CHAPTER II

LITERATURE REVIEW

The chapter starts with a brief description of the process of a systematic review which forms the basis for the decision to include an article or material for this chapter and the thesis. The chapter then continues with a review of the extant literature on technology acceptance, adoption and use. It traces the historical development of acceptance and use models in information systems research. The models reviewed are the Theory of Reasoned Action, Technology Acceptance Model, Theory of Planned Behaviour and the Unified Theory of Acceptance and Use of Technology. These theories have their roots in psychology and sociology. Descriptions and critiques of these acceptance models are presented.

The chapter continues with a description of the Innovation Diffusion Theory, the Social Exchange Theory and the Critical Mass Theory which are often used in adoption of interorganizational information system (IOS) research. These theories are synthesized to build the foundation for the research framework. Next, the literature on organizational innovation adoption is reviewed based on the adoption factors.

2.1 Systematic Literature Review Process

The journals that are searched include all the top MIS ranked journals listed by the Association for Information Systems. The journals searched include but are not limited to the following journals mentioned below. They are MISQ, ISR, MS, JMIS, DSI, IEEE Transactions, EJIS, IEEE Software, Information and Management (I&M), CAIS. The following databases were searched for journal articles and published thesis. They are ABI/INFORM(ProQuest), ABI/INFORM Trade and Industry Database, EBSCOHOST, ACM Digital Library, Digital Dissertation & Thesis @ProQuest, EMERALD, IEEE Explore, JSTOR Archive, SAGE Journal – Social Sciences and Humanities, ScienceDirect, SpringerLink, Taylor and Francis Journals and Wiley Online Library.

Based on the research questions, the major keywords that are searched include but are not limited to the following. The keywords are “innovation”, “electronic data interchange”, “electronic commerce”, “enterprise resource planning”, “trust”, “compatibility”, “critical mass”, “interorganizational trust”, “legal framework”, “top management support”, “meta-analysis”, “survey research”, “technology acceptance model”, “theory of planned behaviour”, “theory of reasoned action” and “UTAUT”.

Over 5000 articles have been downloaded and after going through the vetting process for quality and relevance to this research, 2000 articles have been retained for further analysis. The bibliography in this thesis are either from the top MIS and management journals and those from the second-ranked journals have been included because they have met the quality criteria of relevance, reliability and validity measures. Most of the articles selected are quantitative in nature following from this research’s quantitative orientation. As a result of this strict selection process, almost all the fundamental literature and primary research work would have been included here.

The literature review is structured around the main theories of acceptance and use of technology that are common in IS research and includes the Theory of Reasoned Action, Technology Acceptance Model, Theory of Plannned Action and The Unified Theory of Acceptance and Use of Technology. The literature review is also structured around the main hypothesized variables of the organizational, environmental and technological contexts. The literature has been synthesized, analyzed and contrasted for each hypothesized variable in this chapter.

2.2 Theory of Reasoned Action (TRA)

Fishbein and Ajzen (1975) proposed the Theory of Reasoned Action as shown in Figure 2.1.

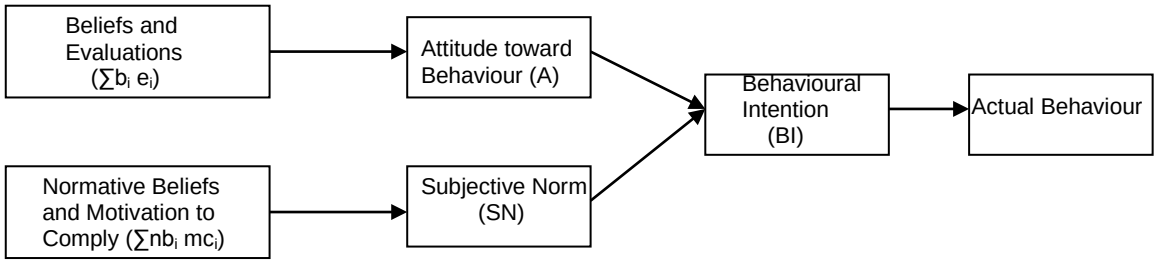

Figure 2.1 The Theory of Reasoned Action (Fishbein and Ajzen, 1975)

Fishbein and Ajzen stated that a person's actual behaviour can be determined by his prior (behavioural) intention together with his beliefs for the given behaviour. The behavioural intention measures a person's intention to perform a behaviour. They proposed that behavioural intention can be determined by a person's attitude towards an actual behaviour and the subjective norm associated with the behaviour. They suggested that attitude towards a behaviour (A) can be measured by the sum of the product of all salient beliefs (b_i) about the consequences of performing that behaviour and an evaluation (e_i) of those consequences as given by the formula.

$$A = \sum b_i e_i$$

They suggested that the subjective norm could be measured by the sum of the product of a person's normative beliefs (nb_i), which is the perceived expectations of other individuals or groups and his motivation to comply (mc_i). They proposed the formula for measuring subjective norm as follows.

$$SN = \sum nb_i mc_i$$

The behavioural intention (BI) of a person to perform a behaviour is calculated using the formula below.

$$BI = A + SN$$

Studies (Belleau et al., 2007; Hansen et al., 2004) have shown that the actual behaviour of an individual can be adequately explained and predicted from The Theory of Reasoned Action.

2.3 Technology Acceptance Model (TAM): An Introduction

The Technology Acceptance Model has been a very popular model for explaining and predicting information system use by an individual for more than two decades. Information system researchers use TAM which is a parsimonious and powerful model (Lucas and Spitler, 1999; Venkatesh and Davis, 2000) to produce quick and easy research without addressing the real problem of technology adoption (Lee et al., 2003). After the first two published TAM articles (Davis, 1989, Davis et al., 1989), TAM has been studied extensively for different technologies, under different situations with different control factors and different subjects.

TAM has been found to be a simpler, easier to use and more powerful model of user acceptance of computer technology than TRA and TPB (Hubona and Cheney, 1994; Igbaria et al., 1997). A number of studies to validate the TAM model has been carried out between 1992 to 1994 (Adams et al., 1992; Segars and Grover, 1993; Szajna, 1994). The studies in this period investigated the validity, consistency and reliability of the TAM instruments which were acceptable. This is followed by the model extension period where efforts to introduce new variables postulating different relationships between constructs and the identification of new antecedents/external variables (individual, organizational and task characteristics) of the major TAM constructs (PEOU and PU) started (Agarwal and Prasad, 1999; Karahanna and Limayem, 2000). In 2000, Venkatesh and Davis introduced TAM II as an improvement over the original TAM. A meta-analysis of TAM by King and He (2006) has shown that TAM is still a powerful and robust predictive model even though the model has a number of serious limitations (Lee et al., 2003, Legris et al., 2003; Yousafzai et al., 2007). Further details of original TAM, its history and development and limitations are elaborated over the next sections.

Davis (1985) adapted the TRA model to explain user acceptance of an information system in his Technology Acceptance Model. Davis made two important changes to the TRA model. He eliminated subjective norm in the prediction of a person's actual behaviour because subjective norm is the least understood aspect of TRA and have uncertain theoretical status (Fishbein and Ajzen, 1975). He only considered a person's attitude towards a given behaviour in his TAM model. Instead of using salient beliefs to determine attitude towards a given behaviour, Davis (1985) identified perceived usefulness and perceived ease of use from a few related studies (Bandura, 1982; Schultz and Slevin, 1975; Swanson, 1982, Tornatzky and Klein, 1982) as being sufficient to predict the individual's attitude towards system use.

Davis (1985) in his doctoral thesis proposed that system use is a response that can be explained by user motivation which is directly influenced by external stimulus of actual system's features and capabilities (Figure 2.2).

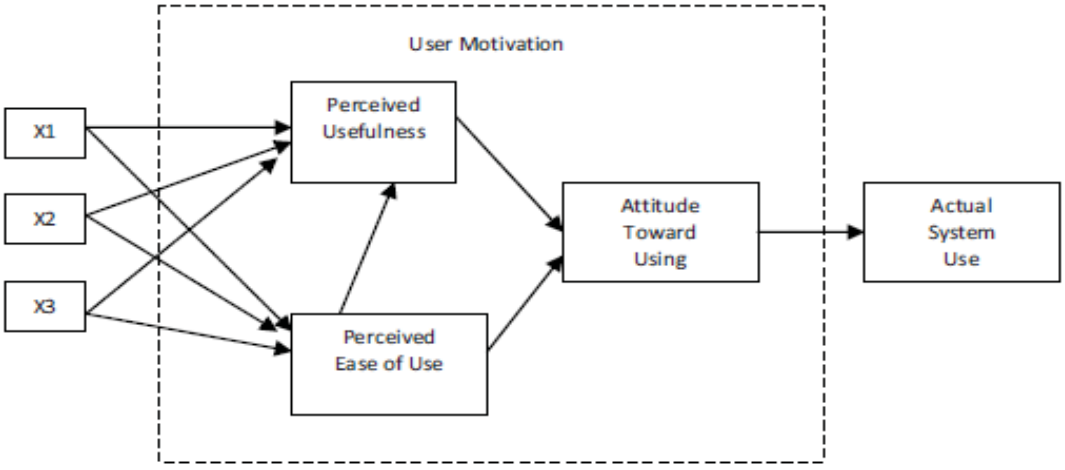

Figure 2.2 Original TAM proposed by Fred Davis (Davis, 1986, p.24)

Davis (1985) user's motivation in his conceptual model is explained by three factors, i.e. perceived ease of use, perceived usefulness and attitude toward using the system. He hypothesized that a user attitude toward a system would largely determine whether the user will actually use the system. The user's attitude is influenced by two major beliefs: perceived usefulness and perceived ease of use with perceived ease of use directly influencing perceived

usefulness. These two beliefs were hypothesized to be directly influenced by system characteristics (X_1, X_2, X_3) in Figure 2.2.

