CHAPTER VII

CONCLUSION

This chapter starts by providing an overview of the research objectives, questions and methodology and next summarizes the key findings and presents the limitations, contributions, implications and future research directions of the study. In the first section an overview of the study is presented. The second section provides a summary discussion of the key results obtained from the questionnaire survey. In the third section, the limitations of the dissertation are discussed. The fourth and fifth sections address the contributions of the study and the practical implications for top management, public policy makers, marketers/vendors and researchers. A discussion of future research directions is provided in the sixth section. The final section concludes the dissertation effort.

7.1 Overview of the Study

This research is a study of the general environment of EDI use and EDI adoption factors in the Malaysian manufacturing industry. The objectives of the EDI adoption study are as follows.

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

(2) To identify significant factors that affect EDI adoption decision.

Two research questions are developed to achieve the study's research objectives. The questions addressed are as follows.

(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?

This study adopts a positivist research perspective where the existence of a priori fixed relationships within phenomena is usually investigated using structured instrumentation (Orlikowski and Baroudi, 1991). Positivist studies are normally used to test theory and

attempt to increase predictive understanding of phenomenon. Research questions were formulated and hypotheses were developed and tested.

The hypotheses are based on the technology-organization-environment framework (Tornatzky and Fleischer, 1990) with the theoretical bases of diffusion of innovation theory (DOI), social exchange theory (SET) and critical mass theory (CMT). The security, risks and technical complexity which are important EDI adoption factors have also been incorporated into the study.

The fourteen hypotheses (3.1) are as follows.

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

The research hypotheses key findings from binary logistic regression showed that costs, size, external pressure and interorganizational trust are key variables for EDI adoption. The key findings from t-tests showed that IT capability, internal championship, critical mass, top

management support, external pressure and interorganizational trust are key variables which differentiate between EDI adopters and non-adopters.

7.2 Summary of Major Findings

Descriptive statistics of company's characteristics and logistic regression results of the research hypotheses are summarised here.

7.2.1 Descriptive Statistics

The sampling frame of 2165 companies is drawn from the 2003, 2004 and 2005 Federation of Malaysian Manufacturers (FMM) Directory of Malaysian industries. 284 questionnaires out of the 325 returned questionnaires were retained for further analysis, yielding a 13.12% usable response rate. Analysis of missing data using SPSS MVA and analysis of non-response bias did not indicate any problems with the sample.

7.2.1.1 Sample Characteristics

198 (69.7%) were EDI non-adopters and 86 (30.3%) were EDI adopters. There was at least one respondent company for the 26 major sectors classified for this study. The top five sectors in the survey represent 50% of the sample. The top five sectors are from the chemical sector (11.97%), metal products sector (10.92%), food products, beverages and tobacco products sector (10.56%), electrical machinery and apparatus nec (8.80%) and plastic products sector (7.75%). 262 (92.25%) are private limited companies while 22 (7.75%) are public limited companies. 159 (55.99%) are fully locally owned companies, 39 (13.73%) are majority owned by locals, 8 (13.73%) companies have equal local and foreign ownership, 42 (14.79%) are majority owned by foreigners and 36 (12.68%) are fully owned by foreigners.

40 (14.08%) are small-size companies, 100 (35.21%) are medium-size companies and 144 (50.70%) are large-size companies. 77 (27.50%) companies have less than MYR10 million annual sales turnover, 99 (35.36%) companies have annual sales turnover between MYR10 million and MYR50 million, 42 (15.00%) companies have annual sales turnover

between 50 million and MYR100 million and 62 (22.14%) companies have annual sales turnover greater than MYR100 million.

7.2.1.2 Characteristics of EDI Adopters

EDI adopters from the top five sectors were from 12 (13.95%) companies in the electrical machinery and apparatus nec sector, 10 (11.63%) companies in the food products, beverages and tobacco sector, 10 (11.63%) companies in the metal products sector and 9 (10.47%) companies in the plastics sector and 7 (8.10%) in the chemical sector. These five sectors represent 48 (55.80%) companies out of the 86 EDI companies in the sample. 80 (93.02%) companies are private limited companies and 6 (6.98%) are public limited companies. 39 (45.35%) are fully local-owned companies, 11 (12.79%) are majority local-owned companies, 3 (3.49%) are 50% local and 50% foreign owned companies, 16 (18.60%) are majority foreign-owned companies and 17 (19.77%) are fully foreign-owned companies. 4 (4.65%) are small-size companies, 30 (39.53%) are medium-size companies and 52 (60.47%) are large-size companies. 15 (9.30%) companies have annual sales turnover of less than MYR10 million, 32 (37.215) companies have annual sales turnover of between MYR10 million and MYR50 million, 14 (16.28%) companies have annual sales turnover of greater than MYR50 million and MYR100 million and 25 (29.07%) companies have annual sales turnover greater than MYR100 million.

