CHAPTER I

INTRODUCTION

This chapter presents an overview of electronic data interchange (EDI). The historical development, mechanism, Internet EDI, EDI in Malaysia and the Asian region customs EDI project are discussed next.

The problem statement, research objectives and research questions are addressed followed by the significance of the study. A brief description of the research methodology is given followed by the terminology of electronic data interchange. Finally an outline of the organization of the study is provided.

1.1   Introduction

The Data Interchange Standards Association, INC. (DISA) defines EDI as the transmission, in a standard syntax, of unambiguous information of business or strategic significance between computers of independent organizations (http://www.x12.org/x12org/about/faqs.cfm#a1).

EDI now plays an increasingly integral role in industries such as manufacturing, distribution and services. With rapid changes in business philosophy and practices, EDI is perceived as an enabling technology implemented as part of business process reengineering. EDI is not just a means to transmit documents but has evolved to dynamically move data to support all business processes from pre-ordering, ordering, schedule production, logistics, accounts receivable and account payable.

There has been considerable research documenting EDI benefits over the past decade (Jimenez-Martinez and Polo-Redondo, 2004; Li and Mula, 2009; Mukhopadhyay and Kekre, 2002; Themistocleous et al., 2004). These direct and indirect benefits include improved customer services, reduced shipment errors, reduced stockouts, reduced transaction costs and better data accuracy. However many companies are still not able to receive the full benefits of EDI (Dearing, 1990; Hunter and Valentino, 1995; Lummus, 1997, Plunkett, 2009; Raymond et al., 2009).

1.2 EDI History

EDI began in the 1960s when several industry group came together to develop standards for purchasing, transportation and financial applications (Sokol, 1995). From the start, EDI is used mainly for intra-industry trading except for applications such as bills of lading and freight invoices which were used across industries. United States transportation industry adopted EDI in the early 1970s followed quickly by U.S. grocers and the automotive industry. Today, the retail industry with names such as Wal-Mart, Home Depot and JC Penny strongly support standards-based EDI implementations. In 1968, the Transportation Data Coordinating Committee (TDCC) and the National Association of Credit Management's Credit Research Foundation began standards development for EDI. Later in 1979, the American National Standards Institute (ANSI) formed the Accredited Standards Committee (ASC) X12 to develop uniform EDI standards. The first five ANSI standards were first published in 1983. ANSI standards have gained wide acceptance in North America by 1985 (Neef, 2001; http://www.x12.org). The Guidelines for Trade Data Interchange (GTDI) which is a different standard was being used in Europe at that time. Because of the incompatibility of the two standards, United Nations EDI for Administration, Commerce and Transport (UN/EDIFACT) was established with the objective to create a standard flexible enough to make the two standards interoperable (http://www.unece.org/trade/untdid/welcome.html). Besides Europe, UN/EDIFACT standards are widely used in regions such as Australia/New Zealand, Asia and Africa.

1.3 How EDI Works

The traditional model of EDI facilitates the electronic exchange of business documents (e.g. purchase orders, shipping manifests, and invoices) between trading partners (e.g. a manufacturer and its parts suppliers). These exchanges may take place over incompatible hardware and software by employing standard transaction sets and translation software. EDI electronic message exchanges may occur over different types of communication medium such

as private networks, proprietary networks and third-party networks of value-added operators and recently over the Internet.

EDI is an application-to-application layer protocol from the technology viewpoint. Four tasks i.e., mapping, extraction, translation and communication are required to create and deliver an EDI message. Three of the tasks are performed by software utilities, i.e. extraction software, translation software, and communication software.