Davis (1993) suggested two new relationships to the original TAM model. Perceived usefulness could directly influence actual use of a system and system characteristics could directly influence a person's attitude towards using a system. (Figure 2.3).

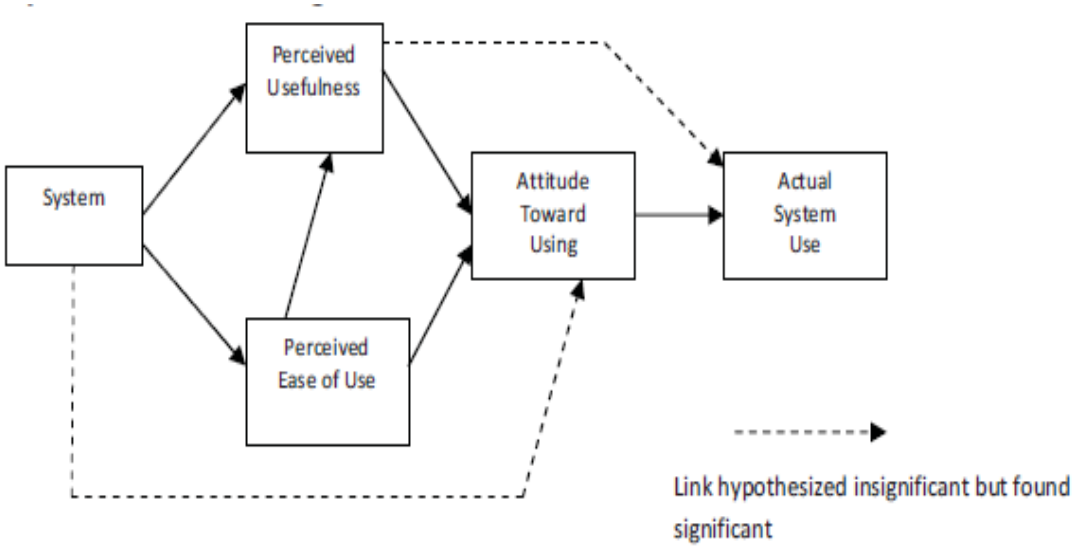

Figure 2.3 New Relationship Formulation in TAM (Davis, 1993, p. 481)

2.4 TAM's History

Davis et al. (1989) suggested that if a system is perceived to be useful, a person might form a strong behavioural intention to use the system without forming any attitude. (Figure 2.4).

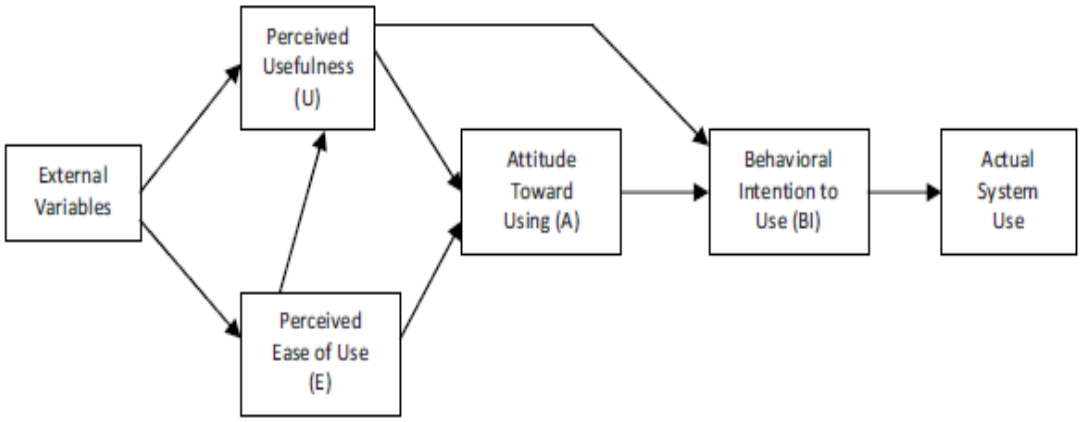

Figure 2.4 First Modified Version of TAM (Davis et al., 1989, p. 985)

Reported intention strongly correlates with self-reported system usage and perceived usefulness was shown to have the greatest influence on intention to use. The main finding that perceived usefulness and perceived ease of use directly influence behavioural intention strongly hints that the attitude construct in the model can be eliminated.

Venkatesh and Davis (1996) introduced to the final TAM model (Figure 2.5), external variables (includes system characteristics such as user training, user participation in design, etc.) that may influence a person's beliefs towards a system.

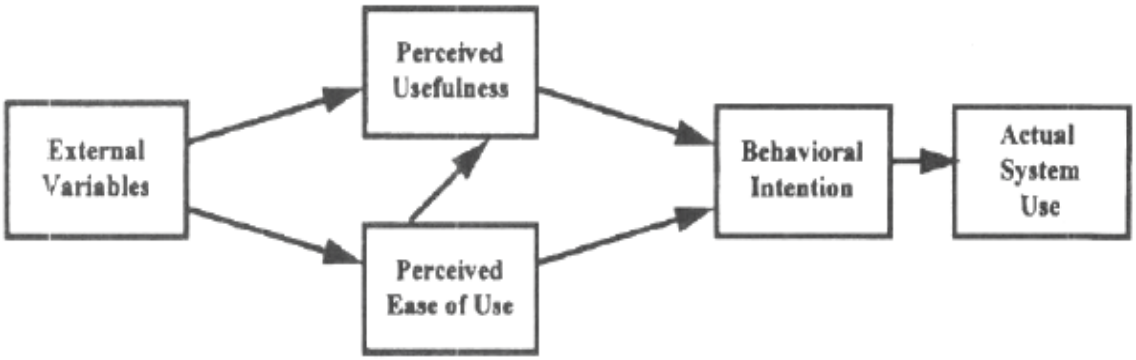

Figure 2.5 Final TAM Version (Venkatesh and Davis, 1996, p. 453)

Research after the final TAM model is proposed has mostly focused on replicating TAM and testing its propositions and limitations, comparing TAM with other user acceptance models such as Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) and extending TAM to other applications, mandatory use situation and including other variables (Hwang, 2005; Holden and Karsh, 2010; Mathieson, 2001, Pedersen, 2005).

2.5 Limitations of TAM

There are a number of serious limitations of the TAM model (Lee et al., 2003; Legris et al., 2003; Yousafzai et al., 2007). The criticisms of these shortcomings can be summarized under the three categories of (1) the methodology for testing the TAM model, (2) the variables and relationships hypothesized for the TAM model, and (3) the core theoretical assumptions underlying the TAM model.

2.5.1 Methodology Used for Model Testing

Self-reported data use in the TAM model to measure system use is criticised as a subjective measure and is thus unreliable for measuring actual system use (Lee et al., 2003; Legris et al., 2003; Yousafzai et al., 2007). Another limitation of the TAM studies is the tendency to examine only one information system with a homogeneous group of subjects on a single task at a single point in time thus raising the problem of generalization of any single study (Lee et al., 2003). Using students as subjects also impairs the generalizability of the findings (Lee et al., 2003). TAM have been applied mostly to explain voluntary use of systems with very few studies on mandatory system use. In the real world, users in many organizations do not have free choice of system use. TAM have not been sufficiently validated for system use in a mandatory setting (Lee et al., 2003).

2.5.2 Limitations in the Variables and Relationships Posited by the TAM 2 Model

Davis et al. (1989) eliminated the attitude variable in their revised TAM 2 model. Yang and Yoo (2003) argued that attitude cannot be excluded from the TAM model since it may have important influence on system use. They added two attitude variables, affective and cognitive and found that the cognitive attitude variable was very significant to predict system use while the affective attitude variable did not show statistical significance.

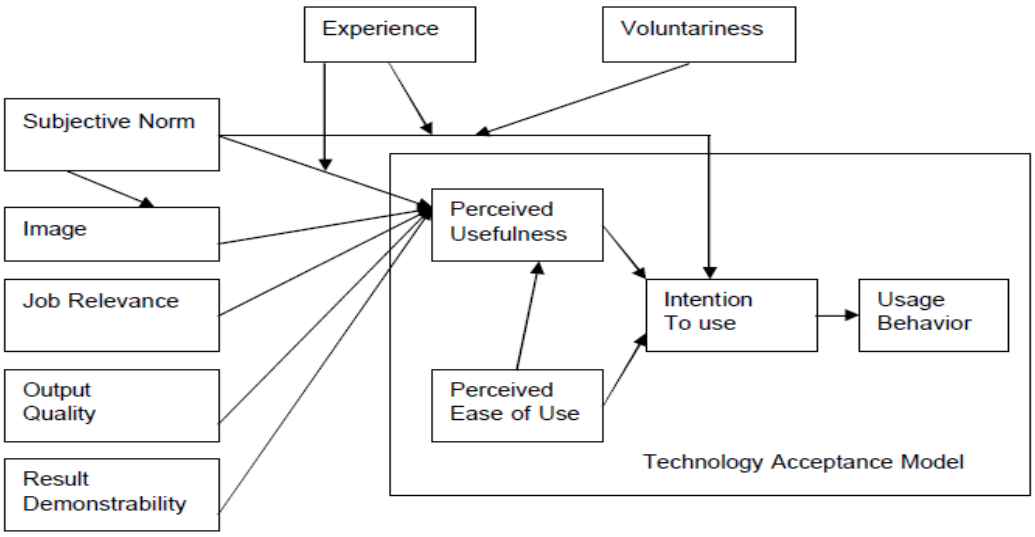

Figure 2.6 TAM2 (Venkatesh and Davis, 2000)

Burton-Jones and Hubona (2006) applied the TAM model to predict system use by employees of a US government agency. They found that perceived usefulness and perceived ease of use may not mediate all influences from the external environment factors on system use. System experience, education level and age which are important external factors and have a direct influence on system use were left out.

