI was connected to the inventory system. It is difficult to understand how it is not needed to connect the EDI to the inventory system almost in any line of business. Therefore, we infer that the reason for the adoption is a force outside the organisation as suggested in the last proposition.

Next, we examined the external integration of EDI. Table 18 presents a summary of the responses to the question how many businesses are connected to the EDI system in the different categories? Some of the responses did not include the number of businesses that are connected to the EDI system rather they just indicated that they are connected to external organisations using EDI. Therefore, we coded all the entries in this part of the questionnaires as 1 when it is connected to external organisation and 0 when it is not.

As we can see from Table 18, the external integration in most businesses is mainly with one category of external organisation. Moreover, the most common categories are suppliers and customers. Financial and government institutions were

rarely indicated as EDI partners. Finally, out of 50 responses only 2 organisations indicated that they are connected to more than two categories of external organisations.

Table 18 Level of External Integration

n= 50	Suppliers	Customers	Financial institutions	Government	Other
Suppliers	21	10	1	0	2
Customers	10	33	2	0	2
Financial Institutions	1	2	3	0	0
Government	0	0	0	1	0
Other	2	2	0	0	5

We indicated earlier that important partner may have an important contribution to the adoption decision (i.e. either big customer or big supplier). If the reasons affecting the decision to adopt EDI were different, more categories of EDI partners would have been interacting over the EDI. For example, if the reasons to adopt EDI were to increase efficiency, to lower error rate, etc., banks would have been more common partners. Because, external integrating EDI system with the bank can save time, reduce error rates and save money.

To sum up the last analysis, we learned that internal and external integration is relatively low. Businesses adopt EDI for one or two purposes only and do not expand its use to other functions in the business or to other business partners. This is despite the advantages these companies could gain by fully integrating the EDI system.

7 CONCLUSION

The following section will review the findings described in the previous section. An analysis of each of these findings and the reference to the current study will be discussed and analysed. Then the limitation of the study as well as implication for future research will be outlined.

7.1 DISCUSSION

The current study suggests that awareness, perceived benefits, financial strength, technology used and external pressure may affect the decision to adopt EDI. The following section will elaborate on the findings presented in the previous section regarding these variables.

From the analysis of the awareness variable we found that 25% of the sample did not know what EDI is and 19% had only some knowledge. Since EDI involves an on line business relationships, this may be an important finding. Conducting business using EDI requires usually that two or more businesses will be connected to EDI. Therefore, businesses that use EDI will want to increase the number of EDI partners. Thus, enabling them to convert manual transactions used with non-EDI users to an on line transactions with EDI users. Consequently, by maximising the number of EDI user they are increasing the benefits from the use EDI, as indicated also by Puccio III, (1997) and Iacovou *et al.*(1995). However, if large segment of the business community is either unaware of EDI or have only limited knowledge of it, it may hinder the diffusion of EDI adoption. Businesses that have the required technological resources may be interested to

adopt EDI, however, lack of knowledge may slow down or even block the adoption process entirely.

After learning that awareness level is relatively low among businesses, we continued to examine the differences between the three groups: the group that knows what EDI is, the group that has only limited knowledge of EDI and the group that has no knowledge of EDI. We compared the number of employees, annual sales, perceived benefits, and use of hardware and software in the three groups.

We found that organisations that are aware of the technology are significantly larger in terms of number of employees and annual sales than the organisations that have limited or no knowledge of EDI. It is possible that the needs of large organisation may expose them to a type of technology such as EDI. Small organisations on the other hand, generally will attempt to cut costs and manage with any technology that will be sufficient for their operation. From Table 7 we see that the knowledgeable group is using more sophisticated software than the other two groups. Table 8 also shows that the knowledgeable group is using more hardware compare to the other two groups.

We also examined whether there is a difference in the way the group that knows what EDI is and the group that has only limited knowledge of EDI view the benefits from using EDI. We found that there is no significant difference between them. With the exception of lower error rate, the two groups viewed almost equally all the other benefits. Thus, regardless of the level of knowledge of EDI, in most cases companies have relatively good idea what benefits they may obtain by using EDI. These results however, do not take into account that large portion of the sample that was not examined in this

section simply because they do not know what EDI is. If we classify this group as low perceived benefits, our conclusions may be substantially different.