The inter-company flow of EDI information in a manufacturing company is discussed in detail next. Figure 1.1 shows the business processes and data flow occurring in a manufacturing company. The rectangles represent entities such as trading partners, customers, suppliers, financial institutions, carriers and public warehouses. The ovals represent the general functional areas of business such as engineering, sales/marketing, purchasing. All transactions between entities are shown along the data flow lines. These transactions could be in the form of paper-based, telephone or EDI transactions.
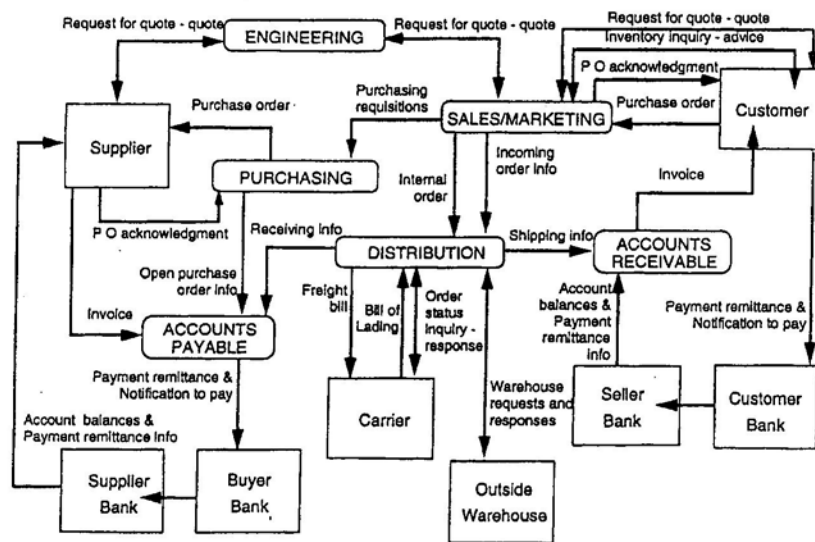

Figure 1.1   EDI in a Manufacturing Company (Sokol, P. K., 1995, p. 83)

The procure-to-pay cycle shown to the left of Figure 1.1 is between a company and its suppliers. The sales order processing to accounts receivable cycle shown to the right of Figure 1.1 is between a company and its customers. The transactions that take place in the two cycles are described below.

If inventory have reached reorder levels (inventory inquiry, inventory advice), a request for quotation (RFQ) is send by engineering to supplier. Purchase requisition is initiated by engineering. Purchase order is send to the supplier after it is authorized by purchasing department. EDI messages that may be used in the purchase order (PO) transaction include PO acknowledgement, PO change and PO change acknowledgment. Purchasing department may initiate an order status inquiry and receive an order status report at any time. If the goods purchased have been received in good order, purchasing will notify accounts payable to pay the supplier based on invoice, delivery order from supplier and receiving report from distribution. Once the goods have been shipped from distribution (warehouse), accounts receivable will be notified by sales/marketing to invoice the customer. Payment from the buyer (manufacturer) bank to supplier bank is usually through electronic fund transfer (EFT). Payment from customer bank to seller (manufacturer) bank is also through EFT. Shipping transactions include flow of information and physical goods between the manufacturer's distribution centers (warehouse), public warehouses and the shipping lines/inland transport (carrier).

Further details of EDI systems architecture which consists of value-added networks (VANs) and EDI network is shown in Appendix IV. Further information on EDI technology and standards (ANSI ASC X12 and ISO EDIFACT) is shown in Appendix V.

1.4 Internet EDI

Traditional EDI has evolved today to allow exchanges with web-based applications through the Internet. Web-based EDI allows electronic documents to be exchanged using a web browser. The company's data is first converted into an EDI standard compliant format

and transmitted to its trading partner through pre-populated forms with built-in business rules. In this way, a company can easily communicate with its trading partners and complies with their requirements.

Through an easy-to-use web interface, web-based EDI makes receiving, editing and sending electronic documents simple and efficient. Web-based EDI doesn't require installation of any EDI software. An Internet connection is all that is needed for reliable and secure EDI implementation. This allows companies to send to and receive from anywhere in the world, shipping documents, EDI invoices and other EDI documents. EDI transactions can be safely conducted with little support from IT staff because of the effectiveness of EDI controls (Hitech Dimensions Inc., 2002).

AS2, which stands for Applicability Statement 2, is a communication method that allows EDI data to be transported securely and reliably using the Internet. With an AS2 Internet EDI program, two computers, a client and a server communicate with each other via the Internet. When AS2 communication occurs, an envelope is created by AS2 program that uses both encryption and digital certificates to send the envelope securely (en.wikipedia.org/wiki/AS2).