2.5.3 Limitations in the Theoretical Foundation of the TAM Model

Bagozzi (2007) questioned the weak theoretical relationship formulated among the different TAM constructs. He also questioned the theoretical strength of the intention-actual use link and disagreed that behaviour could be considered as a terminal goal. According to him, intention may not be representative enough of actual use because in the time period between forming an intention and adoption, an individual may change his decision to use a technology due to uncertainties and other influencing factors occurring in that time period. Bagozzi also argued that a person's intention to act is subjected to evaluation and reflection and this may cause a person to change his intention or take a different course of action. He concluded that the TAM model could not be suitable for explaining and predicting system use.

2.6 Theory of Planned Behaviour (TPB)

Social psychologists have attempted to improve the predictive power of attitude on behaviour after Wicker (1969) published his review of research examining the relationship between attitude and behaviour which concludes that attitudes probably do not predict behaviour. Integrated models of behaviour have been developed and the most popular in research are based on the Theory of Reasoned Action (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975) and the Theory of Planned Behaviour (Ajzen, 1988, 1991). The Theory of Planned Behaviour extends the Theory of Reasoned Action by including measures of control belief and perceived behavioural control (Figure 2.7).

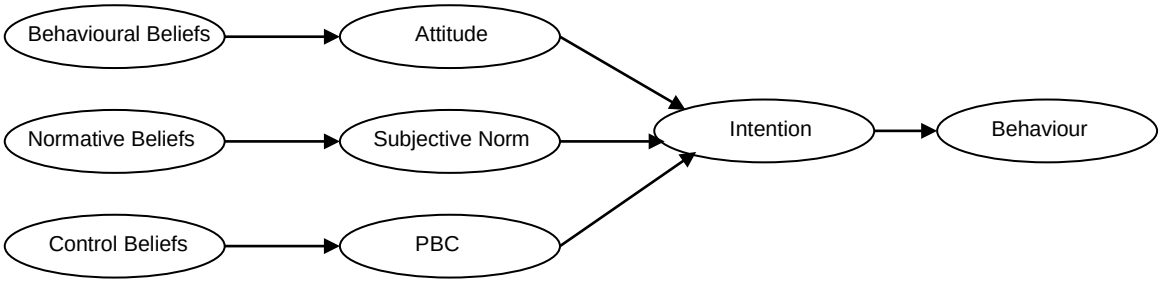

Figure 2.7 The Theory of Planned Behaviour (Ajzen, 1991, p. 183; Armitage, 2001, p. 472)

TRA's limitation is that it adequately predicts behaviours that were under complete volitional control (Ajzen, 1991). If there are constraints on action, intention alone is insufficient to predict behaviour. Perceived behavioural control (PCB) is introduced to provide information about potential constraints on action as perceived by the actor and also to explain why intentions do not always predict behaviour. Ajzen (1991) argues that the strength of the PBC-intention relationship depends on the type of behaviour and the nature of the situation. Individuals are more inclined to engage in behaviours that are believed to be achievable (Bandura, 1997). The introduction of perceived behavioural control should become more useful as volitional control over behaviour decreases (Ajzen, 1991). Under complete volitional control, the intention-behaviour relationship should be optimal, and PBC should not exert any influence on this relationship. PBC should be moderate the relationship between intention and behaviour where behaviour is not under complete volitional control (Baron and Kenny, 1986).

Since research did not provide much evidence for the effects of PBC on the intention-behaviour relationship, Ajzen (1991) argued for a direct relationship between PBC and behaviour which is supported by available data. According to Ajzen, where there are problems of volitional control, PBC should be directly predictive of behaviour. Equally problematic is the explicit assumption that PBC accurately represents actual volitional control. From the current literature on "illusions of control", it is likely that PBC will rarely reflect actual control in an accurate way (Langer, 1975; Lerner, 1977).

TPB appears to have more explanatory power than TRA. Godin and Kok (1996) meta-analysis of health behaviours found that PBC contributed an additional 13% variance to prediction of intentions and 12% to prediction of behaviour. However the tendency for authors to report only significant findings may have inflated the reported values (Rosenthal, 1979). Hausenblas et al. (1997) concluded in their meta-analysis that TPB is more useful than TRA. However their conclusion is based solely on the magnitude of correlations between PBC, intention and behaviour.

Many meta-analyses on TRA/TPB did not report reliability statistics. Even though there are a number of limitations of TPB, meta-analytic reviews suggest that TPB is a useful model for predicting a wide range of behaviours and behavioural intentions.

2.7 Critiques of the TPB Model

One of the main objections to the TPB model is that its validity and reliability is suspect since it relies on self-reports even though such data is vulnerable to self-presentation biases (Gaes et al., 1978). Research have shown that self-reports of behaviour were unreliable compared to more objective behaviour measures (Armitage and Conner, 1999a, 1999b; Norvich and Rovoli, 1993; Pellino, 1997).

The second problem is the control component of the TPB. Ajzen (1991) suggests that PBC and self-efficacy constructs are interchangeable. A number of studies have shown that there is a difference between PBC and self-efficacy (Bandura, 1986, 1992; Dzewaltowski et al., 1990; Manstead and van Eekelen, 1998). Furthermore, Armitage and Conner (1999a, 1999b) have found evidence to show that PBC and self-efficacy are different from each other.

The third difficulty lie in the behavioural intention construct which is the core of both TRA and TPB model. Researchers when applying the TRA/TPB model did not always use measures that clearly capture the intention construct. Shepperd et al. (1988) argued that behavioural intentions and self-predictions must be considered when predicting behaviour.

Warshaw and Davis (1988) argued there are different ways of measuring intentions and measures of behavioural intention should be distinguished from measures of self-predictions.

Another criticism of the TPB is the subjective norm component. Shepperd et al. (1988) meta-analysis of the TRA found that subjective norm was the weakest predictor of intentions. Due to this finding, several authors have removed subjective norms from analysis (Sparks et al., 1995). The poor performance of the subjective norm component is most likely due to its measurement: many researchers use single-item measures in place of more reliable multi-item scales (Nunnally, 1978).

2.8 Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh et al. (2003) formulated a unified model from elements across the eight models (TRA, TAM, motivational model, TPB, model combining TAM and TPB, model of PC utilization, IDT and social cognitive theory). UTAUT was developed with four main effects/determinants (performance expectancy, effort expectancy, social influence and facilitating conditions) which directly affects user acceptance and usage behaviour and four moderators (gender, age, experience, voluntariness of use) of the main effects. Venkatesh et al. found that UTAUT outperformed the eight individual models and explained as much as 70% of the variance in intention.

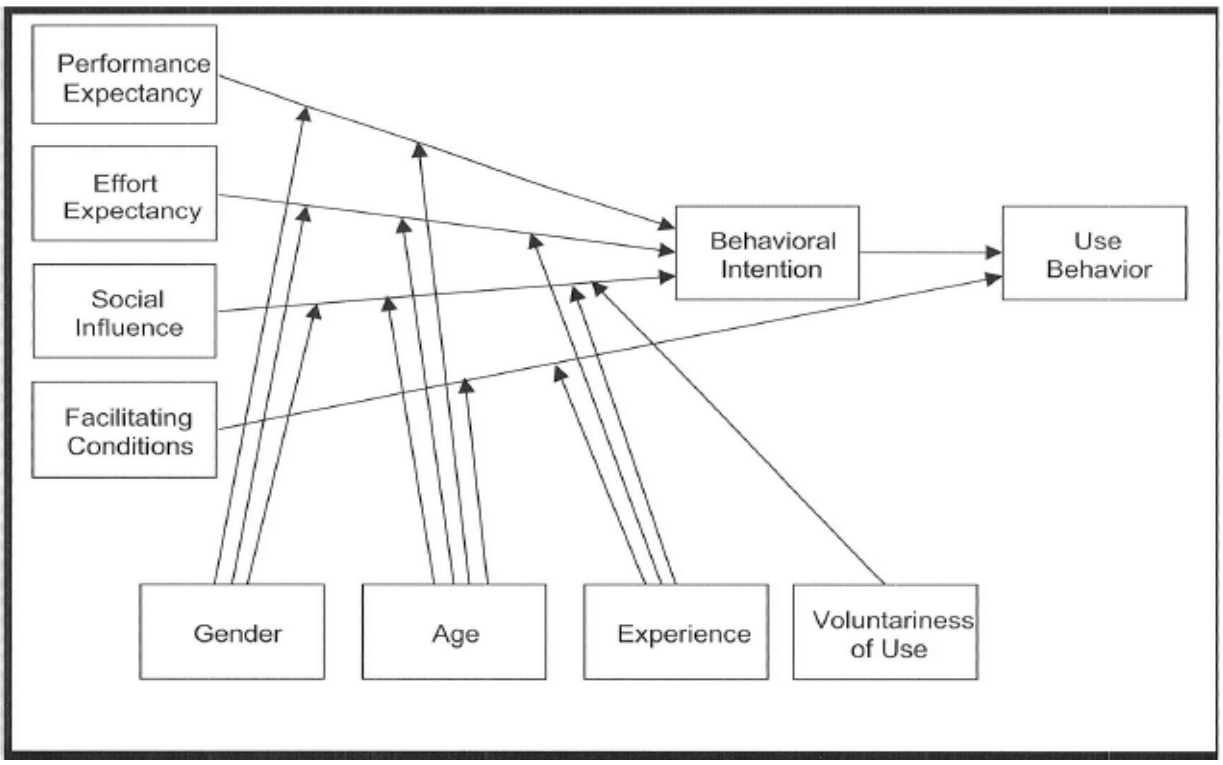

Figure 2.8 Unified Theory of Acceptance and Use of Technology (UTAUT) Model (Venkatesh et al., 2003, p. 447)

UTAUT has emerged as a popular alternative to the TAM model for adoption/acceptance of IS/IT (Dwivedi et al., 2010). Two of its independent constructs, "performance expectancy" and "effort expectancy" can be mapped to the two TAM constructs of "perceived usefulness" and "perceived ease of use" respectively. Researchers have now shifted their attention from TAM to UTAUT because it provides two other constructs (social influence and facilitating conditions), thus providing a better understanding of technology acceptance than TAM (Dwivedi et al., 2010).