7.2.1.3 Perception of Importance of Technological Variables

The top five benefits variables ranked in descending order of mean importance are improved productivity and efficiency (4.26), improved customer service (4.15), costs savings (4.10), compressed production cycle and delivery time (4.09) and competitive advantage (4.09). All 18 benefits variables were perceived as being between “half way between neutral and fairly important” (3.50) to “fairly important” (4.00) with a range from 3.65 to 4.26.

The top five costs variables ranked in descending order of mean importance are setup (installation) costs (4.29), integration costs (4.22), consulting costs (4.18), maintenance costs

(4.12) and support staff costs (4.10). All five costs variables were perceived as being around fairly important (4.00) with a range from 4.10 to 4.29.

The top five risks variables ranked in descending order of mean importance are risk of disclosure of EDI messages to unauthorized person (4.15), risk of unauthorized EDI transactions (4.15), risk of modification of EDI message content (4.07), risk of lost EDI message during transmission (4.04) and risk of repudiation of EDI message origin (4.04). All fifteen risks variables were perceived as being between "half way between neutral and fairly important" (3.50) to around "fairly important" (4.00) with a range from 3.71 to 4.15.

The top five security variables ranked in descending order of mean importance are password security for EDI transactions (4.19), data encryption security for EDI transactions (4.13), EDI security standards for integrity of EDI message (4.01), EDI security standards for confidentiality of EDI message (4.01) and digital signature security for EDI transactions (4.00). All six security variables were perceived to be around fairly important (4.00) with a range from 3.99 to 4.19.

The four technological complexity variables ranked in descending order of mean importance are EDI uses many different standards for information exchange of protocols, procedures and data forms (3.52), EDI uses technical standards that are unclear and difficult to implement (3.38), EDI is difficult to understand and use (3.33) and EDI is a technically complex document transfer process (3.30). All four "technological complexity" variables were perceived as being between neutral (3.00) to around "half way between neutral and fairly important" (3.50) with a range from 3.30 to 3.52.

The technological constructs ranked in descending order of mean importance are costs (4.13), security (4.04), benefits (3.95), risks (3.94) and complexity (3.39)

7.2.1.4 Perception of Importance of Organizational Variables

The top five top management support variables ranked in descending order of mean importance are EDI participation to gain competitive advantage (3.59) , EDI with trading partners important (3.59), commitment to provide financial and other resources (3.57), management communicated support for EDI use to trading partners (3.41) and management communicated support for EDI use to company employees (3.39). All 6 “top management support” variables were perceived as being around half-way between neutral and fairly important (3.50) with a range from 3.39 to 3.59.

The five “information technology” variables ranked in descending order of mean importance are “good telecommunications infrastructure (3.83), computer literate employees (3.77), strong IT support (3.64), technical staff with EDI knowledge (3.51) and technical staff with EDI experience (3.43). The mean importance ratings are 3.83, 3.77, 3.64, 3.51 and 3.43 respectively. All five “information technology” variables were perceived as being around half-way past neutral (3.50) to fairly important (4.00) with a range from 3.43 to 3.83.

The three “organizational compatibility” variables ranked in descending order of mean importance are compatibility with company needs (3.73), compatibility with existing standard operating procedures (3.69) and compatibility of EDI software with company’s beliefs, values and experiences with similar systems (3.56). All three “organizational compatibility” variables were perceived as being between half way between neutral and fairly important to fairly important with a range from 3.56 to 3.73.

The four “internal championship” variables ranked in descending order of mean importance are active EDI support from someone influential in company (3.34), active promotion of EDI benefits from someone influential in company (3.30), someone influential in company has shown keen interest to use EDI (3.30) and someone influential in company has tried to create a favorable opinion towards EDI among the employees (3.23). All four

"internal championship" variables were perceived as being between neutral (3.00) to half way between neutral and fairly important (3.50) with a range from 3.23 to 3.34.