Internet EDI makes conducting EDI transactions more affordable and accessible to small and medium size businesses. Internet EDI systems are attractive to companies already using traditional EDI because they allow the continued use of the business's initial investment in the EDI system while also allowing access to other trading partners who may not be EDI enabled (Huang et al., 2008). This is because Internet EDI integrates with the existing legacy EDI systems thus making Internet EDI interoperable with modern e-commerce packages.

Internet EDI has some disadvantages i.e., it is less secure and provides lower quality of service when compared with a value-added network (VAN) (web.mit.edu/ecom/wwwproject98/G6/3.html).

1.5 EDI in Malaysia

There are no publicly available statistical data on EDI usage on Malaysia as a whole. Published research work is on small samples such as in the shipping industry. The Malaysian Statistics Department, the National Productivity Centre (NPC), the Ministry of Trade and Industry and other government departments either do not collect or do not publish such data. Almost all studies concentrate on the SMK-DaganganNet which is provided by Royal Customs Malaysia and is mainly used by shipping and logistics providers. The implication is that a large portion of the EDI uses is confined to trade declaration by logistics operators and port operators.

Even in more advanced countries like the United States the EDI penetration rate is still low (Perry and Bodkin, 2002). Therefore it is reasonable to assume that for a less advanced country such as Malaysia, where EDI and other e-procurement methods have not really diffused here, the EDI usage must be even lower than that of the United States

In Malaysia EDI for trade facilitation is a government driven effort. The Malaysian customs information systems have been interfaced with DagangNet to form SMK-Dagang*Net to provide seamless EDI transactions between customs and users such as port authority, exporter, importer, shipping lines etc. EDI roll-out schedules for SMK-Dagang*Net in Malaysian ports and airports is described. The EDI applications developed by Dagang Net Technologies Sdn. Bhd. which is the implementor of SMK-Dagang*Net are also described. This section also describes other major EDI implementation in Malaysia i.e. EDI in for sea transport.

All shipping agents, freight forwarders, importers and exporters are required to use EDI for trade facilitation at the ports, e.g. Port Klang. EDI is also used for trade declaration, customs documentation and duty payment to the Customs Department. The Malaysian Royal Customs has mandated the use of EDI for trade declaration.

The SMK-Dagang*Net Interface Project is the Malaysian national EDI project. Sistem Maklumat Kastam (SMK) is the Malaysian customs administration's internal automated information system that has been operational since 1995. The SMK-Dagang*Net interface enables electronic exchanges between the Sistem Maklumat Kastam (SMK) and its clients through the value-added network i.e. Dagang*Net.

Some of the EDIFACT messages already implemented for customs purposes are CUSREP, CUSCAR, CUSDEC, CUSRES, PAYORD, DEBADV, PAYMUL, CREADV, CREMUL and SANCRT (see Table 1.1).

Table 1.1 EDI Messages for Customs Purposes

CUSREP	Customs conveyance report message
CUSCAR	Customs cargo report message
CUSDEC	Customs declaration message
CUSRES	Customs response message
CREADV	Credit advice message
CREMUL	Multiple credit advice message
DEBADV	Debit advice message
PAYORD	Payment order message
SANCRT	International movement of goods governmental regulatory message

 (src: http://www.stylusstudio.com/edifact/D00A/messages.htm)

The SMK and SMK-Dagang*Net Interface is implemented in phases with phase 1 within the Klang valley and phase 2 covering the southern states and all major sea and air ports. EDI via SMK-Dagang*Net was first available to the Port Klang Community System (PKCS) followed by Kuala Lumpur International Airport Community System (PKCS). MASkargo which is the air cargo services operated by Malaysian Airlines and other air cargo operators at KLIA are already using EDI.

In 2004, the project has entered into its third phase which is the nation-wide rollout of Sistem Maklumat Kastam. The SMK-DagangNet System is now available in 30 locations at all major airports and seaports, major border checkpoints, inland cargo terminals, free zone (ZB) areas and several smaller airports and seaports in Malaysia.

The number of EDI users of SMK-DagangNet has increased from about 975 in 2002 to about 3480 in June 2004. The volume of transactions in terms of kilobytes has increased from 9,485 million kilobytes in 2001 to 16,809 million kilobytes in 2003.

