CHAPTER III

RESEARCH FRAMEWORK AND HYPOTHESES

The research framework to test factors that influence EDI adoption decision in Malaysian manufacturing companies is presented. Research hypotheses developed based on the technology-organization-environment framework are discussed next.

3.1 Research Framework

The IT governance model (Wilkin and Chenhall, 2010) and Weill and Ross (2004) has been examined to determine its suitability in the research framework. Although there are some similarities in the independent variables, the model is incompatible with the relationships hypothesized for our research framework and therefore cannot be incorporated into it.

The research framework and questionnaire are not specifically designed for structural equation modeling (SEM). Most SEM analysis in information systems research are based on either TAM (Lai and Lee, 2004; Lin, 2009), TPB (Pavlou and Feygenson, 2006), TRA (Hansen et al., 2004) or UTAUT (Im et al., 2011) models. For TRA, variables attitude (A), subjective norm, PCB and BI are needed for SEM analysis. Variables such as perceived usefulness (PU) and perceived ease of use (PEOU) and behavioural intention (BI) are needed for TAM SEM analysis. Variables such as subjective norm and perceived behavioural control (PCB) are needed for TPB SEM analysis. In the case of UTAUT models, variables such as BI, use behaviour, performance expectancy, effort expectancy, social influence and facilitating conditions need to be collected. The main reason for not using structural equation modeling (SEM) is because the research framework is not based on the behaviour-use link and the required variables are not collected.

The diffusion of innovation theory (DOI), social exchange theory (SET), trust theory and critical mass theory (CMT) are synthesized into the Tornatzky and Fleischer (1990) technology-organization-environment research framework (Figure 3.1) shown below.

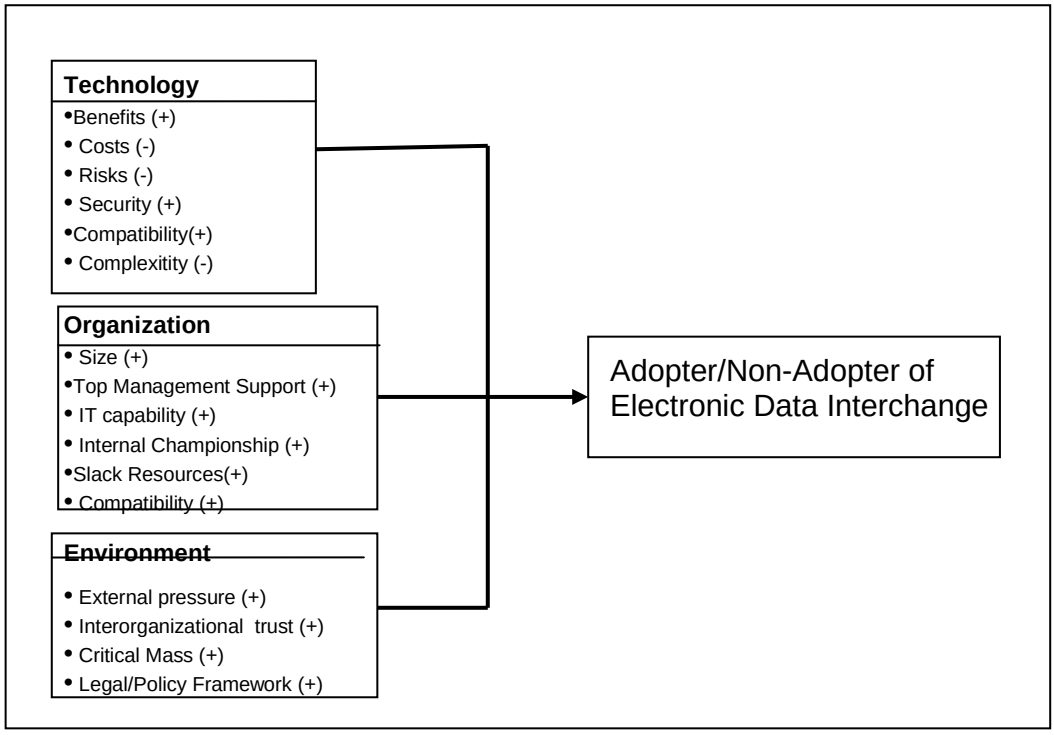

Figure 3.1: Research Framework: Factors that influence adoption of Electronic Data Interchange
(Adapted from Tornatkzky and Fleischer, 1990; Zhu et al., 2003)

Tornatzky and Fleischer (1990) developed the technology-organization-environment framework which can be applied to research in the adoption of general technological innovations. The technology-organization-environment contexts influence the process by which a company adopts and implements information technology. Technological context refers to the internal and external technologies relevant to the firm. Organizational context is usually defined in terms of company size, the amount of slack resources, informal linkage and communication and top management leadership. Environmental context describes the environment (industry, competitors, suppliers, government) in which the company conducts its business (Tornatzky and Fleischer, 1990: 152-154), intensity of competition, technology support infrastructure and government regulation.

This framework has been empirically tested and found to be useful in understanding the adoption of technological innovations as evidenced by prior adoption studies discussed next (Chau and Hui, 2001; Chau and Tam, 1997; Iacovou et al., 1995; Kuan and Chau, 2001; Zhu et al., 2003).

Iacovou et al. (1995) model incorporates three EDI adoption factors, i.e. perceived benefits (technological), organizational readiness (organization) and external pressure (environment) that has been empirically validated by seven case studies. Chau and Hui (2001) research model identifies the significant factors from the technological, organizational and environmental context in small business EDI adoption. Chau and Tam (1997) model for open systems adoption based on the Tornatzky and Fleischer (1990) framework is used to identify factors which represent the three major context of open systems adoption.