To sum up the awareness variable, the results suggest that nearly half of the organisations either do not know what EDI is or have only limited knowledge of EDI. In addition, the organisations that know what EDI is are generally larger and use more sophisticated technology. A longitudinal study is needed to be able to confirm the relationship between awareness and EDI adoption. This way the changes in the company's perception and behaviour (i.e. adopting or not) can be examined.

Following the results of the above analysis, we can suggest the inclusion of the awareness variable in the model proposed by Iacovou *et al.* (1995)(Figure 2). Thus, awareness variable may affect the adoption of EDI.

The second proposition is that the perceived benefits affect the decision to adopt EDI. Thus, businesses that value the benefits from using EDI will be more likely adopt the system. Therefore, we compared the perceived benefits indicated by non-EDI users to the actual benefits indicated by users. We learned that the differences in the responses between the two groups are insignificant in most of the benefits (see Table 9). Thus, EDI users and non-EDI users view the benefits from using EDI almost equally. The only three benefits that were found to be viewed significantly different are: better access to information, lower inventory cost, and reduce ordering cost. In addition, there was marginally significant difference in the case of save on paper. Surprisingly though, in these cases the non-EDI users perceived the benefits from using EDI more than the actual benefits indicated by the users. Thus, the results do not suggest a relationship between perceived benefits and EDI adoption.

It is possible that users' perception of the benefits from using EDI changed after the adoption. Conceivably their perceived benefits were higher before the adoption but after using the system, they realised that their expectations were too high.

The third proposition states that financial strength may facilitate the adoption of EDI. It was suggested earlier that large size firms with financial resources could afford the initial investment as well as the on going cost of implementing EDI. Moreover, it is more likely that they will experience the need to use more sophisticated or more advanced technology. Large size firms are more likely to seek more advanced technology to improve their financial and competitive situation. The findings presented in Tables 10 and 11 suggest that businesses that use EDI have significantly more employees and higher annual sales. These finding are in line with the findings of Iacovou *et al.* (1995), Thong *et al.* (1995), Daugherty *et al.* (1995) and Premkumar *et al.* (1997). EDI users have approximately ten times more employees and almost 24 times more annual sales. This indicates that EDI users are in a better financial position.

The forth proposition states that companies that are using more sophisticated hardware and software and are more likely to adopt EDI. As stated earlier, the integration of new and sophisticated information system such as EDI is more difficult for companies that do not use advanced technology. Also, sophisticated firms are less likely to be intimidated by an advanced technology, and therefore, are more likely to adopt EDI. Tables 12 and 13 present the differences in technology use between EDI users and non-EDI users. We found from Table 12 that EDI users are using almost twice as much minicomputer and mainframe compare to non-EDI users. In addition, Table 13 shows that EDI users are using more computer applications than non-EDI users. Furthermore,

this gap between EDI users and non-EDI users increases as the computer applications become more sophisticated. Thus, the two groups use almost equally common applications such as accounting and word processing. Programming applications on the other hand, which are not commonly used by businesses and require users to be more knowledgeable, are used by EDI users far more than by non-EDI users. To sum up, the above suggests that EDI users are better equipped in term of hardware and software.

The last proposition states that external pressure affect the adoption of EDI. Large corporations may be a strong force behind the decision to adopt EDI. They may require business partners to adopt EDI as a pre-requisite to do business with them. We considered several factors as an external pressure: pressure from important partner, pressure from the competition, need to improve performance and better access to information. From Table 15, we can see that an average of 4.21 out of five was recorded for pressure from important partner. This suggests that external pressure may be an important factor affecting the decision to adopt EDI. This high average did not repeat itself in the other options, which ranged from 2.1 to 3.98. This suggests that the reason for adopting EDI is not really to have an edge over the competition by using advanced technology. Rather, EDI is used because they were required to use it by an important partner. These findings suggest that there may be some relationship between external pressure and EDI adoption. These findings are in line with previous studies (Iacovou *et al.*, 1995; Prekumar *et al.*, 1997; Daugherty *et al.* (1995).

7.2 LIMITATION

- The questionnaire used in this study was limited in its capacity to provide conclusive results. The data collected on each of the variables did not provide a clear cause and effect relationship between the independent variables and EDI adoption. Therefore, we were unable to statistically reject or accept our propositions.
- The measures of financial strength is not complete, other financial ratios such as debt to asset ratio etc. may be needed to show conclusively the financial strength.
- Collecting the data over relatively short period of time did not permit us to test whether some variables changed during and after the adoption of EDI. For example, the perceived benefits may have changed after the adoption of EDI. After the adoption, EDI users may realise that they had impractical expectation from the system or that they under estimated the system's capabilities.