The organisational constructs ranked in descending order of mean importance are compatibility (3.66), IT capability (3.64), top management support (3.48) and internal championship (3.29)

7.2.1.5 Perception of Importance of Environmental Variables

The five "external pressure" variables ranked in descending order of mean importance are pressure from loss of competitive advantage due to lack of EDI links to trading partners (3.39), trading partners mandated use of EDI for business transactions (3.36), industry pressure on EDI as a standard purchasing practice (3.29), trading partners request to use EDI (3.21) and trading partners recommend to use EDI (3.16). All five "external pressure" variables were perceived as being between neutral (3.00) to half way between neutral and fairly important (3.50) with a range from 3.16 to 3.39.

The top five "interorganizational trust" variables ranked in descending order of mean importance are ability to deliver on promises made by trading partners (3.72), the accuracy of deadlines met by trading partners (3.68), the competency of trading partners in accurately and efficiently performing required tasks (3.68), trading partner's honesty in business dealings (3.67) and the reliability of the computer systems of the trading partners (3.63). All eight "interorganizational trust" variables were perceived as being from neutral (3.00) to fairly important (4.00) with a range from 3.30 to 3.72.

The three "critical mass" variables ranked in descending order of mean importance are the adoption of EDI by trading partners is essential and inevitable (3.43), our trading partners are using or will soon be using EDI (3.15) and if our company were to use EDI, other trading partners will follow in the use of EDI (3.04). All three "critical mass" variables were perceived as being between neutral (3.00) to half way between neutral and fairly important (3.50) with a range from 3.04 to 3.43.

The environmental constructs ranked in descending order of mean importance are legal framework (3.70), interorganizational trust (3.56), external pressure (3.28) and critical mass (3.20)

7.2.2 Hypothesized Relationships

This section summarizes the research hypotheses results. The 14 hypotheses are tests of individual factor that influences EDI adoption decision. The significant variables are identified and each hypothesis result is discussed briefly. Table 6.7 summarizes the hypotheses testing results. Only 12 hypotheses were tested because factor analysis did not extract two of the hypothesized factors. The following subsections discuss the hypotheses based on technological, organizational and environmental factors.

7.2.2.1 Technological Variables

The hypotheses on the influence of the technological variables of benefits, costs, risks, security and technological complexity on EDI adoption will be discussed next.

Hypothesis H_1 postulates that EDI benefits will have a positive effect on a company's decision to adopt EDI. Even though both EDI adopters and non-adopters perceive direct and indirect benefits to be fairly important to EDI adoption, they also know that the benefits are difficult to obtain and usually is over a long time. Without incentives from one's trading partners or the government, the benefits are not a strong enough pull factor for EDI adoption. Both direct and indirect benefits were studied as EDI benefits in this study. This finding concurs with Kuan and Chow (2001) study where perceived indirect benefits was not significant for small business EDI adoption. This implies that management do not view indirect benefits as sufficiently attractive to adopt EDI. However, the same study (Kuan and Chow, 2001) also have a different finding with regards to perceived direct benefits which is significant to EDI adoption in small businesses. This implies that management view direct benefits as sufficiently attractive to adopt EDI.

Hypothesis H_2 postulates that EDI costs will have a negative effect on a company's decision to adopt EDI. Cost was found to be significant ($p < 0.05$) on EDI adoption.

An explanation for the negative perception of costs for the EDI adopters is that the costs incurred are sunk costs and their only concern is to obtain real benefits from EDI as early as possible. To the EDI non-adopters, the real benefits from EDI expenditure (costs) are perceived to be difficult to achieve or can only be achieved in the long run. Hence EDI costs are perceived more negatively by the EDI non-adopter.

Today, the option of implementing Internet EDI with lower costs is open to small and medium-sized companies. Internet EDI is particularly suitable for companies which have low EDI transaction volumes. Therefore companies heavily dependent on EDI will opt to use more traditional EDI transactions over Internet EDI transactions. The majority of the EDI users are large size companies (52) followed by medium size companies (33) and small size companies (1). Even though 77.1% use Internet EDI, it does not account for the majority of transactions, so while Internet EDI transactions are cheaper, the main cost is through traditional EDI which forms the bulk of transactions for large companies

Many EDI non-adopters are still unaware of the significant cost savings from adopting Internet EDI. Many companies still perceive that EDI can only be implemented at high costs and therefore are reluctant to adopt EDI..