Kuan and Chau (2001) developed the perception based model for small business EDI adoption in Hong Kong from the technology-organization-environment framework. They used the model to test perceived direct benefits, perceived indirect benefits, perceived financial cost, perceived technical competence, perceived industry pressure and perceived government pressure. The model for electronic business adoption (Zhu et al., 2003) to identify adoption facilitators and inhibitors is also based on the technology-organization-environment framework. The studies above show the usefulness and applicability of the technology-organization-environment framework to study adoption under different conditions.

The technology-organization-environment research framework provides a comprehensive framework to investigate organization EDI adoption because it not only combines the organization context of size, top management support and internal championship but also addresses the characteristics of technology (DOI) and the exchange relationships (SET/trust theory) and critical mass under environment context. The technology-organization-environment framework best addresses the organizational adoption of an interorganizational information system of EDI which no single theory is able to do on its own by taking into account all the three major context of IOS adoption.

Based on the technology-organization-environment framework (Tornatzky and Fleischer, 1990) which argues that adoption decisions should be examined within these contexts, the research framework proposes that the decision to adopt electronic data

interchange (EDI) is influenced by (a) characteristics of the technology (technological context), (b) organizational characteristics (organizational context), and (c) environmental characteristics (environmental context).

Technological compatibility and slack resources were dropped from the final model as they are not suitable for the Malaysian context. Furthermore, the two variables are not strong predictors of adoption and are not often used in adoption research settings (Jeyaraj et al., 2006; Narayanan et al., 2009). The non-inclusion of these two variables would also lead to a leaner and more parsimonious model.

The research framework for EDI adoption with the corresponding hypothesis is shown in Figure 3.2.

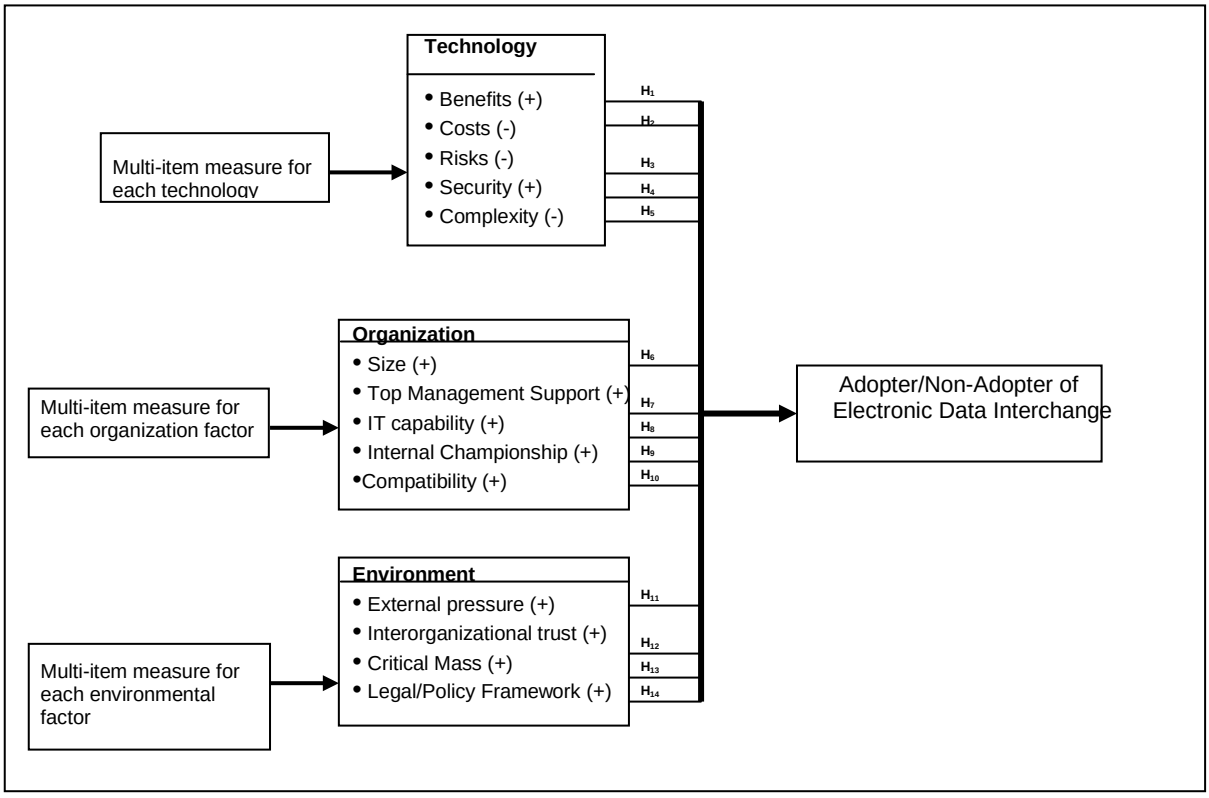

Figure 3.2 Conceptual model for EDI adoption (Adapted from Tornatkzky and Fleischer, 1990; Zhu et al., 2003)

3.1.1 Technological Context

The technological context is examined through the lens of DOI theory using the characteristics (attributes) of electronic data interchange. The factors of benefits, costs, risks

and security is drawn from the innovation adoption literature reviewed (Chwelos et al., 2001; Tornatzky and Klein, 1982; Ratnasingham and Swatman, 1997; Sanderson and Forcht, 1996). The influence of innovation characteristics on the innovation adoption process has been frequently reviewed in the IS literature (e.g. Kwon and Zmud, 1987; Rogers, 1983, 1995, 2003; Tornatzky and Fleischer, 1990; Tornatzky and Klein, 1982). Meta-analysis of the IS innovation implementation literature (Tornatzky and Klein, 1982) has identified compatibility, relative advantage, and complexity consistently as important variables associated with innovation behaviors.