Dagang Net Technologies Sdn. Bhd. is the only value-added network operator who is involved in the DagangNet EDI related projects. Dagang Net Technologies Sdn Bhd. has developed a number of EDI applications such as ePermit, eDeclare, eLogistics, Vessel Information System (VIS) and MyPorts. These suites of applications are developed to provide port authority, customs, importers, exporters, forwarding agents, shipping agents and shipping lines with the necessary information for expediting container movement in and out of the ports. The applications above are described below.

The ePermit system allows importers, exporters and forwarding agents to apply for permits from permit issuing agencies and obtain approval via the Internet. Approved permits from the agencies will be transmitted electronically for validation and cross-reference purposes against customs regulations. By March 2006, three government agencies are linked to the ePermit portal. They are Federal Agricultural Marketing Authority (FAMA), the Pesticide Board and the Malaysian cocoa board. The implementation of the ePermit system would eliminate the need for paper-based trade documents and link all 23 permit-issuing agencies, Royal Malaysian Customs, importers, exporters and forwarding agents through the Internet. The web-based permit application system, ePermit would go online at all 23 permit issuing agencies by September 1, 2006. Dagang Net Technologies estimates that the ePermit system would be capable of transmitting an average of 250,000 permit applications per month, benefiting 5,000 importers and exporters in the country. The processing time of import and export permit applications was reduced from a week to just a day with the e-Permit system.

eDeclare is a web-based application to facilitate preparation and submission of trade declarations via the Internet. In order to access eDeclare, the user must provide the required

information using an online registration form. Once the company's registration is verified, the user can start using eDeclare with the purchased software.

eLogistics is a web-based application designed for the electronic preparation and transmission of Customs, Free Zone Authorities and Dangerous Goods declarations. eLogistics is used by the agent community in Port of Tanjung Pelepas, Port Klang and KLIA Cargo Village. eLogistics is designed for those in the transport and logistics industry such as shippers, customs brokers, freight agents to prepare and transmit their trade declarations to the relevant authorities.

The Vessel Information System (VIS) which is an Internet-based system developed to provide vessel and berth information for port operators, shipping agents, customs and port authorities was launched at Kuantan Port in August 2003. Information that is transacted through VIS will be routed to SMK-Dagang*Net for validation and cross-reference purposes against customs declarations.

MyPorts is a suite of service offerings that complement the core of SMK-Dagang*Net Services. MyPorts are web-based services provided by DagangNet Technologies and it specifically caters to the needs of the clients in the trade and logistics value chain.

("The PKCS is today widely acknowledged as a model implementation and reference site by other countries." *New Straits Times Press. ,8 Aug 2001.* ;

"Port Klang on the right track to becoming a regional load centre." *New Straits Times Press. 14 Aug 2000.;*

"Test results indicate that the trade documentation process for cargo moving through Port Klang(above) and KLIA will be disruption free come Jan 1, 2000." *New Straits Times Press. 15 Dec 1999.;*

"SMK-Dagang*Net to be expanded nationwide Note:MSC." *Business Times, 11 April 1997.;*

"Shipping agencies rap EDI for poor services." *Business Times, 3 May 1996.*)

Dagang Net Technologies will begin to implement UneDocs format in order to make EDI more affordable and accessible to small and medium enterprises (SME) in the import/export business. The format standardizes country, port, currency, measurement units and other codes for e-documents across national boundaries. These standardized e-documents would also comply with international regulatory, legal, taxation and other requirements.

Value Added Data Services (VADS) which is a joint venture between Malaysian Telecoms and IBM is another major EDI services provider in Malaysia. VADS has implemented EDI systems in Malaysia which include the Veterinary Community System which facilitates the electronic application of permits for the import/export of livestock or meat products, health certificates and payment. Medi*Link is an EDI system which connects participants in the medical community electronically. Supply*Link is an integrated EDI solution for buyers, suppliers and their trading partners. KWSP*Link is an EDI solution which connects banks and employers and employees for Employee's Provident Fund transfers. There are also a number of other private sector EDI operators besides Dagang*Net technologies and VADS.