7.3 IMPLICATIONS FOR FUTURE STUDY

Ideally, this study should be a longitudinal study where companies will be studied during different stages of the adoption process. This way the changes in the organisation as well as the management's perception can be studied during different stages of the adoption process. In addition, a longitudinal study can provide a conclusive answer to whether the adoption process was affected by the perceived benefits. Moreover, it will enable testing each of the thirteen variables of the perceived benefits before and after the adoption. Thus, providing the answer to whether there was a change in these variables due to EDI adoption.

A longitudinal study will also enable the comparison of financial performance before and after the adoption of EDI. Thus, showing whether EDI contributes to the financial performance of the company?

Future studies should use other financial indicators to test for financial strength of companies. Indicators such as Return on Investments and Debt to Assets ratios may reflect more accurately the financial strength of a company. Finally, future study should be able to prove statistically all its propositions. Therefore, providing results that can be drawn for the entire population.

8 REFERENCES

1. Abdul-Gader *et al.* (1995). "The Impact of Computer Alienation of Information Technology Investment Decisions: An Exploratory Cross-National Analysis". *MIS Quarterly*, 19, (4), 535-557.
2. Anonymous,(1995). "The Why Guide for small and medium-sized enterprises". EDI World Institute, 1-19.
3. Attewell P.(1992). "Technology Diffusion and Organizational Learning: The Case of Business Computing," *Organizational Science*, (3:1), 1-19.
4. Dianne D. (1996). "Will EDI be forced to retire or can it co-exist with Internet?". *Computing Canada*, Oct. 24, 22 (22), S3.
5. Daugherty J.P., Germain R. & Droge C. (1995). "Predicting EDI Technology Adoption in Logistics Management: The Influence of Context and Structure. *Logistics and Transportation Review*, 31(4), 309-324.
6. Davis F. D. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 319-340.
7. Davis F. D. (1993). "User acceptance of information technology: system characteristics, user perceptions and behavioural impacts. *International Journal of Human-Computer Studies*, 38, 475-487.
8. Davis S & Wiedenbeck S. (1997), "The influence of interaction style and experience on user perceptions of software packages". *International Journal of Human-Computer Studies*, 46, 563-588.
9. E. K. Strong, *The Psychology of Selling*, New York: McGraw-Hill, 1925.
10. E. M. Rogers, "Diffusion of Innovations", New York: Free Press, 1962, 79-86.
11. EDI Primer: A guide to EDI. Texas Instruments (1993).
12. Gibson C.F., and Nolan L. R. (1974). "Managing the four stages of EDP growth", *Harvard Business Review*, January-February 1974, 52 (1), 76-88.
13. Harler C. (1996). "Logistics on the Internet: Freeway or dead end?", *Transportation & Distribution*, Apr.,37 (4), 46-48.
14. Huan Neng Chiu.(1996). "The integrated logistics management system: A framework and case study". *International Journal of Physical Distribution & Logistics Management*, 25(6) 4-22.