No accepted list of innovation attributes has emerged even though many typologies have been proposed and are discussed below.

Five attributes of innovation, i.e. relative advantage, compatibility, trialability, complexity and observability were first identified by Rogers and Shoemaker (1971). After these initial attributes appeared in the literature, other innovation attributes and characteristics have been proposed. Zaltman et al. (1973) extended Rogers and Shoemaker's (1971) five attributes to 21 attributes. Other typologies and attributes have been proposed later (Beyer and Trice, 1978; Daft and Becker, 1978; Nord and Tucker, 1987). Rogers (1983, 1995, 2003) identified five perceived attributes of innovation (relative advantage, compatibility, complexity, trialability and observability) that consistently influence adoption.

This study focuses on the following EDI characteristics (relative advantage/benefits, costs, risks, security and complexity) which are discussed in detail in Section 3.2.1

The innovation adoption literature argues that the innovation characteristics may be perceived differently by different adopters. Research should therefore adopt a "perception-based characteristics of innovations" approach rather than based on the "primary characteristics" which do not vary across settings and organizations (Downs and Mohr, 1976; Moore and Benbasat, 1991). Following from this argument, this study focuses on the perceived characteristics of electronic data interchange.

3.1.2 Organizational Context

The organizational context refers to the internal characteristics of organizational structure that exert an influence on the organization adoption behavior.

Research has shown that the organization provides a rich source of structures and processes that either constrain or facilitate the adoption of innovations (Tornatzky and Fleischer, 1990). The organization context of Tornatzky and Fleischer (1990) technology-environment-organization framework provides the innovation adoption factors of size, championship and top management support for the study's research framework while the compatibility factor is drawn from the DOI theory. The organizational characteristics of company size, top management support, IT capability, slack resources, championing, organizational readiness, and organizational compatibility have been found to have a significant influence on adoption (Damanpour, 1991; Jeyaraj et al., 2006; Premkumar et al., 1994; Ramamurthy and Premkumar, 1995; Rogers, 1983, 1995, 2003; Tornatzky and Fleischer, 1990).

Based on the discussion above, this study focuses on the characteristics of size, top management support, information technology capability and organizational compatibility which are explained in detail in Section 3.2.2.

3.1.3 Environmental Context

The environmental context refers to the characteristics of the environment in which the company operates. Prior research has shown that elements of the external environment such as the social, competitive, industry and regulatory context consistently influence adoption behavior. Environmental characteristics that have been studied in innovation literature are external influence, government regulations, market uncertainty, supplier relationships, power, trust and critical mass (Bouchard, 1993; Grover, 1993; Hart and Saunders, 1997; Katz and Shapiro, 1986; Markus, 1987; Tigre, 2003).

The innovation adoption factors of legal framework is adapted from government regulation drawn from the external task environment of the technology-environment framework (Tornatzky and Fleischer, 1990), critical mass factor is drawn from critical mass theory, interorganizational trust is drawn from trust theories/social exchange theories while external pressure factor is drawn from the innovation adoption literature (Chwelos et al., 2001; Daniel and Grimshaw, 2002; Premkumar and Ramurthy, 1995; Zhu et al., 2003).

From the preceding discussion, it follows that this study should focus on the characteristics of external pressure, interorganizational trust, critical mass and legal framework which are discussed in detail in Section 3.2.3.

3.1.4 Adoption Dependent Variable

The adoption variable was operationalized in this study as a dichotomous variable and takes on the two values of adopter (1) and non-adopter (0). An adopter is a company which is using EDI during the survey. A company in the process of adopting and implementing EDI is also classified as an adopter. A non-adopter is a company which is not using EDI.

A number of studies have used the adoption variable in the study of the adoption of technological innovations. Hwang (1991) also studied the adoption/non-adoption of EDI systems from the context of industry characteristics and organizational characteristics using adoption /non-adoption as the dependent variable. Kuan and Chau (2001) likewise used this dichotomous variable as a dependent variable in the technology-environmental framework to investigate EDI adoption for small businesses in Hong Kong. Henriksen (2002) also examined the motivators (size, part of an industry group, being a wholesaler) for the adoption of EDI in Danish companies with adoption/non-adoption as the dependent variable. Zhu et al. (2003) also used the adoption/nonadoption as the dependent variable in their study of e-business adoption using the technology-organization-environment framework. Soares Aguiar and Palma-dos-Reis (2008) studied the adoption of electronic procurement systems using

variables from the technological, organizational and environmental context with adoption as the dependent variable.

The above studies address different innovation context, uses logistic regression for analysis and generally found that the variables from TOE framework were eminently suitable to study adoption under these different contexts.

Chwelos et al. (2000) studied the relationship between the 3 variables of external pressure, perceived benefits and readiness and the variable “intent to adopt” using PLS. Huang (2003) similarly studied the adoption of I-EDI using variables from the technological, environmental, interorganizational and organizational readiness context using structural equation modelling with adoption as the dependent variable.

Seyal and Rahim (2006) studied adoption as the level of adoption with a Likert scale from 1 (not adopted) to 5 (fully adopted). They studied EDI adoption in Bruneian SMES, used a contextual model of organizational, external and economic factors and used multiple regression for analysis.

Lin (2006) studied the extent of e-commerce adoption in SMEs in Taiwan from a TOE perspective The extent of e-commerce adoption was studied as B2B inbound communications, B2B procurement, B2C outbound communications and B2C ordertaking and each of the four components was individually regressed against the variables from the TOE context.

As can been seen from the above, the dependent variable adoption can be studied as a dichotomous variable, as the intent to adopt and as the level/extent of adoption. These methods of measuring adoption has its advantages and limitations. When modelled as a dichotomous variable it is very clear that we are limited to logistic regression analysis, however we can be very certain of our measurement (ie. either a company has adopted or not adopted EDI or any other innovation). However, in the case of intent to adopt and level/extent of adoption we are open to more subjective interpretation. The measures for these vary greatly

depending on technology studied and the researcher. Even the responses may vary greatly from one respondent to another even within an organzation.