A study on EDI use in the shipping industry in Port Klang showed that EDI was primarily used in transactions with the Customs Department for duty payments and import-export declarations (Ang et al., 2003). The volume of EDI transactions at Port Klang is high but limited in terms of diversity, breadth and depth. The results show that for the average EDI user at Port Klang, other than the mandatory transactions with the Customs Department, there were almost no transactions with other trading partners. The six most frequent document types used are export manifest (56.5%), import manifest (56.5%), dangerous goods declaration (34.8%), funds transfer (34.8%), dangerous goods response (28.3%) and trans-shipment manifest (28.3%). The study also found that the major barriers hindering EDI adoption are initial investment, requirements of trading partners and software-related and hardware-related issues faced by these companies.

1.6   Asian Region Customs EDI Project

EDI message exchange between Malaysian customs and the customs services of its major trading partners has been implemented in various stages. The advantages of these exchanges are improved productivity, reduced costs, goods imported or exported can be cleared faster through customs. The pilot EDI projects between Malaysia and its trading partners are discussed below.

The Asian region customs EDI project was initiated under the framework of the Internetworking Implementation Committee (IIC) of the Asia EDIFACT Board. Its objective was to enable Customs EDI message exchanges between cooperating customs administration of the participating countries. Currently, the countries participating in the pilot are Malaysia, Korea, Philippines, Chinese Taipei, the People's Republic of China and India. The weekly Export Declaration EDI message exchange between Korea and Malaysia went live on 19 April 2000. The Malaysian customs is also in the process of testing EDI exchanges with Chinese Taipei customs.

1.7   Problem Statement

Electronic data interchange (EDI) is an early form of interorganizational information system (IOS) (Cash and Konsynski, 1985) which is in use since the 1960s (Philip and Pedersen, 1997). An IOS is built around information technology that enables the creation, storage, transformation and transmission of information (Johnston and Vitale, 1988, Saeed et al., 2011). Even though EDI is a mature technology, it is still much in use today by many large companies to transact business with trade partners (Kauffman and Mohtadi, 2004; Narayanan et al., 2009). EDI has evolved and improved through the standardization efforts of ANSI and EDIFACT. The benefits of EDI adoption has been extensively studied in many disciplines (Graham et al., 1994; Jimenez-Martinez and Polo-Redondo, 2004; Li and Mula, 2009; Parfett, 1992, Themistocleous et al., 2004). EDI is also a value-added communications technology and enabler of change (Jackson and Sloane, 2003).

The EDI adoption rate is not encouraging in developing countries and also in the advanced economies such as the United States, Europe and Japan (Chau and Hui, 2001; Gottardi et al., 2009; Kanakamedala et al., 2003; Raymond et al., 2009). Early on, most EDI users are either large companies or companies operating in industries such as automotive, chemicals, logistics and pharmaceuticals where EDI use is common place. There has been an increase in EDI adoption in the last decade because of the Internet, cheap computing power and lower-cost EDI software (Computerworld, 2003; Economist, 2009; Philip and Pedersen, 1997, Plunkett, 2009).

There are relatively few in-depth industry-wide EDI research in the Malaysian manufacturing industry. Many Malaysian studies have focused on EDI in specific sectors (Ang, et al., 2003; Muthaiyah, 2004; Norzaidi, 2007). For example, Ang et al. (2003) and Norzaidi (2007) studied the use of the mandatory SMK-DagangNet by the shipping and port industry.

Muthaiyah (2004) studied how financial EDI is implemented in the Royal Customs and Excise department of Malaysia. The study investigates the implementation of FEDI, pre and post business processes, transfers of payment received by customs and forms clearance. The study also examines how business processes are enhanced and facilitated by FEDI.

The study focuses on a particular application of EDI, i.e. FEDI within the Customs department and addresses the following benefit issues and hypothesis.

1   Implementation of FEDI reduces workload, simplification and non-duplication of business processes

2   Implementation of FEDI systems will reduce wages and stationery cost

3   FEDI will increase number of transaction volume

4   Implementation of FEDI systems will increase the tax revenue of the government

5   Implementation of FEDI systems increases competitive advantage for an institution as a result of reduction in commission charged levied to participating agents

6   The implementation of FEDI will provide a platform for effective Customer Relation

Management solutions

Ang et al. (2003) study found that EDI was mainly used by logistics companies for duty payments and import/export declaration to the Customs department. The study found that EDI transactions was high in volume but its use is limited in terms of diversity, breadth and depth. The shipping industry had hardly any EDI transactions with other business partners except with the Customs department because its use is mandatory and essential to shipping operations. The other major issues faced by the shippers include cost of initial investment and requirements of trading partners and software-related problems.