In the bibliometric comparison of TAM and UTAUT based on publishing authors and keywords investigated, UTAUT is found to be utilized in a more or less similar way as TAM (Dwivedi et al., 2010). For instance, both TAM and UTAUT have been popular and useful models for IS acceptance in studies of e-commerce, Internet banking , e-government services and health services (Cheng et al., 2008; Han and Jin, 2009; Hung et al., 2007; Im et al., 2010; Lean et al., 2009; Thomas, 2006; Qureshi and York, 2008). UTAUT has also been a very popular model for studying ICT acceptance in the health sector (Han et al., 2004;

Kijsanayotin et al., 2009; Schaper and Pervan, 2005, 2007; Siracuse and Sowell, 2008; Wills et al., 2008).

2.9 Limitations of the UTAUT Model

UTAUT have attempted to integrate the best of 8 models but is still subject to the same basic limitations of its predecessor models since it is reliant on the behaviour-actual use link. Although UTAUT model is an improvement over the earlier models (e.g., TRA, TAM, TPB), it is necessary to recognize some of its limitations (Venkatesh et al., 2003). The core constructs in UTAUT was operationalized by using the highest loading items from each construct. The problem with this method is that some facet of each construct may be eliminated thus impairing content validity (e.g., items from MPCU were not represented in performance expectancy). The research used standard measures of intention. In order to revalidate the research, alternative measures of intention should be used. The role of social influence constructs has been controversial Previous research has shown that social influence is significant only in mandatory settings (Hartwick and Bakri, 1994; Venkatesh and Davis, 2000). Other research have reported different findings, such as social influence is significant among woman in early stages of experience (Venkatesh and Morris, 2000) or social influence is more significant among older workers (Morris and Venkatesh, 2000). Venkatesh et al. (2003) findings show that social influence has to be considered even though it is more likely to be important to older workers.

2.10 Summary of the TRA, TAM, TPB and UTAUT models

The four models focus mainly on the individual user acceptance of an information technology. They are similar in that the four models include the intention-use relationship. Their difference lie in the antecedents to intention and their interaction with intention and actual use. The TAM model is simpler to use than the TRA model and provides general information about the individual's perception of a system (Mathieson, 2001).

The TPB was proposed to overcome the limitation of the TRA when dealing with behaviours in which people have incomplete volitional control (Ajzen, 1991) by introducing the perceived behavioural control (PCB) construct. The TPB provide more specific information as to why an individual might be dissatisfied. Mathieson (2001) suggested that TAM can be used to identify dissatisfied users while TPB can be used to provide more detailed information about this group. Mathieson (2001) found that TAM model explained more variance than TPB but the difference is not significant. The UTAUT model that combines the best elements of all eight models is an improvement over the eight individual models (Venkatesh et al., 2003) but needs to be validated in different situations.

2.11 Why TRA, TAM, TPB and UTAUT models are not suitable for this research

The critiques provided above for the four models are sufficient for the researcher to be wary when applying these models to his research. From the above review and discussion, it is clear that the four models are mostly used for individual acceptance (adoption) and use of an information system where there is freedom of choice. The models are not suitable to be applied in situations where both mandatory and non-mandatory decision making is applicable in the case of organizational adoption. The models are based on the individual user motivation which is quite different from the reasons why an organization would adopt an information system. As argued earlier in my thesis, the weak link of UTAUT is its reliance on the behaviour actual use link which implies individual adoption. Therefore UTAUT in its unmodified form is definitely unsuitable for organizational adoption of information technology. Most of these studies have looked at personal information software such as word processor, e-mail, spreadsheet, world wide web (WWW) and not on interorganizational information systems (Agarwal and Prasad, 1997; Al-Gahtani, 2001; Gefen and Straub, 1997; Venkatesh and Davis, 1996; Shih, 2004). There would be at least two adopters for an interorganizational information systems to function and their reasons for adoption would have to be mutually beneficial. The adoption (acceptance) of an interorganizational information

system is dependent on at least two parties which is not the case with the four models discussed above. These models also do not comprehensively address the technology, organizational and environmental contexts of adoption by an organization. Because of the above reasons, the following sections reviews and discusses the innovation diffusion theory (IDT), the social exchange theory (SET) and the critical mass theory (CMT) which avoids some of these issues and form the main theoretical bases which are used as the foundation of this research.

2.12 Theoretical Bases for Study's Adoption Research

The following section introduces the common theoretical bases in innovation adoption research. Diffusion of innovation theory (Rogers, 1983, 1995, 2003) is discussed followed by critical mass theory (Oliver et al., 1985) and social exchange theory (Homans, 1958).

2.12.1 Diffusion of Innovation Theory

An innovation is any idea, practice or object that is perceived as new by the adopter (Rogers, 1983, 1995, 2003; Zaltman et al., 1973). Daft (1978) defines an organizational innovation as "the adoption of an idea or behavior that is new to the organization adopting it" (Swanson 1994: 1070).

Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system. Diffusion is perceived as a special type of communication in which the messages are about a new idea. Diffusion is perceived as a kind of social exchange by which alteration occurs in the structure and function of a social system. Social change occurs when new ideas are invented, diffused and adopted or rejected, leading to certain consequences (Rogers, 1983, 1995, 2003).

An innovation creates uncertainty and an individual or organization in an uncertain environment will seek more information about the innovation or its alternatives. Innovation diffusion theory explains individual innovativeness and the rate of adoption of an innovation.

Rogers (1983, 1995, 2003) has identified several generalizations and factors that determine the rate of adoption of innovation and diffusion. Innovations possess five perceived attributes of relative advantage, compatibility, observability, trialability and complexity. The five attributes have often been used in various combinations in adoption decision studies.

The first four factors are consistently positively correlated with the rate of adoption, with complexity consistently negatively related to rate of adoption (Rogers, 1995). Individual adopter characteristics such as cosmopolitanism and education level exert a strong influence on the adoption decision. The adoption decision goes through stages and the adopters are affected by different influences during different stages. It is important to perform stage-based research to identify the important determinants during the stages of awareness, evaluation and adoption (Frambach et al., 2002).

The influence of certain individuals (opinion leaders and change agents) can strongly affect technology adoption. It is observed that the diffusion of innovation process starts out slowly, reaches a take-off point and levels off as the population of potential adopters becomes exhausted thus giving rise to an S-shaped cumulative adoption curve.

Tornatzky and Klein (1982) meta-analysis found that ten out of twenty-five innovation characteristics are most frequently studied in which compatibility, relative advantage and complexity are consistently found to be significant out of the ten characteristics.

Diffusion of innovation theory has been used as a theoretical base for innovation adoption research in anthropology, economics, education, marketing, sociology and technology (Frambach and Schillewaert, 2002; Gopalakrishnan and Damanpour, 1997; Wolfe, 1994).

The early literature on technological innovation was mostly based on individual user adoption of personal software applications such as word processor, spreadsheet, microcomputer or e-mail (Brancheau and Wetherbe, 1990; Huff and Munro, 1989). Classical diffusion theory assumes that an individual user can choose to adopt or reject the

technological innovation based on rational choice, i.e. the benefits the user expects to gain from their independent use of the technology (Fichman, 1992). Classical diffusion theory is insufficient to explain how groups in an organization make adoption decisions. Later adoption research based on innovation diffusion theory has been extended to an organization's adoption of technology (Chau and Tam, 2000; Thong, 1999; Zhu et al., 2002). Group decisions in an organization are collective decision and are different from individual decision.

Innovation studies on technology adoption have successfully applied diffusion of innovation theory using factors e.g. the perceived characteristics of innovation, individual innovativeness and organizational innovativeness as key adoption variables (Chwelos et al., 2001; Grover, 1993; Kuan and Chau, 2001; Premkumar and Ramamurthy, 1995; Thong, 1999).

2.12.2 Critical Mass Theory

Sociologists Oliver, Marwell and Teixera (1985) developed critical mass theory to integrate theories of collective action regarding phenomena variously labeled as "snob and bandwagon effects, the free rider problem, and the tragedy of the commons" (Markus, 1987). Critical mass theory has been applied in the communications field to explain the diffusion of interactive communication technologies in businesses, organizations and other social groups.

Diffusion researchers agree that an individual is more likely to adopt an innovation if it provides him with some kind of net benefit. The benefit derived from the adoption of an interactive innovation does not depend only on an individual's efforts but more on how others respond to those efforts. For example, a single e-mail user or mobile phone user will not benefit much from his adoption of the innovation until others adopt the innovation. A user will not receive all the benefits of an innovation until a sizable number of users have adopted the innovation. This "sizable number" is what sociologists Oliver, Marwell and Teixeira (1985) and Markus (1987) refer to as "critical mass." Economists refer to the technologies which are dependent on others adopting it as showing characteristics of "network economies

or network externalities." Mobile telephony, facsimile and internet applications such as e-mail and chat rooms all show characteristics of network externalities.