3.2 Hypotheses

Hypotheses for the technological, organizational and environmental factors identified in the research framework are developed in this section.

3.2.1 Technological Context

Hypotheses of the technological factors of benefits, costs, risks, security and complexity are developed in the following sections.

3.2.1.1 Benefits

Benefits refer to the perceived gains of adopting electronic data interchange. A rationally behaving organization is expected to adopt an innovation only if it believes that the innovation offers significant benefits compared to alternative choices or to what the organization is currently using. Prior research shows that perceived benefits exert a strong positive influence on the organizational adoption of innovation (Crum et al., 1996, Jimenez-Martinez and Polo-Redondo, 2004, Ramamurthy and Premkumar, 1995). These studies also found that perceived benefits are important predictors of EDI adoption (Banerjee and Golhar, 1993; Chwelos et al., 2001; Iacovou et al., 1995; Kuan and Chau, 2001, Peffers et al., 1998).

Benefits have been studied and its importance ranked in different studies (Arunachalam, 1995, 1997; Banerjee and Golhar, 1993; Bouchard, 1993; Li and Mula, 2009; Scala and McGrath, 1993). Arunachalam (1995) found improved customer service, reduced clerical errors and improved data control to be the most important benefits while Banerjee and Golhar (1993) found improved customer service, improved control of data and reduced clerical errors as most important benefits. Scala and McGrath (1993) found improved information accuracy and reduced errors, reduced data entry and speeds information transmission between organizations as most important. The most important benefits identified in the studies are inconsistent mainly because not all of the benefits studied are the same. Benefits perceived to

be most important may be dependent on the type of technology to be adopted and whether the technology is interorganizational in nature or not.

Iacovou et al. (1995) first studied how organizational readiness, external pressure and perceived benefits influence EDI adoption in small firms. This model has since been tested by other researchers and perceived benefits are shown to be positively related to EDI adoption (Chwelos et al., 2001; Van Heck and Ribbers, 1999).

Benefits have been studied in a technology-organization-framework as direct benefits and indirect benefits in small business EDI adoption (Kuan and Chau, 2001). Direct benefits are perceived to be higher by adopter firms than non-adopter firms while indirect benefits are not perceived differently.

From the discussion above, it is hypothesized that:

H_1: Benefits will be positively related to EDI adoption.

3.2.1.2 Costs

Costs refer to the perceived costs of adopting, implementing and using EDI. EDI costs include installation (setup), migration, training, operations (running), maintenance and integration costs. Tornatzky and Klein's (1982) meta-analysis shows that besides the compatibility, complexity and relative advantage characteristics, the cost of an innovation is a key variable in innovation adoption. Higher cost is negatively associated with adoption but some researchers argue that once an adoption decision is made, these higher costs can be positively associated with diffusion because it is in the organization best interest to leverage the high sunk investment to its best advantage (Premkumar et al., 1994; Zaltman and Duncan, 1973).

From the discussion above, it is hypothesized that:

H_2: Costs will be negatively related to EDI adoption

3.2.1.3 Risks

Companies need to assess EDI adoption risks. Risks refer to the perceived risks of using EDI. The risks could arise from factors internal or external to the company. EDI risks give rise to a number of auditing, security and control issues which are the legitimate concern of companies adopting EDI (Arunachalam, 1995; Bergeron and Raymond, 1997; Crook and Kumar, 1998).

Internal risks come from using EDI in the company. These risks are inherent to EDI technology. EDI does not use paper (source) documents and hence the absence of an authorized signature on a paper (source) document (Hansen and Hill, 1989). Authorization for EDI transactions is implemented through the use of access controls which limit certain EDI functions to different classes of users (Bergeron and Raymond, 1997). Audit trails for EDI transactions between trading partners need to be logged using transaction logs. Information such as user, date and time stamp for each transaction becomes mandatory and is enforced in software. The audit trail serves two purposes, i.e. to allow for an auditor to examine the records for auditing purposes and to allow for conflict resolution in the case of disputes concerning EDI transactions.

External risks refer to risks that occur during EDI message transmission between trading partners. Such risks include incomplete messages, errors in received EDI messages, tampered EDI messages and hacker intercepted EDI messages. There is a need to verify that the data were received exactly as sent, i.e. data integrity is maintained in EDI exchanges between parties. Because all companies doing EDI are now using communications protocols with error-detecting capability, there is the assurance that the data received will be identical to that sent (Sokol, 1995). The translator program on the receiving end will examine the EDI data stream that was sent and will generate a functional acknowledgement (FA) which is returned via EDI to the sending trading partner. The functional acknowledgement contains documentation of any errors found as well as notification of acceptance or rejection at the

preagreed level: functional group, transaction set, or segment/data element level. If the EDI data stream is rejected then the rejected data must be resent (Arunachalam, 1995; Sokol, 1995).

Lim and Jamieson (1995) discuss the organizational perceptions of EDI risks and controls. The most significant risks identified were those associated with loss or delay of documents during transmission, errors or alterations introduced into messages, network interconnection risks and risks arising from inadequate record retention controls and legal liability. Their study ranks the importance of EDI risks, implementation, operational and network controls.