Hypothesis H_3 postulates that EDI risks will have a negative effect on a company's decision to adopt EDI. Risk was found to be insignificant on EDI adoption. Our finding is consistent with Frambach et al. (2002) study which reported a similar finding, i.e. perceived risks play a minor role in the adoption process. An explanation is that EDI adopters would have found their implemented security measures are safe enough for them to continue their EDI transactions with their partners. The use of network and application level security, stronger encryption (from 32 bits to 256 bits AES) and digital signatures have reduced the risk in EDI transactions. They are therefore not too concerned about the risk posed by EDI to

their EDI operations. EDI non-adopters also do not perceive risks to be significant because they do not run the risks of EDI operations.

Hypothesis H_4 postulates that EDI security will have a positive effect on a company's decision to adopt EDI. Security was found to be insignificant to EDI adoption. An explanation is the EDI adopters have not faced much security issues during their EDI operations and therefore do not regard security as being important. EDI non-adopters also do not perceive security to be significant because they currently have no EDI systems to secure.

Hypothesis H_5 postulates that EDI technological complexity will have a negative effect on a company's decision to adopt EDI. Technological complexity was found to be insignificant on EDI adoption. An explanation is that with adequate training EDI adopters will not find EDI to be difficult to use. Most of the technical complexity is shielded from the end user as translation of formats is handled by the software and is unseen by the end user. EDI non-adopters do not perceive technological complexity to be significant because having no experience using EDI systems they cannot perceive whether it's complex or not.

7.2.2.2 Organizational Variables

The hypotheses on the influence of the organizational variables of size, top management support, information technology capability, internal championship and organizational compatibility on EDI adoption will be discussed next.

Hypothesis H_6 postulates that company size will have a positive effect on a company's decision to adopt EDI. Company size was found to be significant ($p < 0.05$) on EDI adoption. An explanation for the positive perception of company size is that a larger company with more financial and technical resources can afford to adopt EDI. Larger companies are also likely to benefit earlier from EDI as they have economies of scale because having many EDI partners they have sufficient transactions volumes. The larger companies are also able to absorb the substantial risks associated with EDI implementation. A larger company is more

likely to adopt EDI because they have the power to force its business partners to adopt EDI and therefore attain a critical mass of users.

Smaller companies with less access to financial and technical resources have less ability to adopt EDI. The smaller companies are also less able to absorb the substantial risks associated with EDI implementation.

Hypothesis H_7 postulates that top management support will have a positive effect on a company's decision to adopt EDI. Top management support was found to be insignificant on EDI adoption. Top management support will have little influence on EDI adoption if coerced by a more powerful trading partner to adopt EDI. If the parent company has decided to adopt EDI then the top management of the subsidiary or associate company may not have a choice but to adopt EDI. This finding is supported by earlier findings where top management have little choice if forced to accept EDI by a more powerful partner (Chwelos et al., 2001; Ratnasingham, 2000)

Hypothesis H_8 postulates that information technology capability will have a positive effect on a company's decision to adopt EDI. Information technology capability was found to be insignificant for EDI adoption. Many companies today operate a computerized networked system and do not perceive the lack of an IT infrastructure. Companies also have the option of outsourcing their EDI implementation to software vendors. With outsourcing, technical support and knowledge of internal IT staff becomes less important to EDI adoption.

Hypothesis H_9 postulates that internal championship will have a positive effect on a company's decision to adopt EDI. Internal championship was found to be insignificant for EDI adoption. Internal championship is perceived to be insignificant to EDI adoption because the presence of a champion (enthusiastic and committed individual) will not help increase the chances of EDI adoption. Decision making on IT adoption in many companies today is the responsibility of an information systems steering committee which considers all projects based on merits. The influence of an enthusiastic individual is therefore limited.

Hypothesis H_{10} postulates that organizational compatibility will have a positive effect on a company's decision to adopt EDI. This hypothesis could not be tested because factor analysis of the organizational context variables did not extract the organizational compatibility factor. A reason could be that other factors such as external pressure and interorganizational trust are the primary driving force of adoption rather than the company's own needs and experiences with similar systems. As a result, organizational compatibility has only an insignificant influence on adoption.