15. Iacovou, Charalambos L; Benbasat, Izak; Dexter, Albert S(1995) " Electronic data interchange and small organizations: Adoption and impact of technology", *MIS Quarterly*,19, (4), 465-485;
16. Jilovec Nahid. (1996). "Is the Net secure for EDI?", *Midrange Systems*, 9 (12), 42.
17. Julian P.A. & Raymond L. (1994). "Factors of New Technology Adoption in the Retail Sector". *Entrepreneurship Theory and Practice*, 18 (4), 79-90.
18. Kitchell Susan (1997). "CEO characteristics and Technological Innovation. *Canadian Journal of Administration Science*,14(2),111-125.
19. Kotler P., *Marketing Management: Analysis, Planning and Control*, 5th ed., Englewood Cliffs, N.J.: Prentice-Hall, 1984.
20. Lavidge R. J. and G. Steiner. (1961). "A Model for Predictive Measurement of Advertising Effectiveness," *Journal of Marketing*, 25,61.
21. Messmer, Ellen. (1996). "EDI over the Net gets boost from Premenos. *Network World*,13, (29).
22. Montana J. (1996). "Legal issues in EDI", *Records Management Quarterly*, 30 (3).
23. Mooney, J Lowell, Pittman, William D.(1996). "A guide to electronic commerce", *Management Accounting*, 78(3), 43-44.
24. Peter J. Puccio III (1997). "Why Do We Need Standards?", *ECWORLD* , 16.
25. Premkumar G., Ramamurthy K. & Crum M. (1997). "Determinants of EDI adoption in the transportation industry." *European Journal of Information Systems*, 6,
26. Prewitt, Milford. (1996). "Use computerized buying to boost profits", *Nation's Restaurant New*, 30 (44), 62, 92.
27. R. J. Lavidge and G. Steiner. (1961). "A Model for Predictive Measurement of Advertising Effectiveness," *Journal of Marketing*, 25, 61.
28. Reekers N. & Smithson S. (1996), "The role of EDI in inter-organizational coordinations in the European automotive industry". *European Journal of Information Systems*. 5 (2),20-130.
29. Reinbach, A. (1996). "Internet commerce slow, but moving forward", *Bank Systems & Technology*, 33 (10),32.
30. Rogers EM (1995), *The Diffusion of Innovations*, 4th edition. Free Press. NY.
31. Rogers EM.(1996). "Diffusion of Innovations", New York: Free Press, 79-86.

32. Rupnik Miklic E and Zupancic j. (1995), 'Experience and expectation with CASE technology-an example from Slovenia". *Information Management (Netherlands)*, 28(6), 377-91.
33. Schriefer J. (1996). "Computers link steel suppliers to their customers", *Iron Age New Steel*, 12 (7), 66-69.
34. Strong E. K., *The Psychology of Selling*, New York: McGraw-Hill, 1925.
35. Thong JYL & Yap CS (1995). "CEO characteristics, Organizational and Information Technology Adoption in Small Businesses", *Omega International Journal of Management Science*, 23(4),429-442.
36. Tom CartY. (1996). "Secure Retail Transaction over the Internet". *EDI world*, 16.
37. Vincent S. Lai and Jan L. Guynes. (1997) "An Assessment of the Influence of Organizational Characteristics on Information Technology Adoption Decision: A Discriminative Approach." *IEEE Transactions on Engineering Management*, 4 (2),146-157.
38. Webster J. (1995). "Networks of collaboration or conflict? Electronic Data Interchange and power in the supply chain. *Journal of Business Logistics*, 15(2),195-203.
39. Weisul Kimberly. (1996). "Heavy hitters open doors to EDI over the Internet", *Investment Dealers Digest*, 62 (46), 10-11.
40. West Louis J. (1994). "Breaking down the barriers to EDI implementation". *TMA Journal*, 14(1), 10-15.
41. Williams L. and Rao K. (1998). "Information technology adoption: using classical models to predict AEI software implementation". *Journal of Business logistics*, 19(1), 5-16.

9 EXHIBIT 1: THE QUESTIONNAIRE

SECTION I

1. Does your organisation use computers: YES NO

If you answered Yes, please indicate

A. What type of computers does your organisation use ?

(please indicate all that apply)

Mainframe Minicomputer PC

B. Which computer application are used:

a) Accounting: YES NO

b) Database: YES NO

c) Word processing YES NO

d) Programming: YES NO

e) Order entry system YES NO

f) Invoicing system: YES NO

g) Billing system: YES NO

h) Payment transfer: YES NO

2. Does your organisation use Electronic Data Interchange (EDI)?

YES NO

If you answered YES please continue to **Section II**.

If you answered NO, Please answer the following:

Do you know what EDI is ?

YES Have Some Knowledge NO

If you answered NO, please continue to **Section IV**.

3. If you had the opportunity, would you install an EDI system?

YES Maybe NO

4. What are the reasons you do not use EDI? (Please indicate all that apply)

- a. I am not interested in EDI.
- b. Do not have enough knowledge.
- c. Do not have the financial resources.
- d. Do not have the technological capabilities
- e. Other reason(s), please specify:

Please continue to **Section III.**

SECTION II.