Findings by Eastin (2002) show that perceived risks play an important role in the adoption process of (1) online shopping (2) online banking (3) online investing and (4) electronic payment for an Internet service. Tan et al. (2008) found that the lack of confidence in security is the main barrier to ICT adoption in Malaysian SMEs. Hussin et al. (2008) investigated the willingness of Malaysian SMEs to adopt e-commerce and their findings showed that the security of payment systems is the highest ranked barrier to e-commerce adoption. 70% of the Malaysian companies surveyed on e-business indicated that security concerns was the most important barrier to e-commerce development (Abdul Mukti, 2000). Alam et al. (2008) also found that security risks/confidentiality was negatively related to e-commerce adoption in electronic manufacturing companies in Malaysia. The reason why most people are still sceptical about using electronic commerce is the perceived security risks associated with electronic transactions over the Internet (Labuschagne and Eloff, 2000). Concerns about the security risks of e-commerce systems and payment systems are perceived to be important barriers to e-commerce adoption (Liebermann and Stashevsky, 2002**;** Poon and Swatman, 1997**;** Van Akkeren and Cavaye, 1999).

From the discussion above, it is hypothesized that:

H_3: Risks will be negatively related to EDI adoption

3.2.1.4 Security

Electronic commerce security is defined as the protection of an information resource and system against the threat of risks in the integrity, confidentiality, authenticity, non-repudiation, availability and access control of the electronic transactions transmitted and more importantly “the reliability of the direct parties” involved in electronic commerce (Ratnasingham, 1998).

The common concerns of traditional and Internet-based EDI are reliability and security (Ratnasingham, 1998). Internet-based EDI lacks security and does not always guarantee delivery and is more open to fraud and deception (Ratnasingham, 1998).

Organizations using EDI are concerned with data security issues (Bergeron and Raymond, 1997; Tuunainen, 1999). Organizations that perceive EDI security as being weak or lacking are less likely to adopt EDI. Data security is important both in the company during EDI use and between the company and its trading partners during data transmission. Two important elements of data security are authentication and encryption (Pipkin, 2000; Pfleeger, 1997). Authentication guarantees the receiver that the data received has not been tampered with and the sender of the data is who he claims to be, i.e. he is not an impostor. Encryption guarantees that the data which is intercepted during transmission of the EDI message remains confidential. A public key infrastructure (PKI) that uses digital certificates is an example of a system that provides for both encryption and authentication. Digital signatures offer authentication of the originating party. A digital signature is part of a digital certificate. If the digital signature is invalid then the contents of the EDI transmission should be rejected.

Password is the most common access control mechanism for EDI transactions. Passwords when used properly are a safe means of authorization for EDI transactions. If an organization do not perceive that the security mechanisms offered by EDI is adequate, then it is less likely to adopt EDI.

Organizations often perceive the lack of security enforcement in electronic transactions as a significant barrier to the adoption of electronic commerce and interorganizational information systems, (Hsiao, 2001), ERP (Lijuan, 2011), eprocurement (Gunasekaran and Ngai, 2008) and e-commerce (Mansor and Abidin, 2010). Similar concerns were expressed by 70% of the respondents in a survey of e-business in Malaysian companies who identified security as the most important barrier to e-commerce adoption (Mukti, 2000). Cheng et al. (2006) found that Web security has a direct positive relationship with customer's intention to adopt Internet banking. Gunasekaran and Ngai (2008) argued that having security systems will encourage adoption of e-procurement by allowing stakeholders to develop enough confidence for electronic exchanges. Higher levels of security for e-business transactions will provide a risk free environment for organizations to transact electronic commerce. Organizations will feel safer in the knowledge that no major security incidents will occur and this will be be a positive factor in their adoption decisions. Therefore it is posited that higher levels of security such as enforced standards, the enforced use of digital signature and passwords will lead to higher levels of EDI adoption.

From the discussion above, it is hypothesized that:

H_4: Security will be positively related to EDI adoption

3.2.1.5 Technological Complexity

Complexity refers to the extent to which an innovation is perceived as difficult to understand and use (Rogers, 1995: 242). To the adopting organization, technological (technical) complexity refers to the extent that the innovation can be implemented on a limited basis, the sophistication or intellectual difficulty associated with understanding the innovation and the extent of newness of the innovation (Gopalakrishnan and Damanpour, 1994: 103). Technological innovations are generally complex products with unfamiliar (new) attributes to the adopting organization. The degree to which technical skills are required to use the innovation may inhibit its adoption (Cooper and Zmud, 1990; Robertson and Gatignon,

1986). Complexity will be negatively associated with adoption unless users have high achievement needs or possess great skill and knowledge (specialists or techies).

Complexity is a multidimensional construct. Bouchard (1993) classifies complexity into business and technical complexity. Business complexity is the degree to which EDI is perceived as difficult to understand and use from a business perspective. Technical complexity is the degree to which EDI is perceived as difficult to understand and use from a technical perspective. Innovation complexity usually described as the perceived difficulty of understanding and using the innovation has been observed to discourage adoption and later lead to greater difficulty in implementation and further diffusion (Tornatzky and Klein, 1982).

From the discussion above, it is hypothesized that:

H_5: Technological complexity will be negatively related to EDI adoption

3.2.2 Organizational Context

Hypotheses of the organizational factors of size, top management support, information technology (IT) capability, organizational compatibility and internal championship are developed in the following sections.

3.2.2.1 Size

Organization size has been consistently found to be positively related to innovation adoption (Damanpour, 1992; Damanpour and Evan, 1984; Fennell, 1984; Kimberley and Evanisko, 1981, Soares-Aguiar and Dos-Reis, 2008). There is some evidence that large organizations adopt disproportionately more innovations than smaller organizations (Mansfield, 1968).

The tendency for larger organizations to adopt more innovations has been attributed to critical mass (Baldridge and Burnham, 1975) and the availability of slack resources. The slack resources are financial, technological and human resources. The increased problems of coordination and control in a large organization may encourage the adoption of new technology because it helps to reduce coordination complexity and costs (Slappendel, 1996).