7.2.2.3 Environmental Variables

The hypotheses on the influence of the environmental variables of external pressure, interorganizational trust, critical mass and e-commerce legal framework on EDI adoption will be discussed next.

Hypothesis H_{11} postulates that external pressure will have a positive effect on a company's decision to adopt EDI. External pressure was found to be significant ($p < 0.05$) for EDI adoption. A less powerful company which wants to continue doing business with a more powerful business partner will find itself powerless if coerced to adopt EDI. Subtle external pressure in the form of non-coercive influence tactics such as providing financial or technical assistance by a more powerful trading partner could exert a strong influence on EDI adoption by a less powerful trading partner.

Hypothesis H_{12} postulates that interorganizational trust will have a positive effect on a company's decision to adopt EDI. Interorganizational trust was found to be significant ($p < 0.10$) for EDI adoption.

A trading partner has to trust and be trusted by its trading partner that both parties will complete EDI transactions competently within a reasonable time frame. Trust in one's partner and be trusted by one's partner is all the more important because the security of EDI transactions depends on the security controls enforced in both trading partner's computer system. The transmitting party needs to trust that confidential information is secured at the

receiving trading partner's computers. EDI as an interorganizational information system cannot operate successfully without building a trusting relationship between both trading partners.

Hypothesis H_{13} postulates that critical mass will have a positive effect on a company's decision to adopt EDI. This hypothesis could not be tested because factor analysis of the organizational context variables did not extract the critical mass factor. A reason could be that there is already a sufficiently large number (critical mass) of EDI adopter companies among would-be adopters and as such critical mass do not have such an important influence as in earlier adoption studies.

Hypothesis H_{14} postulates that e-commerce legal framework will have a positive effect on a company's decision to adopt EDI.

Contrary to expectation, the influence of e-commerce legal framework was found to be significant ($p < 0.05$) in the opposite direction to that hypothesized.

EDI non-adopters are more likely to be less familiar with the existing e-commerce legal framework and therefore would be more concerned about the scope of its protection. Because of this, EDI non-adopters tend to perceive e-commerce legal framework as more negatively related to EDI adoption. EDI adopters are more likely to be familiar with the existing e-commerce legal framework and are more confident of the protection provided. Because of this, EDI adopters tend to perceive e-commerce legal framework as less negatively related to EDI adoption.

7.3 Limitations

The research limitations are discussed in this section.

The first limitation is the inability to test all of the hypotheses. Two hypotheses (H_{10} and H_{13}) could not be tested because factor analyses did not extract the factors of "organizational compatibility" and "critical mass".

The second limitation is the use of the single informant method for data collection. Although a single key informant such as the CEO or key personnel is sufficiently reliable for the survey, getting a response from at least two key personnel in each company would provide better results. Any variations in responses between key informants of the company can be analyzed to provide a better picture of that company. However, the multiple informant method was not utilized because it would be difficult to implement for a mail survey.

The third limitation is the inability of the mail questionnaire survey method to provide in-depth and richer understanding of EDI adoption such as that which can be provided by a case study. However, the case study method using personal interviews is in not within the scope of the study.

The fourth limitation is that the data collected in a cross-sectional study only applies to a particular point in time. A longitudinal survey which is able to show changes that occur through a longer period of time will be suitable for a stage-based study. However the cross-sectional method is not within the scope of this study due to time constraints.

7.4 Contributions

This study makes a number of theoretical and practical contributions which will be discussed next.

The theoretical contribution is through extending research work in the area of interorganizational systems (IOS) to provide better understanding of the research area.

The study provides updated information to the body of EDI knowledge on EDI use in Malaysia. This information includes EDI diversity, breadth and main uses in the manufacturing industry. A comprehensive literature search did not reveal any large scale EDI adoption study in the manufacturing industry in Malaysia. This study is one of the major EDI adoption study in manufacturing industry in Malaysia.

Hypothesis testing found a number of important EDI adoption findings. Hypothesis testing found costs, size, external pressure and interorganizational trust to be significant.