Critical mass is closely related to the concept of network externalities when referring to network or network goods. Critical mass and network externalities have been used to investigate the adoption and diffusion of networks (telephone, e-mail, fax and Internet) and network goods (VCRs).

Networks are unlike other technological innovations because they are subject to network externalities (Economides, 1996; Shapiro and Varian, 1999). The larger the number of adopters, the higher is the value of a network to a subscriber (Oren and Smith, 1981; Rohlfs, 1974). Many technological innovations such as software suites and telecommunications networks share characteristics of physical network and are affected by network externalities.

The dynamics of network goods are fundamentally different from conventional innovations because of scale economics and network externalities (Katz and Shapiro, 1986; Shapiro and Varian, 1999). In the presence of network externalities, the total benefit derived from the network depends in part on the number of consumers who adopt compatible products in the future.

When a critical mass of users of an IOS technological innovation is reached, the rate of adoption will suddenly take off. When this happens the value of adoption to the user will increase manifold. In the case of EDI, greater value is derived from linking to more business partners and the likelihood that the adoption cost will be substantially reduced because more partners are using the innovation (Mahajan et al., 1990).

2.12.3 Social Exchange Theory

Social exchange theory has its early roots in the intersection of economics, psychology and sociology. Homans (1958) initiated the theory to explain the social behaviour of humans in economic undertakings. What differentiates economic exchange and social exchange is the way we view the actors. Exchange theory "views actors (person or firm) as dealing with a

market and not with one another" and responding to various market characteristics" (Emerson, 1987). Social exchange theory views the exchange relationship between specific actors with "actions contingent on rewarding reactions from others" (Blau, 1964).

In social exchange theory, the outcomes of an organization's behaviour will be based on the responsive behaviour of other participants within the relationship (Son et al., 2000; Zafirovski, 2005). Social exchange theory has been used as the theoretical background to study different antecedents of interorganizational relationships through non-economic aspects such as power, trust and interdependency (Premkumar and Ramamurthy, 1995; Ramamurthy et al. 1999).

The mechanisms of trust and power from social exchange theory (Blau, 1964; Emerson, 1962) can be used to explain adaptations. Social exchange assumes that as processes occur over time, the actors have the opportunity to mutually and sequentially demonstrate their trustworthiness. Trustworthiness is demonstrated by a commitment to the exchange relationship such as by adapting the product or production processes to the other.

Emerson (1962) developed the role of power in social exchange. The relative power of any two actors is associated with the relative dependence between two actors in an exchange relationship. For e.g. large automotive companies which have great purchasing power can force their suppliers to adopt an innovation or lose their business.

Emerson's power model has been extended and generalized to the organizational level in the resource-dependence model (Pfeffer and Salancik, 1978). Organizations respond to the demands of organizations that control critical resources which implies suppliers that control critical resources exert great power over their customer to adopt an innovation (Pfeffer and Salancik, 1978).

Social exchange theory which has links to critical mass theory are often used in studies of technological IOS e.g. B2B e-commerce, electronic data interchange (EDI) and distribution

resource planning (Bouchard, 1993; Hart and Saunders, 1997, 1998; Jeyaraj et al., 2006, Kaufman et al., 2000; Teo et al., 2003).

2.12 Relevance of Theory Bases to this Study

Diffusion of innovation theory, critical mass theory and social exchange theory provide some of the most influential theories for interorganizational systems (IOS) adoption studies. Each theory by itself is insufficient to capture the complexities of an IOS which includes not only organization characteristics but also relationships and exchanges. The three theories complement each other by covering areas not addressed by any one of them. These theories are therefore suitable to form the integrative framework for investigating IOS adoption.

Diffusion of Innovation Theory (DOI) has been used to explain adoption in anthropology, sociology, marketing and information systems. DOI can also be used to explain how IOS characteristics influence an organization's adoption behaviour. DOI theory is often used to predict innovation adoption through the perceived attributes of innovation of compatibility, complexity and relative advantage. DOI provides the basis for including innovation adoption factors in the study.

Social exchange theory provides a base for investigating interorganizational relationships such as power and trust. Dependence and interdependence relationships are often studied in an organization's adoption of IOS innovation. Power imbalances can exist in a relationship because of dependence in the social exchange relationship. An organization which is more powerful in the exchange relationship can influence its partner's decision in the IOS adoption process. Empirical studies have shown that exercised power can influence an organization's adoption of IOS (Chwelos et al., 2001; Hart and Saunders, 1997, Premkumar and Ramamurthy, 1995; Williams, 1994).

Trust theories address an important aspect of adoption. A successful relationship in business is dependent on building trust between business partners. A trusting relationship is essential in an interorganizational relationship and positively influences IOS adoption.

Empirical studies have shown that trust has a significant influence on an organization's adoption of IOS (Hart and Saunders, 1997, 1998, Saunders and Clark, 1992). Social exchange theory is used to predict innovation adoption by determining the level of trust between trade partners (Hart and Saunders, 1998; Mishra, 1995; Nidomulu, 1989). Social exchange theory forms the basis for including interorganizational factors in the study since EDI involves interorganizational exchanges of business transactions. For this research, the interorganizational trust variable from trust theory which is frequently used in the study of technological adoption has been chosen (Huang and Fox, 2006; Seppanen et al., 2007).

Critical mass is necessary for the adoption of an IOS innovation because full benefits cannot be received until a sizable number of users have adopted the innovation (Bouchard, 1993; Oren and Smith, 1981). Critical mass is important for the adoption of interactive communication technologies (e-mail and fax) and technological innovations which are subject to network externalities (software suites and telecommunications networks) (Economides, 1996; Rohlfs, 1974; Shapiro and Varian, 1999). The rate of adoption is expected to take off rapidly when a critical mass of users of a technological innovation is reached. The value of adoption will be greatly increased and the cost of adoption will drop significantly when critical mass is reached (Mahajan et al., 1990). Critical mass achieved will positively influence the adoption of an IOS. The inclusion of critical mass to investigate its significance on EDI adoption is justified because EDI is an IOS which is subject to network externalities.

The three theories provide a strong theoretical foundation for the research framework.

The technology-organization-environment research framework provides a comprehensive framework to investigate organizational EDI adoption because it not only combines the organization context variables of size, top management support, internal championship but also addresses the characteristics of technology (DOI) such as compatibility, complexity and benefits and the interorganizational trust relationships (SET/trust theory) and critical mass under environment context. The technology-organization-

environment framework is able to adequately address the organizational adoption of an interorganizational information system such as EDI where no single theory is able to do on its own by taking into account all the three major contexts of IOS adoption with reference to the aforementioned theoretical bases (Tornatzky and Fleischer, 1990). The next section reviews the literature on the study of innovation adoption in interorganizational systems and EDI from the organizational, environmental and technological perspectives.

2.14 Technological Perspective

Prior research has shown that technological characteristics have a strong influence on innovation adoption (Frambach and Schillewaert, 2002; Hausman and Oyedele, 2004; Jeyaraj et al., 2006; Tornatzky and Fleischer, 1990). This section reviews the relationship of benefits, costs, risks, security and complexity to interorganizational innovation adoption.

2.14.1 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. The nature of innovation determines what specific type of benefits (economic, social) is important to adopters, although the characteristics of the potential adopters also affect which subdimensions of benefits are most important.

Benefits can be subdivided into direct, indirect, strategic and operational benefits (Dearing, 1990; Pfeiffer, 1992; Reekers and Smithson, 1994; Sokol, 1995). Benefits have been found to emerge consistently as a significant determinant of technology adoption in prior studies (Arunachalam, 1995, 1997; Banerjee and Golhar, 1993; Bouchard, 1993; Li and Mula, 2009; Scala and McGrath, 1993).

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). The following studies have 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).

Banerjee and Golhar (1993) classifies the EDI benefits as customer related, communication related, peer pressure related, productivity related and cost related for JIT and non-JIT firms. Banerjee and Golhar (1993) found that just-in-time (JIT) firms realize more EDI benefits than non-JIT firms.

Sokol (1995) discusses direct and indirect benefits. Direct benefits comes from data being sent electronically from one application to another and do not rely on either business's making changes in their business practices (Dearing, 1990). A direct benefit is the elimination of the need to reenter data at the receiving company resulting in improved data accuracy. Other direct benefits include reduced human handling costs and eliminating the need for envelopes and stamps. Most EDI studies focus on direct benefits because they are the easiest to identify and quantify. Gains and savings from direct benefits are less compared to those which may be obtained from indirect benefits.

Indirect benefits are only realized in the longer term and through reengineering business procedures and system processes (Peffers and Santos, 1998). For example, EDI can facilitate a change in inventory policy to a JIT management whereby materials are purchased and units are produced only as needed to meet actual customer demand.

Pfeiffer (1992) also classifies benefits into direct and indirect benefits (Sokol, 1995). Direct benefits refer to operational savings related to the internal efficiency of the organization. Indirect benefits or opportunities refer to the effect of EDI on the business processes and relationships. Examples are tactical and competitive advantages.

Dearing (1990) groups EDI benefits into direct, indirect and strategic. The long-term strategic benefits of EDI are probably the most significant although they are the hardest to measure. An example is the beneficial close ties with customers which enable the company to anticipate what the customers need, the quantities required and when it is required. Other examples of strategic benefits include market share expansion and new business made possible through EDI.

Reekers and Smithson (1994) classifies EDI benefits as strategic and operational. Strategic benefits relates to the development of corporate strategy by forming external relationships with customers and competitors. Iacovou et al. (1995) refers to this strategic grouping as 'indirect benefits', which also include improving organization's image, competitive advantage, customer services, relationships with business partners, as well as benefiting other business practices. Operational benefits refer to improvements made to the internal operations of the organization. Examples include, improving data security, data accuracy, operational efficiency and reducing clerical errors. Iacovou et al. (1995) called these 'direct benefits'.