Alam et al. (2008) studied e-commerce adoption in 194 electronic manufacturing companies in Malaysia using Roger's five innovation diffusion characteristics and security/confidentiality. Multi regression analysis results showed that relative advantage, compatibility and observability have positive and significant influence on EC adoption while complexity and security have negative and significant influence on EC adoption. Trialability is insignificant on EC adoption. The results concur with most major studies on e-commerce adoption (Jeyaraj et al, 2006; Narayanan et al., 2009). The new finding which is of most interest to researchers and managers is that security is negatively related to e-commerce adoption. This implies that by improving security and reducing the risk perception of companies will increase the usage of e-commerce.

Alam et al. (2009) surveyed the adoption of Internet in 465 SMEs from the Klang valley. Five of the seven factors that are tested are significant in Internet adoption for SMEs. The significant factors are manager's characteristics, perceived benefits, organizational culture, technological competency and cost of adoption, whereas the insignificant factors are English language proficiency and growth of the Internet. The cost of adoption with a positive effect on Internet adoption contradicts many studies (Chau and Tam, 2000; Kuan and Chau,

2001; Tornatzky and Klein, 1982) in which companies perceive higher costs as a barrier towards Internet adoption.

Alam et al. (2011) investigated the factors affecting the adoption of electronic commerce among SMEs in Malaysia using the diffusion of innovation variables of relative advantage, compatibility, the TAM variable of perceived ease of use and four other variables which are organizational readiness, security, perceived costs and manager's characteristics. Multiple regression analysis showed that relative advantage, compatibility, organizational readiness and manager characteristics have a significant positive effect on electronic commerce adoption in SMES whereas security have a significant negative effect on electronic commerce adoption in SMEs.

Mansor and Abidin (2010) investigated e-commerce application in Kelantanese SMEs. Their theoretical framework identifies significant relationships between the independent variables of marketing, logistic, procurement, security and government policy and the application of e-commerce in SMEs. The study found that logistic, security and marketing are positively and significantly correlated with the application of e-commerce in SMEs.

Shaharudin et al. (2012) examines the adoption of e-commerce in Malaysian SME furniture industry. The theoretical framework proposes that there is a relationship between organizational readiness, external pressure, perceived ease of use, perceived benefits and e-commerce adoption. Multiple regression analysis showed that organizational readiness, external pressure, perceived ease of use and perceived benefit have significant influence on e-commerce adoption. These results tend to concur with many studies using the technology acceptance model (Amoako-Gyampah and Salam, 2004; Turner et al., 2010; Yu et al., 2001).

Hamid et al. (2008) investigated the factors influencing the implementation of EDI in manufacturers. Their research model hypothesizes a relationship between firm size, type of user, influencing factors and implementation level. The findings indicate that the implementation level do not differ based on firm size, user type or influencing factors.

The studies discussed above showed that many of the EDI adoption studies in Malaysia are either limited in applications or to a specific sector. Related studies in Malaysia are on e-commerce adoption, Internet adoption, EDI implementation and e-commerce related such as Internet banking or mobile commerce. These studies are also mostly limited to either a particular industry (e.g. furniture) or to a subsector such as SMEs. Due to the above limiting factors and reasons, the proposed EDI research study is directed towards investigating a broader range of EDI uses in a target population of small, medium and large companies.

EDI usage statistics such as usage type, penetration rate and factors affecting adoption are not widely available for Malaysian manufacturers. The customs SMK-DagangNet, a trade-net for importers, exporters and logistics agents for trade declaration is the only EDI trade platform most often reported in the press (Business Times, 2006; Business Times, 2011, DagangNet, 2010).

The research literature and popular press have focused mostly on EDI facilitators and inhibitors for an adopter company. As a company identifies with EDI facilitators, EDI will become a prerequisite for all businesses (Pawar and Driva, 2000). Many Malaysian companies are not using EDI even though there are many direct and indirect benefits to be gained EDI adoption (Jimenez-Martinez and Polo-Redondo, 2004).