Costs is still a major inhibitor while interorganizational trust is gaining importance as a facilitator as more and more information systems are networked and data is shared between these systems. Hypothesis testing found the following variables to be insignificant, i.e, benefits, risks, security, technological complexity, top management support, IT capability and internal championship. Top management support, IT capability and internal championship which used to be important adoption facilitators seem to be losing their importance in today's networked world. E-commerce legal framework was significant in the opposite direction. This result is surprising because EDI non-adopters are more concerned about legal framework than the EDI adopters.

The measurement instrument has been rigorously tested and validated. Reliability has been established. Content validity has been established throughout careful selection and refinement of items. Convergent and discriminant validity have also been established. Internal validity has been determined using subsamples of the original sample. The instrument could be used in later innovation adoption research.

Security and risk factors have seldom been studied in innovation adoption even though both have often been mentioned as adoption factors. This study investigated both factors in EDI adoption and found that both factors are insignificant.

This study has shown the usefulness of the Diffusion of Innovation Theory variables and Social Exchange Theory variables in the Technology-Organizational-Environmental framework. However, the Critical Mass theory variables could not be studied because factor analysis did not extract the critical mass factor. This study provides further empirical validation of the applicability of the Technology-Organization-Environment (TOE) framework in innovation adoption studies.

The earlier EDI adoption research has mostly studied small and medium-size industries. This study's sample includes large-size companies in addition to small and medium-size companies.

7.5 Practical Contributions

Managers, government agencies, marketers and vendors will be able to improve their decision making regarding EDI adoption and researchers will get new insight on EDI adoption from the research findings.

7.5.1 Implications for Top Management

Top management of the EDI initiator should take an active role if they want their suppliers to be EDI-enabled. They could apply coercive measures or non-coercive measures. Coercive measures include threatening to cut business ties to suppliers who do not comply. Non-coercive measures include providing technical training and financial support to one's suppliers. The study found that coercive measures (external pressure) are very effective to EDI adoption. Top management should try to create a trusting relationship between themselves and their trading partners. This research showed that interorganizational trust is essential for EDI adoption. Top management can for example, ensure the reliability of their computer systems and deliver on promises made to EDI partners. Costs were found to be an important inhibitor of EDI adoption. Top management should consider costs reduction by outsourcing EDI implementation or using Internet EDI.

7.5.2 Implications for Vendors

Knowing the significant EDI facilitators and inhibitors and the EDI adopter characteristics are advantageous to the vendor. This information would be relevant to target companies for EDI sales, to use facilitators as a selling point and to address the inhibitors as customer's concerns. Knowing that benefits are not a significant factor, the vendor should emphasize less on benefits and knowing that costs are a significant factor, the vendor should try to change the customer's preconception that costs are high by offering a low-cost solution. Vendors should try to increase company's awareness of EDI outside support and its low costs by organizing seminars, road shows or promotions for potential customers.

7.5.3 Implications for Government

The Malaysian government supports the increase in global competitiveness of Malaysian companies. One way is through EDI which is known to increase a company's operational efficiency which will enable it to compete locally and globally. Knowing the facilitators and inhibitors will aid government agencies to formulate recommendations, strategies and policies to promote EDI adoption. The Malaysian government should consider giving more tax incentives to encourage businesses especially the SMEs to adopt EDI. This is because costs are a significant barrier to EDI adoption.

External championship plays a critical role in EDI adoption (Damsgaard and Lyytinen, 2001). In Malaysia, almost all EDI effort by the Malaysian government is to e-enable trade facilitation through the Customs SMK-DagangNet. There is no national committee comprising industry and government agencies that specifically promotes EDI in Malaysia. For instance, the Japan Electronic Data Interchange Council (JEDIC) and Centre for Informatization of Industry (CII) are actively engaged in promotion of EDI in Japan.

Industry association and government collaboration should be formalized through a national committee that is empowered to disseminate EDI information and support EDI adoption. The Malaysian government should play a more active and central role by channeling government procurement through EDI. This will encourage more of its suppliers to adopt EDI.

7.5.4 Implications for Researchers

The purpose of this section is to highlight some of the more promising research directions that is derived from the findings from t-tests and binary logistic regression in this study. It is to be noted that the points raised here are equally relevant to innovation adoption, implementation success and the extent of implementation.