2.14.2 Costs

Costs refer to the perceived costs incurred to adopt, implement and use EDI. Types of costs are consultation, migration/integration, installation/setup, training, operations/running and maintenance costs. The cost of adopting an innovation has been consistently found to be negatively related to innovation adoption (Tornatzky and Klein, 1982).

The EDI Association (UK) believes that cost-associated problems are less of an issue with the introduction of new low-cost software packages (Philip and Pedersen, 1997). However this belief is not borne out by Philip and Pedersen (1997) study with respondent comments such as: "EDI is expensive for low volumes"; "Software and network fees are relatively expensive and create problems for small suppliers", which shows that cost is still a major problem for organizations.

High set-up costs are a significant barrier for EDI adoption in the automotive industry and EDI costs are too high for the smallest companies with low volumes (Crum et al., 1996; Tuunainen, 1999).

Different types of costs have been studied and have consistently been shown to negatively influence the adoption of different technology in company of different size in different industry.

For example, migration cost was negatively related to decisions to adopt open systems while establishing costs is a negative factor in the adoption of Internet-based interorganizational systems (Chau and Tam, 2000; Soliman and Janz, 2004). Perceived costs negatively affects EDI adoption in small and medium industries (Chau and Jim, 2002; Seyal and Rahim, 2006). Cost is also a significant factor in EDI adoption in retail firms (Jimenez-Martinez and Polo-Redondo, 2001).

2.14.3 Risks

Risks refer to the perceived risks of using EDI. Risks arise from factors internal and external to the company (Ratnasingham and Swatman, 1997). These risks give rise to various control and auditing issues (Arunachalam, 1995; Bergeron and Raymond, 1997; Crook and Kumar, 1998; Sanderson and Forcht, 1996). Controls must be enforced to mitigate harm inflicted on a company through exposure to risks. Effective control means that a specific information resource is neither under-controlled which introduces unacceptable risks nor over-controlled which introduces unnecessary costs (Ratnasingham and Swatman, 1997). The objective of EDI control is to ensure that all EDI-related software and data is adequately protected against risks such as unauthorized disclosure or change during storage and unsecured transmission and physical access to premises and equipment (Picard, 1992).

Internal risks refer to risks from EDI operations in the company. These inherent EDI risks arise because of inadequate control procedures. Internal risks are risks related to EDI message security and threats which affect message integrity, authenticity, repudiation,

availability, timeliness and confidentiality (Ratnasingham and Swatman, 1997; Ratnasingham, 1998). Deficiencies in the EDI system result in impaired customer/supplier relationships, production delays, legal liability and employee dissatisfaction.

External risks refer to risks that occur during EDI message transmission between trading partners. Risks are incomplete messages, lost messages, errors in received EDI messages, tampered EDI messages and intercepted EDI messages by hackers (Jamieson, 1994).

Controls to manage internal and external risks verify that data were received exactly as sent, i.e. data integrity is maintained in EDI exchanges between parties. The data received will be identical to that sent because EDI technology is now using communications protocols with error-detecting capability (Sokol, 1995). The translator program on the receiving end will examine the EDI data stream sent and generate a functional acknowledgement (FA) which is returned 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 data must be resent (Arunachalam, 1995; Sokol, 1995).

Risks and corresponding controls have been identified in a number of studies (Jamieson, 1996; Lim and Jamieson, 1995; Ratnasingham and Swatman, 1997). For example, Lim and Jamieson (1995) rank the importance of EDI risks, implementation, operational and network controls. The most significant risks identified were loss or delay of documents during transmission, errors/alterations introduced into messages, network interconnection risks and risks arising from inadequate record retention controls and legal liability.

Jamieson (1996) identifies EDI internal, external, general risks and EDI controls. The identified risks are interconnection problems, non-delivery or delayed delivery, incorrect data, tables or software, inaccurate or incomplete transactions and record retention problems while the identified controls are audit trails of network access, contingency planning and backup, accounting controls, encryption mechanisms and procedures for delivery failures.

Ratnasingham and Swatman (1997) built on Jamieson's findings and identified additional risks and controls. A model of EDI risks was developed and mapped onto their associated control group. How each control can reduce the risks identified was discussed. The most important control issues were transaction accuracy, transaction authorization, error recovery and audit trails (Ratnasingham and Swatman, 1997). Similar to previous studies, Simpact Associates (1990) also found that security risks can be classified into six categories, i.e. disclosure of messages, modification of message contents, modification of message sequence, sender masquerade, repudiation of message origin or receipt and denial of services (Jamieson, 1996; Ratnasingham and Swatman, 1997).

Banerjee and Golhar (1995) discuss trading agreement risks, their impact on an organization and potential solutions. Five types of EDI trading agreements and the level of security risk for each EDI agreement were described. Other EDI risks are identified include the lack of standards, lack of hard copy, operator errors, time lag in communication and globalization of EDI.

Different types of general, internal and external risks and controls to reduce these risks have been identified and studied. Risks have been found to negatively impact the adoption of technology (Frambach and Schillewaert, 2002; Tan and Teo; 2000).

2.14.4 Security

Computer security is the shield that companies and government use to protect sensitive and classified information from unauthorized users (Kearvell-White, 1996; Sanderson and Forcht, 1996). In an increasingly networked world, security threats to electronic networks and computer systems is on the rise and a company cannot afford to ignore security of its networks (Ernst & Young, 1997). A security breach would likely have occurred many times before a company could implement a comprehensive security programme (Sanderson and Forcht, 1996).

A security breach may occur from an outside or inside attack. Disgruntled or dishonest employees find it easier to get inside an internal system because internal systems are seldom protected by a firewall. The protection of resources and assets, electronic or physical in nature is at the core of any security system.

Convergence is the overlap of computer technologies, resources, and industries to provide more to customers. Convergence of systems makes security management harder by the day. Threats to companies from convergence include fraud, denial of services, unauthorized disclosure of information, unauthorized modification of sensitive information and illegal information brokering (Sanderson and Forcht, 1996).

All companies should have a security policy which guides its security efforts (Kearvell-White, 1996). A system with good security should have a backup and recovery plan for contingencies such as natural disaster, power failure or a hacker thrashing the system. It is important to hold awareness programmes for employees to educate them on the proper procedures to handle sensitive information (Sanderson and Forcht, 1996).

Security issues on standards, networks, data security, controls and audits are often studied by researchers (Banerjee and Golhar, 1993, 1995; Hains, 1994a, 1994b; Ratnasingham, 1998; Soliman and Janz, 2004). Security can be implemented by security logs, passwords, encryption, firewall and antivirus program (Banerjee and Golhar, 1995; Hains, 1994a; Sanderson and Forcht, 1996).

Minimum standards for network access, encryption technique and security and control are identified as important EDI security (Hains, 1994a). Encryption security which provides for authenticity, establishes legal proof for an electronic contract (Hains, 1994a).

Standards have been extensively studied in innovation adoption (Angeles et al., 2001). The lack of standards is a significant barrier to successful EDI implementation (Banerjee and Golhar, 1993; Emmellhainz, 1988). For example, Van Heck and Ribbers (1999) in their study of EDI adoption in Dutch SMEs extended Iacovou et al. (1995) model with an additional

factor, i.e. “availability of EDI standards”. Perceived importance of standard compliance, interoperability and interconnectivity and selection of EDI standards are significant factors in open systems adoption and EDI implementation in the United States (Angeles et al., 2001; Chau and Tam, 1997). The use of a commercially available standard will reduce the development costs and time and hence reduces risk linked to new EDI application (King and Kraemar, 1995).

Network security has also been studied often in interorganizational systems. For example, Angeles et al. (2001) identify reliable telecommunications infrastructure and security in EDI transmission as critical success factors in international EDI. Soliman and Janz (2004) also found that network reliability is a significant factor in Internet-based information system (IBIS) adoption.

Deterrent, detective, corrective and preventative controls which reduce risk (increases security) in an IOS have been studied (Baskerville, 1988; Ratnasingham, 1998). Access, integrity, availability, repudiation and authentication controls were identified in a model of EDI risks and their associated controls (Ratnasingham and Swatman, 1997). Security and audit controls were identified (Angeles et al., 2001) and an easily auditable EDI control architecture have been proposed (Hansen and Hill, 1989).

Security which has been studied in various forms consistently have a positive effect on the adoption of innovation (Angeles et al., 2001; Jun and Cai, 2003; Ngai and Gunasekaran, 2004).

2.14.5 Complexity

Complexity refers to the extent to which an innovation is perceived as difficult to understand and use (Rogers, 1995: 242). Complexity is a perceived characteristic of innovation which is often studied in innovation adoption (Rogers, 1983, 1998, 2003).

The degree to which technical skills are required to use a complex technological innovation may inhibit its adoption (Cooper and Zmud, 1990; Robertson and Gatignon,

1986). Complexity will be a barrier to adoption unless users have high achievement needs or possess great skill and knowledge.

Complexity can be studied as business and technical complexity (Bouchard, 1993). 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. Business and technical complexity was found to be important to EDI adoption.

Prior studies have shown that complexity is negatively related to adoption decisions (Jeyaraj et al., 2006; Rogers, 1983, 1998, 2003; Tornatzky and Klein, 1982). For example, investigation of the decision to adopt customer-based interorganizational information systems (CIOS) found that complexity is a strong predictor of CIOS adoption (Grover, 1993). Teo et al. (1995) used DOI theory to predict intent to adopt financial EDI in Singapore. They found that complexity is a strong predictor of intent to adopt, as is their measure of the perceived risks of adopting.