Larger organizations tend to be involved in a greater variety of production activities and are more likely to find any given innovation applicable to their operations (Tornatzky and Fleischer, 1990: 169).

Larger organizations have several advantages over small organizations. Larger organizations are more likely to achieve economies of scale which is necessary due to substantial investments in new technology and thus be profitable. They tend to have more slack resources to facilitate adoption and have more capability to absorb the high risk associated with investment in new technology. They also possess more power over their trading partners and thus are able to either force or urge their trading partners to adopt the new technology. Economies of scale for EDI can only be achieved when there is sufficient EDI volume and types conducted with a sufficient number (critical mass) of EDI trading partners.

Others have disputed the above reasons given for more adoption by larger organizations by arguing that smaller companies are more likely to adopt innovations because of their greater flexibility and adaptability which makes them able to respond to the market quickly through the use of innovative technologies such as EDI (Chen and Williams, 1998; Grover, 1993; Utterback, 1971, 1974).

From the discussion above, it is hypothesized that:

H_6: Size will be positively related to EDI adoption

3.2.2.2 Top Management Support

Top management support is a critical factor for innovation adoption, its successful implementation and use (Crook and Kumar, 1998; Emmelhainz, 1988, Jeyaraj et al., 2006). This support is not just merely approval to proceed with the project, but active enthusiastic support and commitment which provides a positive environment throughout the organization (McGinnis and Ackelsberg, 1983). Top management support is necessary to effectively manage the complexities that accompany the introduction of new technology (Ramamurthy et al., 1999). Past research on innovation adoption and implementation success has shown that

top management vision, commitment and support have emerged consistently as key factors (Quinn, 1985). Active support of top management enables development of a strategic vision and direction in addition to sending appropriate signals to other parts of the organization about the importance of the innovation (EDI) project (Burgelman, 1983). Since EDI has the potential to influence the competitive position of the organization as well as its business relations with its trading partners, it is important for top management to have a good understanding of the stakes involved and to mobilize commitment of other organizational stakeholders (Sokol, 1989; Senn, 1992). Top management involvement is also required to persuade the organization's trading partners to use EDI and to convince them that EDI use is in their best interests (Meyers and Canis, 1992). Without top management support, an innovation is less likely to be adopted (Ettlie, 1983; Zmud, 1984). IS implementation research has shown that top management support is a good predictor of successful introduction of a new technology (Ives and Olson, 1984; Kander, 1985).

From the discussion above, it is hypothesized that:

H_7: Top management support will be positively related to EDI adoption

3.2.2.3 Information Technology Capability

IT capability refers to the availability of IT expertise, EDI know-how and the supporting IT infrastructure in the organization. IT expertise includes the IT specialist knowledge to support the system as well as the employee's knowledge of using these EDI technologies (Zhu et al., 2003). Dewar and Dutton (1986) found that the only consistent predictor of incremental adoption is the depth of knowledge resources in the firm. The effect of depth of knowledge resources is even more significant for adoption of radical innovation. Technical specialists are more exposed to new ideas or innovations and can easily understand the importance of the innovation and recommend it to their organizations. Therefore organizations with technical or IT knowledge are more likely to adopt a technological innovation (Soares-Aguiar and Dos-Reis, 2008). EDI is a complex interorganizational system

which is composed of software, hardware and telecommunications technology. IT expertise and EDI know-how are therefore required to adopt, support and successfully implement EDI throughout the organization. The lack of sufficient IT capability has been found to be an important barrier to adoption and use of interorganizational information systems (Crook and Kumar, 1998; Premkumar and Ramamurthy, 1995).

It is important for an organization to have the necessary infrastructure to successfully implement the new technology and obtain its full benefits (Cash et al., 1992). Any new technology has its attendant risk and a firm that has the necessary infrastructure would perceive less risk and therefore be more willing to adopt the new technology. Firms with adequate telecommunications infrastructure and experience with integrated database applications are more likely to feel less threatened by the complexity of the EDI technology. A significant IS infrastructure is required to adopt EDI, establish links with multiple systems of trading partners, and integrate with internal IS applications" (Premkumar and Ramamurthy, 1995). Innovation literature has argued that any technological innovation adoption should be based on a firm's technological strengths **(**Burgelman, 1983; Damanpour and Evan, 1984). Research has shown that interorganizational linkages that connect the firm's internal infrastructure to the external infrastructure of its trading partners positively influence innovation adoption (Keen, 1988; King et al., 1995; Malone et al., 1987).

The level of technical expertise and EDI knowledge has also been found to be positively related to EDI implementation success (McGowan and Madey, 1996, 1998).

From the discussion above, it is hypothesized that:

H_8: IT capability will be positively related to EDI adoption

3.2.2.4 Internal Championship

Internal championship refers to the existence of a person who actively promotes or sponsors the introduction of a new technology in the organization. Champions are often highly enthusiastic and committed individuals. Initially, they convince higher level

management that a new product or process is feasible, beneficial and is needed by the organization (Beath, 1991; Burgelman and Sayles, 1986). Champions often help to secure resources and coordinate the various activities related to the acquisition of the technology (Ettlie et al., 1984; Kimberley and Evanisko, 1981; Rai and Patnayakuni, 1996). They also help to overcome user resistance to new technologies by educating and creating an awareness of the potential benefits of the technology. The lack of champions for e-commerce is a barrier to innovation adoption (Chong et al, 2009). Firms with champions for innovative technologies are three times as likely to adopt e-commerce applications than those without (Teo and Ranganathan, 2004). In a study of B2B e-commerce adoption by Canadian manufacturing firms, Kumar et al. (2007) found that leadership related variables including an internal champion are the most important determinants of adoption. Existence of champions has consistently been found to facilitate the adoption of many IS technologies and interorganizational systems (Beath, 1991; Grover, 1993; Premkumar and Ramamurthy, 1995).

