Information and Communication Technology Adoption Models in Small and Medium Scale Enterprises: A Literature Review

M. H. D. N. Perera[1], M.P.S.R Perera[2]

Department of Entrepreneurship, University of Sri Jayewardenepura, Gangodawila, Sri Lanka

dhanukaprr@sjp.ac.lk[1], shanika@sjp.ac.lk[2]

Abstract

Information and Communication Technology (ICT) is regarded as an important aspect for both businesses and individuals alike. When it comes to businesses, the use of ICT is generally accepted to bring about enhanced performance and competitiveness through various means such as reduction of costs, an increase in efficiency and production. While knowledge of the use of ICT is necessary for businesses, it is equally important to understand the factors that would contribute to or affect such adoption by businesses as well. This study aims to analyse the several models that have been formulated over the years for the Adoption of ICT and summarize its applications, weaknesses, and strengths in explaining ICT Adoption. This literature review hopes to explore the most prominent theories: The Diffusion of Innovation Model, Technology, Organization and Environment (TOE) Framework, and the Iacovou et al. Model in an attempt to close the knowledge gap that exists concerning the Adoption of ICT by the Small and Medium Scale (SME) sector and its implications.

Keywords: *Information and Communication Technology, Small and Medium Scale Enterprises, Diffusion of Innovation*

Introduction

In the 21st Century, Information and Communication Technology (ICT) can be considered as one of the most important aspects of society. And its rapid expansion into almost every aspect of the world has a tremendous impact with regard to new opportunities for both businesses and individuals alike (Azam, 2015). However, these positive impacts can only be expected if ICT adoption is widespread, especially in the case of smaller businesses that are often lagging behind in technology adoption. Therefore, it is important to get a clear understanding of the factors that would explain such Adoption of ICT through models and theories of adoption (Hoffman and Novak, 1996; Evans and Wurster, 1999). In order to remedy this, the objective of this literature review is to

analyse the available literature and models on ICT adoption to get a clear understanding of which aspects of the firm, individual or external environment play a role in the adoption of ICT in SMEs.

While such adoption can be seen in businesses of many scales, this paper focuses on the adoption of technology by the Small and Medium Scale Enterprises (SMEs) while giving a special emphasis on the models of ICT adoption.

In this study, the main models that are reviewed are the Diffusion of Innovation (DOI) Model (Rogers 1995) and Technology, Organization and Environment (TOE) Framework as they are the most commonly cited models of technology adoption, along with the Iacovou et al (1995) model which is essentially a combination of these two models.

ICT and its Implications

An all-inclusive definition of Information and Communication Technology was given by Porter and Millar in 1985. According to them, ICT general refers to a wide range of software and hardware facilitated by telecommunication and various information management techniques, applications, and devices that all come together to "*create, produce, analyse, process, package, distribute, receive, retrieve, store and transform*" information (Porter and Millar, 1985). This definition manages to capture the entirety of what ICT represents rather than focusing on a specific area to which it can apply, and due to this all-encompassing nature of ICT, it is viewed was viewed as a force that is inevitable even before its widespread adoption that we see today. ICT was seen as a revolution that is changing the landscapes of the businesses and of the overall economy through its ability to reduce the costs associated with acquiring, processing, and distributing information (Porter and Millar, 1985).

In a more specific sense, the literature describes Information and Communication Technology under different aspects or perspectives. For instance, in an "*Economic or Managerial point of view, ICT can be seen as (1) a social construct; (2) an information provider; (3) an infrastructure; and (4) a business process and system*". While from a marketing viewpoint," *ICTs have also been viewed as (1) a variety of separate applications (Internet, databases, PowerPoint); (2) a marketing channel; (3) a communication/promotional medium; (4) a marketing technique; and (5) a tool for relationship marketing*" (Brady, Saren, and Tzokas, 2002).