Bouchard (1993), Soliman and Janz (2004) and Tuunainen (1999) all found complexity significant to EDI adoption decision, to Internet-based interorganizational information system (IBIS) adoption and to EDI adoption in SMEs respectively.

In stage-based research, Frambach et al. (2002) found that the perceived level of complexity decreases over the innovation stages of awareness, evaluation and adoption.

The studies above show that complexity is an important variable to be studied in innovation adoption.

2.15 Organizational Perspective

Prior research has shown that organizational characteristics have a strong influence on innovation adoption (Frambach and Schillewaert, 2002; Hausman and Oyedele, 2004; Jeyaraj et al., 2006; Tornatzky and Fleischer 1990). This section reviews the relationship of size, top

management support, information technology capability, organizational compatibility and internal championship to interorganizational innovation adoption.

2.15.1 Size

Size has been defined variously in innovation research, for example as number of beds (Kimberley and Evanisko, 1981), number of employees (Ettlie et al., 1984; Bajwa et al., 2005), annual sales (Lind et al., 1989) and total revenues (Bajwa et al., 2005).

Organizational size is studied extensively in innovation adoption research and is consistently shown to be positively related to innovation adoption (Benjamin et al., 1990; Kimberley and Evanisko, 1981; Masters et al., 1992; Rogers, 1983, 1995, 2003).

Size has also been shown to be a significant innovation adoption variable in collaborative information technologies (Bajwa et al., 2005), EDI implementation (McGowan and Madey, 1998), information systems adoption (Thong, 1999), distribution resource planning (Masters et al., 1992) and electronic business (Zhu, 2002).

Frameworks for IOS adoption have been developed in which size is identified as an internal structural variable which affect the organizational adoption process (Bajwa et al., 2005; Hausman and Oyedele, 2004; Frambach and Schillewaert, 2002, Narayanan et al., 2009). Meta-analysis of information technology innovation adoption also shows that organization size is one of the best predictors of organizational innovation adoption (Jeyaraj et al., 2006).

Several studies argue that larger firms tend to be more innovative because with more resources, economies of scale, they are able to absorb greater risk (Damanpour, 1992; Dewar and Dutton, 1986; Grover, 1993; Moch and Morse, 1977; Utterback, 1974). Other studies take a different position and argue that innovativeness is not the sole domain of large firms because smaller firms with increased flexibility, adaptability which are better able to respond quickly to the market through technologies could also be innovative (Chen and Williams, 1998; Grover, 1993).

Size studied in different forms has been shown to positively influence innovation adoption (Bajwa et al., 2005; Ettlie et al., 1984; Kimberley and Evanisko, 1981; Lind et al., 1989)

2.15.2 Top Management Support

Top management support has been consistently found to be important for individual and organizational adoption of IT innovation (Baldridge and Burham, 1975; Jeyaraj et al., 2006; Rai and Howard, 1994). Top management support is also important for interorganizational systems adoption and implementation (Grover, 1993; Premkumar et al., 1994, Premkumar and Ramamurthy, 1995). Top management support is needed not only to approve a project but also to provide continuous and active support throughout the project life cycle (Quinn, 1985). Top management support is necessary to manage the complexities that accompany the introduction of a new technology (Ramamurthy et al., 1999). Top management who provides strategic vision and enthusiastic support can convince the employee to adopt the innovation (Grover, 1993).

Top management support is needed to adopt an IOS which can improve the competitive position of an organization and its relationships with its trading partners. Top management with a good understanding of the stakes involved is better able to mobilize commitment of other organizational stakeholders when adopting an IOS (Sokol, 1989; Senn, 1992). Top management involvement is often required to persuade the organization's trading partners to adopt an IOS. An IOS innovation would have little chance of being adopted without top management support (Ettlie, 1983; Zmud, 1984).

Top management support in various forms is shown to have a positive influence on innovation adoption (Jeyaraj et al., 2006; Rai and Howard, 1994; Ramamurthy et al., 1999).

2.15.3 Information Technology Capability

IT capability refers to the level and quality of IT resources in an organization e.g. the availability of IT-competent employees and good IT infrastructure. An IOS is a complex

system consisting of software, hardware and telecommunications infrastructure. IT competence, knowledge and adequate IT infrastructure are required to successfully adopt, implement and maintain an IOS throughout its life cycle.

IT infrastructure consists of hardware, software and networking equipment which is needed to support e-business and IOS (Markus and Soh, 2002; Tractinsky and Jarvenpaa, 1995; Walsham and Sahay, 1999). The lack of a suitable IT infrastructure is a major constraint to IT adoption in developing nations (Walsham and Symons, 1990).

An organization must have the necessary infrastructure to successfully implement and obtain full benefits of a new technology (Cash et al., 1992). With adequate infrastructure and experience with integrated database applications, a company will feel less threatened by the complexity of EDI technology, perceive lower risks and be more open to adopting a new technology (Premkumar and Ramamurthy, 1995). Interorganizational linkages that connect the firm's internal infrastructure to the external infrastructure of its trading partners will positively affect innovation adoption (Keen, 1988; King et al., 1994).

An organization with technical competence is more likely to adopt an innovation (Kuan and Chau, 2001; McGowan and Madey, 1996; Zhu et al., 2002). A company with higher levels of employee's IS/IT knowledge is more likely to adopt an IS or EDI (Chau and Jim, 2002; Seyal and Rahim, 2006; Thong, 1999). Innovation adoption literature suggests that a technological innovation adoption should be based on a firm's technological strengths (Damanpour and Evan, 1984; Jeyaraj et al., 2006; Maidique and Zirger, 1984; Tarafdar and Vaidya; 2004).

IT capability in different forms such as IT resources, infrastructure and technical competence is shown to positively influence innovation adoption (Jeyaraj et al., 2006; Kuan and Chau, 2001; Markus and Soh, 2002).

2.15.4 Organizational Compatibility

Compatibility is defined as “the degree to which an innovation is perceived as being consistent with existing values, past experiences and the needs of the potential adopter” (Rogers, 1983, 1995, 2003). Compatibility is a perceived characteristic of innovation and is consistently shown to be positively correlated with the rate of adoption of innovations (Tornatzky and Klein, 1982; Moore and Benbasat, 1991; Rogers, 1983, 1995, 2003 ; Frambach and Schillewaert, 2002).

Compatibility is researched in many innovation adoption studies, e.g. individual adoption of an information technology innovation (Moore and Benbasat, 1991), its impact on IS adoption in small businesses (Thong, 1999), its influence on the extent of external and internal integration (Ramamurthy et al., 1999), internal EDI diffusion (Ramamurthy and Premkumar, 1995) and in computer-mediated communications technologies (Premkumar, 2003).

Compatibility has been studied as organizational compatibility (Kwon and Zmud, 1987) and technical compatibility (Premkumar et al., 1994; Hausman and Oyedele, 2004). Organizational compatibility (validity) refers to the degree of compatibility of the changes introduced by EDI with existing operating practices, culture, management practices and current objectives. Technical compatibility (validity) assesses the degree to which the technology is compatible with existing system of hardware and software in the organization (Schultz and Slevin, 1975). Compatibility is positively related to internal diffusion of EDI in an organization (Ramamurthy and Premkumar, 1995).

Factor-based research on compatibility at the individual and organizational level shows that compatibility is an important antecedent to innovation adoption and diffusion (Bradford and Florin, 2003; Crum et al., 1996; Thong, 1999; Jeyaraj et al., 2006). Stage-based research on compatibility shows that the levels of perceived compatibility increase over the stages of awareness, evaluation and adoption (Frambach et al., 2002).

Compatibility studied as organizational or technical compatibility is shown to be positively related to innovation adoption (Bradford and Florin, 2003; Crum et al., 1996; Jeyaraj et al., 2006; Schultz and Slevin, 1975).

2.15.5 Internal Championship

Internal championship refers to the existence of an executive sponsor who promotes the introduction of a new technology in the organization. Champions are often highly enthusiastic and committed individuals (Beath, 1991; Grover, 1993).. They convince top management that a new product or process is feasible, beneficial and is needed by the organization (Beath, 1991; Burgelman and Sayles, 1986; Grover, 1993). Champions positively influence adoption decisions by helping to secure needed resources and coordinating various activities related to the technology acquisition (Ettlie et al., 1984; Kimberley and Evanisko, 1981; Rai and Patnayakuni, 1996). They help to overcome user resistance to new technologies by educating and creating an awareness of the potential benefits of the technology (Premkumar and Ramamurthy, 1995). The existence of internal champions has been shown to positively influence the adoption of information systems and interorganizational systems (Crum et al., 1996; Grover, 1993; Premkumar and Ramamurthy, 1995).

The traditional combination of an executive sponsor and a project champion is insufficient to provide the necessary leadership when implementing a collaborative interorganizational system (Volkoff et al., 1999). Some management tasks require a sponsor who is external to all partners while other management tasks need the presence of an executive sponsor within each organization (Volkoff et al., 1999). The presence of a network of site champions is important for adoption and implementation of an IOS (Garfield, 2000).

Two types of champions are important for IOS adoption (Garfield, 2000). User champions guide the use of the system and facilitate organization-wide acceptance of the system. Technical champions enable the system to function smoothly and efficiently. Besides this, researchers have also identified other roles for champions when introducing new

technologies. Maidique (1980) defined the three roles of executive champion, product champion and technological entrepreneur while McKenney et al. (1995) defines the three roles of senior executive sponsor, technological maestro and gifted technologist or technical team. Whatever labels or roles are given to champions, they function to positively influence innovation adoption in an organization.