The presence of a network of site champions is important for adoption and the successful implementation of interorganizational systems (Garfield, 2000). Garfield (2000) identified two types of champions in an organization. User champions guide the use of the system, promoted the system to other users and facilitated organization-wide acceptance of the system. Technical champions ensure that the system operated smoothly and effectively. Technical champions are found to be more important than user champions when the users are to be persuaded to accept the system.

Researchers have also identified other roles for champions in the introduction of new technologies. Maidique (1980) identified three roles, i.e. the executive champion, product champion and technological entrepreneur. According to Maidique, this group together with the technical specialists is responsible for the tasks of business definition, technical definition, sponsorship and communication. McKenney et al. (1995) describes three roles which they label as the senior executive sponsors, technological maestro and gifted technologist or

technical team. The maestro plays the pivotal integrative role which includes providing a clear vision of the business and strategic directions and sufficient technical competence so that the technicians have enough confidence in his technological judgment. No matter what the labels or roles are, the various tasks performed by a champion include: definition of business purpose, assessment and acceptance of risk, provision of resources, communication with those directly involved and other members of the organization and integration across the various parts of the project (Volkoff et al. 1999).

All types of champions play an important role to facilitate the adoption of information systems. Their contributions in various forms have been found to be positively related to the adoption of information systems.

From the discussion above, it is hypothesized that:

H_9: Internal championship will be positively related to EDI adoption**.**

3.2.2.5 Organizational Compatibility

Rogers (1983, 1995, 2003) defines compatibility of an innovation as the 'degree to which an innovation is perceived as being consistent with existing values, past experiences and the needs of the potential adopter.' The more an innovation is perceived as consistent with present systems, procedures and value systems of the adopter, the more likely the innovation will be adopted. A technological innovation must have both organizational and technical validity (Schultz and Slevin, 1975). Organizational validity assesses the degree to which the technology is compatible with existing attitudes, beliefs, value systems and work practices. Technical validity assesses the degree to which the technology is compatible with the existing systems of hardware and software in the organization. Organizational and technical compatibility are important factors to be examined in EDI adoption.

Organizational compatibility refers to compatibility of the changes introduced by EDI with existing operating practices (tasks), culture, management practices and current objectives. Organizational compatibility can be thought of as the organizational fit of the

system introduced. It also includes the system's impact on employees' attitudes regarding change, convenience of change and power shifts. (Kwon and Zmud, 1987).

EDI will introduce major changes to the sales, purchases, receiving and payment functions in the adopting organization (Barber, 1991). Present work practices and operating procedures have to be changed or replaced altogether. The employees may feel threatened or insecure in their jobs or even find it difficult to adapt to the new way of working. This resistance to change may hinder the adoption and diffusion of the new innovation. Organizational incompatibilities resulting from changes in work practices are negatively related to adoption (Premkumar et al., 1994; Premkumar and Ramamurthy, 1995). The internal culture and management practices between initiating and target organizations may be very different (incompatible) and result in communication problems (O'Callaghan et al., 1992).

Compatibility of an innovation with existing value and belief systems facilitate technology adoption. Past experiences of adopting organizations with similar innovations can lead to either positive or negative outcomes. Innovation research shows that unless a real internal need exists, an organization would not be likely to adopt a new innovation (Premkumar and Ramamurthy, 1995). An innovation compatibility with the self-interests (needs) of the stakeholders is an important factor in the successful adoption of the innovation (Landsbergen and Wolken, 2001).

Compatibility has also been found to positively influence e-commerce adoption in small and medium businesses (Grandon and Pearson, 2003, Saffu et al., 2008). Beatty et al. (2001) findings reveal that compatibility of the Web with existing technology have a strong positive influence on corporate adopters.

From the discussion above, it is hypothesized that:

H_{10}: Organizational compatibility will be positively related to EDI adoption

3.2.3 Environmental Context

Hypotheses of the environmental factors of external pressure, interorganizational trust, critical mass and legal framework are developed in the following sections.

3.2.3.1 External Pressure

External pressure refers to influences from the organizational environment. The main sources of external pressure are competitive pressure and imposition by trading partners. Competitive pressure refers to the level of EDI capability of the organization's industry and also that of the organization's competitors (Iacovou et al., 1995; Premkumar and Ramamurthy, 1995). Organizations may need to reconsider whether to become EDI-capable as more competitors and trading partners become EDI-capable themselves (Iacovou et al., 1995). Imposition from trading partners is expected to be a key factor for EDI adoption by smaller organizations (Hart and Saunders, 1997). The pressure exercised by trading partners depends on two factors, i.e. the relative power of the imposing partner and its chosen influence strategy (Provan, 1980). Powerful partners who request the small organization to adopt EDI are likely to be more successful than similar requests from less powerful partners. A powerful partner can choose from three strategies to induce a small partner to adopt EDI (Frazier and Summers, 1984). The first strategy is to recommend, i.e. to convince the smaller partner of the effectiveness and benefits of EDI use. The second strategy is promises which refer to technical and financial assistance or other specific rewards if the smaller partner become EDI-capable (Premkumar and Ramamurthy, 1995). The third strategy is threats which refer to actions that include negative sanctions (such as discontinuance of the partnership) should the smaller organization fail to comply. Small organizations that face pressure from their trading partners or the competition will adopt EDI more frequently than those that do not face such pressure (Pfeffer and Salancik, 1978). Research has shown that external pressure plays a critical role in the adoption of EDI (Kavan and Van Over, 1990; Kuan and Chau,

2001; Meier and Chismar, 1991). External pressure is consistently positively related to EDI adoption.