What are the motivators and demotivators for EDI adoption? Could it be awareness of EDI benefits is low or because of integration problems and competing technologies such as e-procurement or other factors? (Arunachalam, 1995; Zuckerman, 1999).

This exploratory study attempts to address a number of research gaps. The first is the lack of in-depth information on EDI usage in Malaysia manufacturing industry. Another motivation for this study is to determine why EDI is still not widely used. Risks and security factors have an influence on EDI adoption but this has not been extensively studied (Banerjee and Golhar, 1993; Ratnasingham and Swatman, 1997, Sanderson and Forcht, 1996). This study adopts the tried-and-tested framework of the technology-organization-environment

model to understand the facilitators and inhibitors of EDI adoption (Tornatzky and Fleischer, 1990). It is hoped that the research findings will provide academics with new data and research direction, managers with ways to promote EDI usage, marketers with ways to sell their EDI solutions and government with data for e-commerce policy formulation.

1.8   Research Objectives

In an attempt to close the gap in EDI research in Malaysia, this research study has the following objectives,

(1)   To determine the extent of EDI usage in Malaysian companies.

(2)   To identify significant factors that affect EDI adoption decision from a technology-organization-environment perspective (Tornatzky and Fleischer, 1990).

1.9   Research Questions

The following research questions are developed to achieve the study's research objectives. The questions are formulated to be as close as possible to previous research on the subject. This allows for easier comparison with past adoption research.

The following research questions are addressed.

(1) What is the function, diversity and breadth of EDI applications in Malaysian companies?

(2) What are the significant facilitators and inhibitors of EDI adoption?

Function includes sales, purchases, financial EDI and others. Diversity includes the different document types used in purchasing, sales, financial EDI and other EDI functions. Breadth represents the EDI-linkages to local customers, suppliers and banks and foreign customers, suppliers and banks

1.10 Significance of Study

Prior EDI studies have mainly investigated EDI adoption in sectors such as automotive, grocery industry, retailing and small and medium size businesses (Crum et al., 1996, Hill, and Scudder, 2002; Kuan and Chau, 2001; Jimenez-Martinez and Polo-Redondo, 2001, 2004). Most of these early studies are conducted in the United States, Europe, Singapore and Hong Kong which are among the first EDI adopter countries.

There have been relatively few studies that have examined EDI usage and adoption across industry groups (Hamid et. al, 2008). Malaysian EDI information in the public domain is mostly centered on the progress of the national EDI project, i.e. SMK-DagangNet. SMK-DagangNet's main objective is to facilitate trade documentation and is mainly used by companies in the logistics business e.g. shippers, importers and exporters. There is a scarcity of publicly available information on EDI usage besides SMK-DagangNet. EDI studies in Malaysia mostly investigate specific industry sector or small-medium size company (Ang et al., 2003; Muthaiyah, 2004; Norzaidi, 2007). EDI studies across industry groups can benefit not just companies in one sector but companies in many other sectors as well. Policy setting government agencies will find EDI studies across industry groups to be more useful than single sector EDI studies because these agencies need to make broad policy decisions that affect many industries.

There is also a lack of studies on the significance of risk and security factors on the EDI adoption decision (Banerjee and Golhar, 1995). This study attempts to address this research gap by investigating the importance of these variables on EDI adoption.

EDI has the potential to transform Malaysian companies internally and externally and make them leaner, more efficient and more competitive domestically and globally. In spite of its many touted benefits, many Malaysian companies have yet to adopt EDI willingly. This study attempts to collect information on EDI usage, facilitators and inhibitors. With a better understanding of the factors that affect EDI adoption, companies, industry associations,

marketers and government which seek to increase EDI usage among companies can address the adoption issue better.

1.11 Research Methodology

This study adopts a positivist research perspective where the existence of a priori fixed relationships within phenomena is typically investigated with structured instrumentation (Orlikowski and Baroudi, 1991). Positivist studies serve basically to test theory, in an attempt to increase predictive understanding of phenomenon.