2.16 Environmental Perspective

Prior research has shown that environmental characteristics influence innovation adoption (Frambach and Schillewaert, 2002; Hausman and Oyedele, 2004; Jeyaraj et al., 2006; Tornatzky and Fleischer 1990). This section reviews the roles of external pressure, interorganizational trust, critical mass and e-commerce legal framework and their significance in innovation adoption.

2.16.1 External Pressure

External pressure refers to influences from the organization's environment. Pressure has been variously defined by authors in innovation adoption research. For example, Iacovou et al. (1995) identified external pressure as competitive pressure and imposition by trading partners. Chwelos et al. (2001) defined dependency on trading partner, enacted trading partner power and industry pressure as subconstructs of external pressure.

Studies have found that external pressure have a positive effect on innovation adoption. Competitive, customer and supplier pressure are used to differentiate between SMEs and large firm's decision to adopt e-commerce (Daniel and Grimshaw, 2002). Competitive and supplier pressure are more significant to small companies than to large companies while there is no significant difference in customer pressure between small and large firm in e-commerce adoption (Daniel and Grimshaw, 2002).

Competitive pressures or intensity in the industry may force an organization to adopt an innovation because non-adoption would lead to a competitive disadvantage (Kimberley and Evanisko, 1981; Robertson and Gatignon, 1986; Utterback, 1971). Industry competitiveness

or pressure is positively related to EDI adoption, use and diffusion as shown by studies in the automotive industry (Crum et al., 1996; Ramamurthy et al., 1999). Industry organizations e.g. automotive industry in the United States have created an environment where there exist significant incentives and peer pressure for firms to use EDI as a standard for exchanging transactions (Norris, 1998).

Competitive pressure is shown to be positively related to innovation adoption. For example, a theoretical study by Meier and Chismar (1991) and an empirical study by Kavan and Van Over (1996) have reconfirmed the positive role of competitive pressure in adoption of EDI. Competitive pressure is a significant differentiator between firms with proactive decision mode and firms with reactive decision mode and also has a significant positive relationship to customer-based interorganizational systems and e-business adoption (Grover, 1993; Premkumar and Ramamurthy, 1995; Zhu et al., 2003).

Government and industry pressure on EDI adoption in Hong Kong small businesses are studied and government pressure is positively related to EDI adoption (Kuan and Chau, 2001). External pressure from EDI initiators is the strongest explanatory variable influencing small firms to adopt EDI (Iacovou et al., 1995). Pressure in different forms such as external, supplier and industry pressure is shown to positively influence innovation adoption (Chwelos et al., 2001; Daniel and Grimshaw, 2002; Premkumar and Ramamurthy, 1995; Zhu et al., 2003).

2.16.2 Interorganizational Trust

Trust is an area often studied in economics (Dasgupta, 1988), industrial buyer-seller relationship (Doney and Cannon, 1997) and marketing (Moorman et al., 1993).

Trust refers to confidence that the behaviour of another will conform to one's expectations and in the goodwill of another (Ring and Van de Ven, 1994). Trust is based on fair dealing and a sense of reciprocity but does not imply that outcomes be divided equally between partners (Gulati, 1995, Ring and Van de Ven, 1994).

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.”

Hosmer (1995) gives a similar definition of trust i.e., “… the reliance by one person, group or firm upon a voluntarily accepted duty on the part of another person, group or firm to recognize and protect the rights and interests of all others engaged in a joint endeavor or economic exchange.”

The previous definitions show that trust involves at least two parties who are mutually committed to a beneficial exchange relationship. Trust also depends on reliance on a partner and involves vulnerability and uncertainty on the part of the trustor (Moorman et al. 1993).

Earlier research on trust addresses relationships between individuals (Dobing, 1989, 1993; Zucker, 1986), while latter research focuses on intra and interorganizational relationships (Mishra, 1995; Ring and Van de Ven, 1994).

Arrow’s (1973) assertion that “some level of trust is a component of every interorganizational relationship” suggests that it is necessary to study trust in interorganizational systems which involves a collaborative relationship such as EDI.

Dependence (power) and transaction climate (trust) are two important variables in interorganizational system and EDI adoption (Reve and Stern, 1986). Two trading partners with a long and cooperative relationship and trust are more likely to establish electronic linkages for mutual gains (Felkner, 1992).

Four dimensions of trust, i.e. competence, openness, caring and reliability were identified (Mishra, 1995). These dimensions represent behaviors which demonstrate goodwill and therefore a firm can confidently expect that a partner will likely demonstrate similar behaviors in the future. These trust dimensions were further investigated by Hart and Saunders (1997).

A theoretical framework on the role of power and trust in EDI adoption proposes links between buyer’s power to supplier’s EDI adoption and supplier’s power to buyer’s EDI

adoption (Hart and Saunders, 1997). Coercive power to force trading partners to adopt EDI is counterproductive to extended use in the long run because this constraint in interorganizational relationships hinders coordination through EDI use. The way in which power is used to influence the partner to adopt EDI will affect the level of trust between them (Hart and Saunders, 1998). Firms manage uncertainties introduced by information sharing through EDI by building trustful relationships with EDI partners (Hart and Saunders, 1997).

Case studies also provide evidence that trust on supplier and information technology has a significant effect on SME's e-procurement adoption behaviour (Chan and Lee, 2002).

2.16.3 Critical Mass

Critical mass refers to the point where a sufficiently large number of organizations have adopted an innovation. When critical mass is reached, the value of the innovation becomes large enough for the adoption to become self-sustaining throughout the population of potential adopters.

Critical mass theory has often been applied in collective innovations research. Innovations that are collectively provided require collaboration among the adopters to obtain optimum benefits (Hardin, 1982).

Research involving collective actions are labeled as "prisoner's dilemma" (Samuelson, 1954) and "demand externalities" in economics (Allen, 1988) and as "critical mass theory" in sociology (Oliver et al., 1985). The actors who participate in a collective action are persons or organizations (Fireman and Gamson, 1979).

Critical mass theorists argue that innovation diffusion theory based on innovation perceptions is insufficient to explain adoption behaviour in a collective innovation. The adoption of a collective innovation (interorganizational information system) depends not only on the characteristics of the innovation, but also on what the group is doing, for example, how many and who have participated.

The value from adopting a collective innovation is dependent on the existing number of adopters of the innovation. The greater the number of adopters, the more likely the rate of adoption will increase. When the critical mass of adopters is reached, the adoption will take off suddenly.

Critical mass theory has been applied to interorganizational technological innovation research in B2B e-commerce, electronic data interchange and distribution resource planning (Masters et al., 1992; Teo et al., 2003).

The importance of critical mass to collaborative innovation adoption is shown in the following studies. Jimenez-Martinez and Polo-Redondo (2001) identified 'number of commercial partners using EDI' as important to Spanish retail sector's adoption of EDI. Teo et al. (2003) examined the adoption intention of financial EDI (FEDI) and found the significant institutional variables are 'the extent of adoption among competitors' and 'the extent of adoption among customers'. Their study found that the 'perceived extent of adoption among suppliers' did not have a significant influence on adoption intention.

Arunachalam (1997) investigates factors that affect EDI adoption and found that benefits received are dependent on factors such as the proportion of customers using EDI. Jimenez-Martinez and Polo-Redondo (2004) argue that the entry of new users is more important for existing users since there will be benefits of increased potential for exchanging data. Their research show that benefits/values of collaborative innovation increase with increased number of adopters.

The potential adopter organization may derive an intrinsic utility when 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 the concept of network externalities (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 as the intrinsic utility of an innovation increases when a firm's suppliers, customers and competitors also use the innovation. For example, banks in markets that can generate a larger effective network size tend to adopt electronic banking earlier (Kaufman, 2000).

Katz and Shapiro (1986) found network externalities are significant for technology adoption of videocassette recorder. The benefits of using compatible products increase significantly in the presence of significant positive network externalities. Frambach and Schillewaert (2002) in their study of organizational adoption have argued for the need to include network externalities as a determinant in addition to 'perceived characteristics of innovation' determinants.

Critical mass has consistently been shown to be positively related to innovation adoption (Kaufman, 2000; Jimenez-Martinez and Polo-Redondo, 2001; Teo et al. 2003).

2.16.4 Legal Framework

Regulatory and legislative policies provide the competitive and external context in which firms take decisions related to electronic commerce. These policies cover the legal and regulatory framework (Gallupe and Tan, 1999; Markus and Soh, 2002; Tractinsky and Jarvenpaa, 1995) and laws regulating e-commerce usage (Markus and Soh, 2002). These policies greatly influence the nature of market and industry competition which in turn exert a significant influence on the adoption of electronic commerce (Deans and Ricks, 1993; Markus and Soh, 2002; Mennecke and West, 2001).

Changes in government policies and legislation have also been identified as an environmental driver for electronic commerce adoption (Ives and Jarvenpaa, 1991; Tarafdar and Vaidya, 2004).

Palacios (2003) identifies the creation of a basic legal framework as enabling e-commerce diffusion in Mexico. A legal framework for electronic transactions and documents

that provides legal protection against electronic fraud and digital crimes is necessary for e-commerce diffusion (Palacios, 2003; Palacios and Kraemer, 2003). Palacios (2003) proposes that the existence of an adequate legal framework is a crucial condition for e-commerce adoption.

Tigre (2003) research findings show the importance of the role of government policies and legal framework for e-commerce diffusion. His study found significant barriers arising from government regulations, concern for data privacy and security issues, lack of business laws for e-commerce and inadequate protection for Internet purchases.

Adequate legal framework has consistently been shown to be positively related to innovation adoption (Markus and Soh, 2002; Palacios and Kraemer, 2003; Tarafdar and Vaidya, 2004).