It is clear that in spite of the fact that it constitutes a large part of ICT, it is more than just the amalgamation of Computers and the Internet. It is, rather, a system of components all acting together in the creation, storage, and dissemination of information and knowledge (Archrol and Kotler, 1999; Vilaseca, 2003) talks about how economies and societies need to adopt a more 'can-do' attitude based around novel idea generation and effectively transform such ideas into business opportunities to be successful. This highlights the importance of knowledge (or information) creation and

dissemination for the development of an economy and how any facilitation to this factor, as such awarded by the Adoption of Information and Communication Technology, can act as a powerful catalyst for the generation of such ideas and their conversion into business opportunities (Barba-sánchez, Martínez-ruiz, and Jiménez-zarco, 2007)

The benefits of ICT adoption are widely cited in the literature. ICT is a tool that can be used by businesses in order to enhance the productivity and effectiveness of their business functions and activities (Brady et al., 2002). This results in enormous cost savings for the businesses that will, in most cases, outweigh the cost incurred in adopting and investing in ICT. Due to the way ICT changes the way businesses and people work ICT will encourage the adoption of new organizational, strategic, and management models (Barba-sánchez, Martínez-ruiz and Jiménez-zarco, 2007). It also acts as an agent that will improve the quality and the specialization of the other resources of production, such as human resources, which again will increase efficiency and the efficacy of employees and businesses (Vilaseca, 2003) And Due to the vast communicational benefits that result from the development of ICT, Adoption of such will enable businesses to access new markets, generations, environments, and even business models that were otherwise previously impossible due to various geographical and logistical limitations. This expansion of the available market for businesses resulted in the rapid growth of many businesses throughout the past decades, even allowing businesses to escape high local competition by moving into untapped markets abroad that were now reachable easily (Corbitt, 2000; Javalgi and Ramsey, 2001).