In this study, research questions were formulated and hypothesis were developed and tested. The primary data was collected via a self-administered survey covering the Malaysian manufacturing industry. Statistical analysis which includes reliability test, t-tests, means, logistic regression and other relevant multivariate techniques were used to test the reliability, validity of the data and also to test the hypothesis. The details of the study's research methodology, operationalization of the construct and development of the questionnaire are addressed more fully in Chapter IV.

1.12 Definition of Terms

The terminology for EDI adoption research is presented.

Electronic data interchange (EDI) is defined as the inter-organizational computer-to-computer exchange of structured information in a standard, machine-processable format (EC world institute resource centre).

Inter-organizational Information Systems (IOS) are systems based on information technology that cross organizational boundaries; a typical IOS is an information system that links one or more firms to their customers or their suppliers and facilitates the exchange of products or services (Johnston and Vitale, 1988).

Information Technology (IT) as defined by the Information Technology Association of America (ITAA) is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer

hardware." (wiki.answers.com/Q/What_is_information_technology) IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and securely retrieve information.

Information Systems refers to a system of people, data records and activities that process the data and information in an organization, and it includes the organization's manual and automated processes. In a narrow sense, the term *information system* (or computer-based information system) refers to the specific application software that is used to store data records in a computer system and automates some of the information-processing activities of the organization. Computer-based information systems are in the field of information technology.

Innovation is defined as an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 1983, 1995, 2003).

Diffusion is defined as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1983, 1995, 2003).

Diffusion of Innovations is a theory that seeks to explain how, why and the rate at which new ideas and technology spread through cultures. Rogers (1983, 1995, 2003) identifies 4 main elements that influence the spread of a new idea, i.e. the innovation, communication channels, time and a social system.

Social Exchange Theory is initiated by Homans (1958) to describe the social behavior of humans in economic undertakings. Social exchange theory core concept is based on the premise that the exchange relationship between specific actors are actions which are contingent on rewarding reactions from others (Blau, 1964, p.91).

The critical mass theory was developed to integrate theories of collection action (Oliver et al., 1985). The theory posits that the diffusion of an interactive innovation (telephone, paper mail systems, electronic mail, voice) will take off when a critical mass of users is reached, at which time the full benefits of the innovation will be received by all (Markus, 1987).

1.13 Organization of this Study

Chapter I – Introduction: This chapter presents an overview of electronic data interchange (EDI). The historical development, mechanism, Internet EDI, EDI in Malaysia and the Asian region customs EDI project are discussed next. The problem statement, research objectives and research questions are addressed followed by the significance of the study. The research methodology is described briefly followed by the terminology of electronic data interchange. Finally an outline of the organization of the report is provided.

Chapter II – Literature Review: In the second chapter, a systematic review process of identifying literature to be included is presented followed by literature based on the theoretical bases of innovation research such as diffusion of innovation theory, critical mass theory and social exchange theory are discussed. Literature based on the study's variables from an organizational, environmental and technological perspective and its relationship to innovation adoption in an IOS environment is reviewed.

Chapter III – Research Framework and Hypotheses: In the third chapter, the research framework for guiding the investigation of factors that influence EDI adoption is introduced. Hypotheses are developed from the proposed research framework.

Chapter IV – Research Methodology: In the fourth chapter, the research methodology, sampling frame, questionnaire development, data collection procedures and data analysis strategies are presented.

Chapter V – Research Results and Findings I: In the fifth chapter, the survey results are reported. Descriptive statistics of the survey data are discussed. A comprehensive discussion of the data analysis techniques for valid and reliable instruments and statistical tests for the research hypotheses are provided. Following this, factor analysis results are presented.

Chapter VI– Research Results and Findings II: In the sixth chapter, analysis of residuals, test for multicollinearity and test of linearity in the logit are reported. The goodness of fit of the logistic regression models are tested using pseudo-R^2 measures, the model χ^2 and -2log

likelihood statistic. The Wald statistic and the Hosmer and Lemeshow goodness of fit test are discussed. Interpretation of logits, measures of predictive efficiency, classification tables and statistical significance of classification rate are presented.

Chapter VII – Conclusion: In the seventh chapter, summary discussions of the survey results are provided. The limitations, theoretical and practical contributions and implications are presented next. Future research directions are provided and the study ends with some final concluding remarks.