Innovation variables may take on different relative importance over time and under different context. It is surprising but not totally unexpected that interorganizational trust is significant

in this EDI adoption study. There is increasing interest to study this variable in recent times (Benbasat et al. 2008; Bunduchi, 2008; Chong et al., 2009; Huang et al., 2008; Lai et al., 2011) as its importance has increased with the proliferation of interorganizational systems which is inherently unsafe without the key element of trust. It is therefore recommend that the trust variable be seriously considered in any innovation research study

For example, we could introduce the trust construct as both an endogenous and exogenous variable in the structural equation modeling of the relationship of trust with the attitude, perceived risk and "willingness to buy" construct (Teo and Liu, 2007). Another way to study trust is the Web Trust Model (McKnight et al., 2002) in which both "Disposition to Trust" and "Institution-based Trust" are exogenous to "Trusting Beliefs" which are exogenous to "Trusting Intentions" which in turn is exogenous to "Trust Related Behaviors".

Trust has emerged as an important factor in interorganizational relationships but there remains major conceptual and methodological challenges in studying this complex concept (Seppanen et al., 2007). Therefore further empirical research is needed to explain the inconsistencies in conceptualization and operationalization of the trust construct (McKnight et al., 2002 ; Seppanen et al., 2007).

By identifying and validating a usable set of common measures of trust construct for the innovation context would be a major step forward in theory building.

The other area that is exciting and holds great prospect for academic research is a longitudinal study using a stage-based approach. In this way we can distinguish between the salience of the variables within the adoption and implementation/use stage (Frambach et al,, 2002). This research would guide management decision with the same or different factors during adoption and implementation stages. For instance, the perceived level of complexity decreases over the innovation stages of awareness, evaluation and adoption (Frambach et al., 2002).

Further proof of the validity and usefulness of this research would be to extend and replicate it in other context such as e-commerce IOS systems which include ERP, e-procurement and electronic markets.

It is not possible to differentiate between adopters and non-adopters using the benefits variable. It appears that the benefits variables have been reduced in importance with the passage of time. Researchers could choose to exclude this variable in the study of adoption. This is the same with the risks and security variables as decision makers do not seem to be greatly affected by these two variables in innovation adoption decisions. Complexity and critical mass may not be as the critical variables today as they were 10 or 20 years ago since relevant and user friendly technology are more common today. Besides most of the major technologies in use today have reached or approaching critical mass. Unless there is a specific good reason to include them, the complexity and critical mass variables may be dropped from newer research. Costs and external pressure has always been significant factors in adoption studies such as this one. Since there is already a wide body of established work validating this result, these two variables may be dropped in studies of innovation adoption.

Internal championship was found to be a significant variable and it would be worthwhile to investigate whether external championship through business partners, industry association or government would have a similar effect (Garfield, 2000; Howell and Boies, 2004; Volkoff et al. 1999)

This research has taken a rather broad based view (TOE framework) and included the major variables from the technology, organization and environment contexts. Rather than taking a broad based approach, it is possible to adopt a narrower view by studying either one or two contexts (e.g. Organization and Technology) in a more detailed setting. This would help remove the influence of the environment context on the other contexts in the study.

Opportunities also exist to study a variable in more detail. For example, top management traits can be studied to determine if there is any relationship between it and

adoption decisions under different context such as in SMEs. By narrowly focusing on top management traits (characteristics) other than support, we can gain a better understanding of the role of top management.

Further implications from this study are discussed in the next section under future research directions.

7.6 Future Research Directions

This is an exploratory study into factors that influence EDI adoption in the manufacturing industry. The objective of future research directions is twofold. Firstly, it is to validate the results provided by this research. Secondly, there is still a need for innovation research in the areas of diffusion and implementation in Malaysia to confirm the results of earlier findings.

The research findings of this thesis can be easily replicated in Asian countries as well as any other countries in the world. The approach taken is not only for EDI adoption but in general could be applied to any other technological innovation such as ERP, mobile banking and e-procurement. The importance of context-based factors on adoption is well studied and the technology-organization-environment framework has been shown to be very successful in extending our understanding of adoption factors. It would serve to strengthen the findings of this thesis should these new studies reconfirm the findings of earlier studies of adoption, i.e. the DOI variables, Tornatzky and Fleischer framework variables are significant predictors of innovation adoption.