5. Is the EDI system connected to your:

- a) Order entry system: YES NO
- b) Invoicing system: YES NO
- c) Billing system: YES NO
- d) Payment transfer: YES NO

If you answered NO in any of a to d above, please indicate the reason(s):

(please indicate all that apply)

- a. Do not need it in my line of business.
- b. Do not have the financial resources.
- c. Do not have the technological capabilities.
- d. Other reason(s), please specify

:

6. How many trading partners do you have on the EDI system ?

- a) Suppliers _____
- b) Financial _____
- c) Customers _____
- d) Government _____
- e) Other _____

7. Please indicate to what extent the following variables affected your decision to adopt the EDI technology.

	Not at all			Very much	
Pressure from an important partner.	1	2	3	4	5
Pressure from the competition in the industry.	1	2	3	4	5
The need to improve performance.	1	2	3	4	5
To increase business contacts.	1	2	3	4	5
To have a better access to information.	1	2	3	4	5

SECTION III

8. In the following questions please indicate what benefits you would expect from the EDI system if you had one, or if you do have an EDI system, what benefits you currently receive:

	Not at all			Very much	
- Saving time/cost of labour.	1	2	3	4	5
- Saving on paper.	1	2	3	4	5
- Lower error rate.	1	2	3	4	5
- Higher operation efficiency.	1	2	3	4	5
- New business connections.	1	2	3	4	5
- Better customer services.	1	2	3	4	5
- Lower inventory cost.	1	2	3	4	5
- Ability to lower price to your customer.	1	2	3	4	5
- Faster processing of information.	1	2	3	4	5
- Reduce ordering cost.	1	2	3	4	5
- Better access to information.	1	2	3	4	5
- Better interim relations with other companies.	1	2	3	4	5

SECTION IV

9. In which industry does your organisation operate? _____

10. Who are your customers ? (e.g. government, paper production firms, restaurants, supermarket chains, direct sales, etc..) _____

11. How many customers does your organisation have ? (Please specify per group)

Retail _____

Small size organisations _____

Medium size organisations _____

Large size organisations _____

13. Who are your suppliers ? (e.g. chemical companies, toys manufacturing, etc..) _____

14. How many suppliers does your organisation have ? (Please specify per group)

Small size organisations _____

Medium size organisations _____

Large size organisations _____

15. How many firms serve the same market as your organisation ? (Please specify per group)

Small size organisations _____

Medium size organisations _____

Large size organisations _____

16. How many full time employees are working in your organisation ? _____

17. What is the annual sales of the company ? _____

10 EXHIBIT 2: THE CODE BOOK

SECTION I

Description	Comments
1. Use computers in the business	9=Missing data 1=No 2=Yes
1A. Type of computers used	9=Missing data 1=PC 1=Minicomputer 1=Mainframe
1B. Computer application used	9=Missing data 0=NO 1=Accounting 1=Word processing 1=Billing system 1=Order entry system 1=Inventory system 1=Database 1=Payment transfer 1=Programming
2. Use of EDI	9=Missing data 1= NO 2= Yes
Knowledge of EDI	9=Missing data 1= No knowledge 2= Some knowledge 3= Yes
3. Would you install EDI	9=Missing data 1= No 2= Maybe 3= Yes

4. Reasons do not use EDI

9=Missing data

1=Not interested

2=Do not have enough knowledge

3=Do not have financial resources

4=Do not have technological capabilities

5=Lack of Security

6=Other reasons

SECTION II

Description

Comments

5. EDI connected to

9=Missing data

1=NO

2=Yes

Reasons do not connected to the EDI

9=Missing data

1=Do not need it in my line of business

2=Do not have the financial resources

3=Do not have technological capabilities

4=Other

6. Number of trading partners on the EDI

9=Missing data

7. Variables affecting the
decision to adopt EDI

9=Missing data

1=Not at all

2=

3=

4=

5=Very much

SECTION III

8. Perceived Benefits

9=Missing data

1=No knowledge of EDI

1=Not at all

2=

3=

4=

5=Very much

SECTION IV

9. Type of industry

9=Missing data

1=Manufacturing

2=Food

3=Distribution

4=Pharmaceutical

5=Transport

6=Retail

7=Furniture

8=Telecommunication

9=Printing

10=Paper

11=Construction

12=Cosmetics

13=Plastic

14=Electronic

15=Other

10. Number of customers & type

9=Missing data

11. Number of supplier & type

9=Missing data

12. How many companies serve the same market

9=Missing data

13. How many full time employees

9=Missing data

14. Annual Sales of the company

9=Missing data