From the discussion above, it is hypothesized that:

H_{11}: External pressure will be positively related to EDI adoption

3.2.3.2 Interorganizational Trust

Blau (1964) defines trust as 'the belief that a party's word or promise is reliable and that a party will fulfill his obligations in an exchange relationship.' Research shows that interorganizational trust is an important precondition to sharing information (Hart and Saunders, 1997; Jones et al., 2000). A trading partner must trust the security of the technology and network reliability before they can trust their other partners in cyberspace (Friedman et al., 2000). Risks may arise because of their unfamiliarity with the technology and the actions or behaviors of their trading partners. For example, in EDI exchanges, confidential information can be stolen before or during transmission or from a trading partner's computer system. A party's own level of risk perception will be dependent on their level of trust on the other party in the exchange relationship. Interorganizational trust takes two important forms. Firstly, the trading partner must trust the competence of its trading partner and believes that this trading partner has taken all the necessary steps to secure the EDI exchanges on its systems. Secondly, for the mutual benefit of their trading relationship, this trading partner is willing to resolve any contentious issues that may arise out of their EDI exchanges. Bensaou (1999) argues that a good relationship with suppliers lowers the buyer's uncertainty and ultimately will positively affect their intention of innovation (e-procurement) adoption. A transaction climate of mutual trust and cooperation will motivate both parties to adopt an innovation (Gaski and Nevin, 1985; Nidumolu, 1989; Saunders and Clark, 1992).

From the discussion above, it is hypothesized that:

H_{12}: Interorganizational trust will be positively related to EDI adoption.

3.2.3.3 Critical Mass

Critical mass refers to the point where a sufficiently large number of organizations have adopted an innovation. At this point, the value of the innovation (which increases with the number of adopters) becomes large enough for the adoption to become self-sustaining throughout the population of potential adopters. Critical mass theorists are concerned with collective actions and innovations. According to critical mass theory, the organizations' decisions to participate in collective action will depend on their perceptions of what the group is doing. Their decisions will be influenced by how many others have participated, how much others have contributed and who has participated (Meyer and Allen, 1988; Markus, 1987; Oliver et al., 1985). The potential adopter organization may derive an intrinsic utility from the fact that their business partners within their network have already adopted the innovation. Organizations may adopt an innovation based on the number of interrelated organizations that have adopted the focal innovation. This is referred to as the concept of network externalities or critical mass (Markus, 1990; Katz and Shapiro, 1994; Kraut et al., 1998). The theory of network externalities claims that the value of the focal innovation is determined by the number of other users. Positive network externalities exist when the intrinsic utility of an innovation increases when a firm's suppliers, customers and other organizations (e.g. government) also use the innovation. For interorganizational information systems (e.g. EDI), the focal innovation will assume greater value and importance once a sufficient number (critical mass) of business partners begin to adopt the innovation.

Critical mass theory is recognized for its potential to explain the adoption decision process (Bouchard, 1993; Mahler and Rogers, 1999; Prescott and Conger, 1995). It views the adoption of IOS as a collective action. The decision to adopt or join the collective action is influenced by the number of participants who have already joined the system. The decision to adopt an IOS is influenced by the adoption decisions of others in the network (Bouchard, 1993; Mahler and Rogers, 1999, Soares-Aguiar and Dos-Reis, 2008).

Mahler and Rogers (1999) studied the reasons given by German banks for not adopting twelve telecommunication technologies and found that the low rate of diffusion of the innovation was ranked highly as the reason for non-adoption. Where there are competing standards for the innovation, each standard will need a critical mass of users before diffusion will accelerate. Research on communication technology acceptance has shown that user perceptions of network externalities have a positive impact on the use of electronic communication systems (Strader et al., 2006). An investigation into the factors influencing the adoption of B2B trading exchanges in small businesses also showed that critical mass is a significant factor in affecting the attitude to adopt (Quaddus and Hofmeyer, 2006).

From the discussion above, it is hypothesized that:

H_{13}: Critical mass will be positively related to EDI adoption.

3.2.3.4 Legal Framework

Government regulations can facilitate or hinder the adoption of technology (Tornatzky and Fleischer, 1990). If government regulations impose additional costs and constraints on business operations, it will hinder technology adoption. Key issues e.g. electronic signatures, electronic contracts, intellectual property rights, jurisdiction, privacy and consumer rights need to be resolved before EDI/e-commerce adoption is perceived to be less risky for companies (Tigre, 2003). A country with the necessary e-commerce (EDI) legal protection, computer crimes law, intellectual property rights law, data privacy (protection) laws will provide a more secure business environment for interorganizational systems. From the discussion above, it is hypothesized that:

H_{14}: E-commerce legal framework will be positively related to EDI adoption.

In this chapter, research hypotheses were developed so that the research model from the technology-organization-environment framework can be empirically tested. A total of fourteen hypotheses were derived and are summarized in Table 3.1. The research

methodology and the operationalization of the items in each construct of the hypothesis are discussed in the following chapter.

Table 3.1 Research Hypotheses

Hypothesis Number	Specific Hypothesis
H_1	Benefits will be positively related to EDI adoption.
H_2	Costs will be negatively related to EDI adoption
H_3	Risks will be negatively related to EDI adoption
H_4	Security will be positively related to EDI adoption
H_5	Technological complexity will be negatively related to EDI adoption
H_6	Size will be positively related to EDI adoption
H_7	Top management support will be positively related to EDI adoption
H_8	Information technology capability will be positively related to EDI adoption
H_9	Internal championship will be positively related to EDI adoption.
H_{10}	Organizational compatibility will be positively related to EDI adoption
H_{11}	External pressure will be positively related to EDI adoption
H_{12}	Interorganizational trust will be positively related to EDI adoption.
H_{13}	Critical mass will be positively related to EDI adoption
H_{14}	E-commerce legal framework will be positively related to EDI adoption