The following section recommends other statistical procedures, other variables and other contexts in which we can study innovation adoption. Firstly we propose some other constructs which could be included as innovation adoption factors. Technological compatibility could be used as a construct in the technological context. Relative Advantage operationalized as benefits construct in this study could be analyzed as 3 separate subconstructs of direct, indirect and strategic benefits.

Slack resources and organizational readiness could be included as constructs in the organizational context. The role of intermediating institutions such as industry associations and government agencies (external championship) could be included as factors in the environmental context (Damsgaard and Lyytinen, 2001).

Future research could address the organizational characteristics of centralization, formalization, specialization and integration as innovation adoption factors.

Future research could use different dependent variables e.g. the likelihood of adoption or the extent of implementation. Research models using other statistical analysis such as discriminant analysis, multiple regression analysis or structural equation modelling could be applied instead of binary logistic regression. Future research could analyze the sample based on three groups, i.e. adopters, planners and non-planners (non-adopters). A multinomial logistic regression analysis could be applied to predict 3-group membership. Future research could also model the cause-effect relationship between adoption variables based on structural equation modeling (SEM). The strength and direction of these relationships could then be analyzed.

Future research could focus on subsectors such as banking, insurance, stock broking, shipping, retailers and their suppliers, automobile manufacturers and their suppliers. Since the sampling frame for these subsectors may be limited, qualitative studies such as case study may be more feasible.

Future research could adopt the stage-based approach (Frambach and Schillewaert, 2002). We could then differentiate the relative significance of the variable within the initiation, adoption and implementation stage.

Social exchange theory states that the outcome of a participant's behavior is dependent on the responsive behavior by the other participant(s) within the exchange relationship (Anderson and Narus, 1984). Most adopter studies based on the social exchange theory have focused on variables such as trust and power (Hart and Saunders, 1997). Variables such as

dependence, commitment, conflict derived from interorganizational exchange relationships could also be studied other than the trust and power variables.

7.7 Conclusion

This study has provided current information on EDI usage and identified the factors that influence EDI adoption in Malaysian manufacturing industry. Hypotheses tests of the EDI adoption factors and t-tests have been performed.

Table 7.1 summarizes the results from t-tests, ANOVA and hypothesis testing.

Table 7.1 Summary of t-tests, ANOVA and Logistic Regression

CONSTRUCTS	t-tests (constructs)	ANOVA (by size)	Logistic Regression
Top management support	*		
IT capability	**		
Internal championship	**		
Organizational compatibility			not tested
External pressure	*		**
Interorganizational trust	*	***	**
Legal framework		**	#
Critical Mass	**	*	not tested
Risks			
Costs			**
Security			
Complexity			
Benefits			
Size	sig (**)	not applicable	**

significant in the opposite direction @0.05 level
t-tests of individual items of construct considered significant if majority of items comprising construct is significant

* significancelevel 0.10 **:significance level 0.05 ***:significance level 0.01

Additional t-tests were carried out based on 86 EDI adopters and a random sample of 86 EDI non-adopters. The significant variables are top management support, IT capability, internal championship, external pressure, interorganizational trust, critical mass and size. Since the significant variables do not differ from the original sample of 86 EDI adopters and 198 EDI non-adopters, the original sample was retained for the other statistical analysis such as logistic regression.

t-tests showed that the variables of top management support, information technology capability, internal championship, external pressure, interorganizational trust, critical mass and size were significantly differently between adopters and non-adopters.

Hypothesis testing showed that external pressure, interorganizational trust, costs and size were significant EDI facilitators. E-commerce legal framework was a significant EDI inhibitor.

Top management support, IT capability, internal championship which are significant in t-tests were not significant in hypothesis testing. Size, external pressure and interorganizational trust were significant in both t-tests and hypothesis tests. Legal framework which was not significant in t-tests was significant in the opposite direction for hypothesis tests.

ANOVA analysis showed that interorganizational trust, legal framework and critical mass differ significantly between organizations of different sizes.

This research has shown that some of the significant adoption factors identified here are different from those identified in earlier studies. This could be due to reasons such as different industry or different innovation type being studied. This empirical research has been undertaken as an exploratory study and therefore further research is needed to validate the findings presented here. Future research can be replicated in other countries because the factors studied are common across countries (many earlier studies are based on similar factors) and also not tied to a particular culture or time setting.