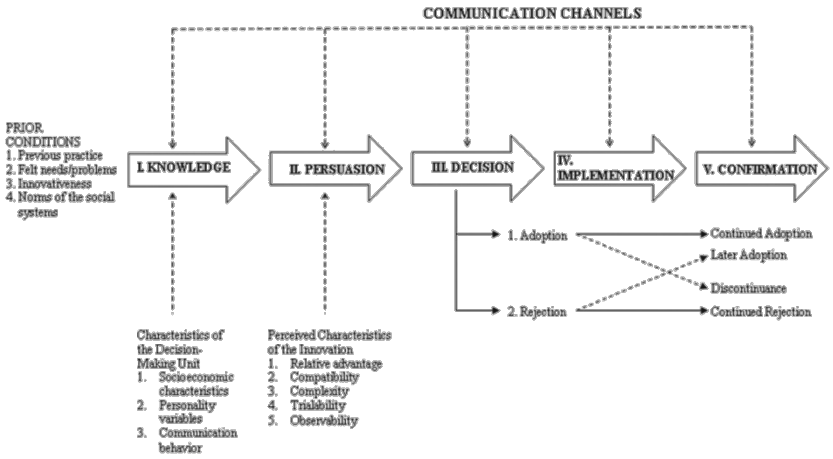
ICT Adoption Models

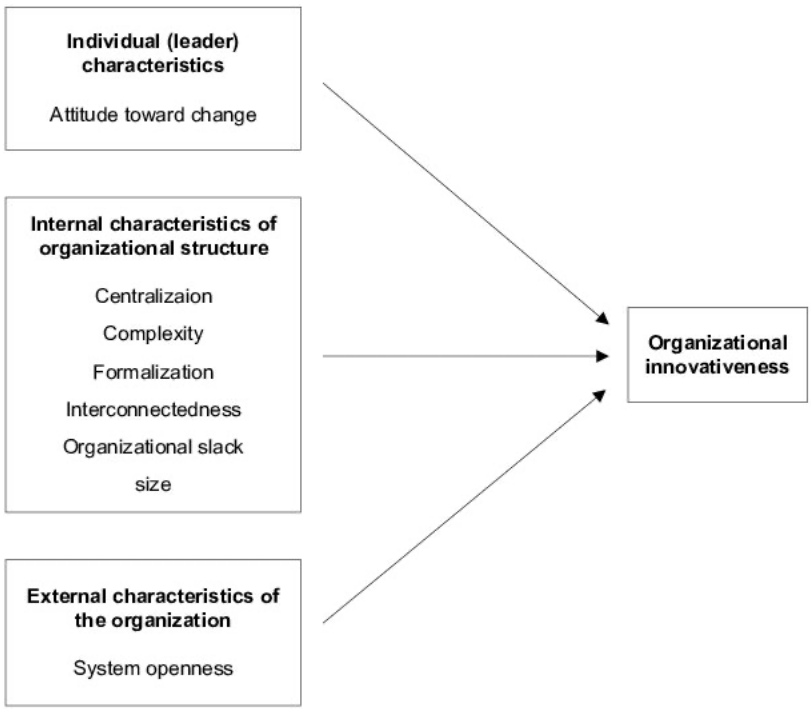
Diffusion of Innovation Model

The Diffusion of Innovation Model (Fig. 1), introduced by Rogers in 1962 and revised in 1995 and 2003, is among the most popular models that are used to explain the adoption of information technology and innovation. The DOI model is helpful in investigating the behaviour of the adopters when it comes to technological innovation. The Diffusion of Innovation model describes the patterns of technology adoption through broad psychological and sociological elements by explaining the mechanisms of adoption and aiding the prediction of whether and how innovations will be successful (Tan *et al*., 2009).

Within the context of the DOI model, diffusion is defined as a process by which innovation is communicated or transferred through certain channels over a given period of time within and among the systems and its members. Whereas Innovation is defined as "*an idea, practice, or object that is perceived to be new by an individual or other unit of adoption*" (Rogers, 2002).

Figure 1: Diffusion of Innovations (Rogers 1995)

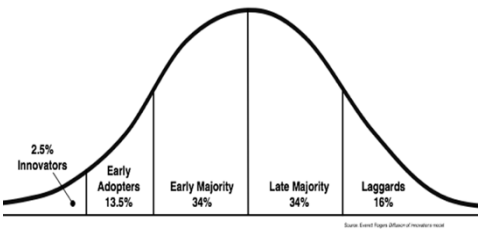




Source: Rogers (1995)

DOI is, therefore, concerned with how new technology or an innovation moves through a social system through specific communication channels from among the members of such system, starting from the creation to the usage of that technology. Rogers noticed that while the majority of the population adopting new technology is normally distributed, there is an exception to this normality in the form of *innovators*: who implement change, *early adopters*: who are the earliest to adopt new technology before the rest, *early majority*: the majority of the population who adopt the technology in its early stages, *late majority*: the portion of the population that delay the adoption and *laggards*: the portion of the population that lags behind when it comes to adoption of innovations (Fig. 02)

Figure 2: Diffusion of the innovations Adoption curve

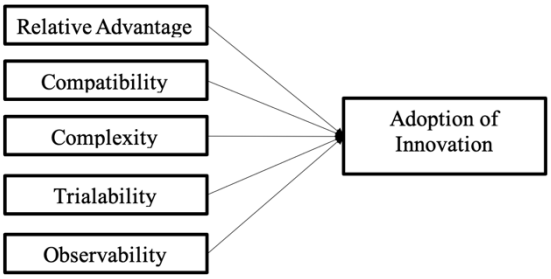


Source: Rogers (1995)

Based on the DOI model (Roger, 1995) and (Roger, 2002), the following characteristics of innovation (which he described being the Perceived Attributes of an Innovation) are deemed to be important in the adoption of technology (or innovation) within a system;

1. Relative Advantage
2. Compatibility
3. Complexity
4. Trialability
5. Observability

Figure 3: Perceived Attributes of an Innovation



Source: Oliveira, Martins and Lisboa (2011)

Relative Advantage

The relative advantages or benefits are among the first to be considered when measuring the value of any component. The relative advantage, therefore, refers to the degree to which an adopter or a potential adopter may perceive such adoption of new technology to be preferable to existing technology or conditions (Le *et al*., 2012). In most cases, the relative advantage acts as a strong indicator when it comes to the adoption of information and communication technology among small and medium scale enterprises (Kendal et al., 2001).

The benefits of ICT Adoption to SMEs have been well established in the literature across different fields. It mostly comes in the form of an increase in profitably through the reduction in costs, increasing the efficiency of processes, etc. This creates a positive relationship

between the relative advantage and the Adoption of ICT among businesses (Tornatzky & Klein, 2012) This was further corroborated through a study conducted in India to determine which factors influenced the adoption of consumer-oriented e-banking. This study was able to prove the existence of a positive relationship between the level of adoption of e-banking technology with the perceived level of the relative advantage of such adoption (Saxena and Kehar, 2011).

Compatibility

Compatibility is how well the new system matches the specifications or the workflows of the existing systems. It measures the degree to which the new system or innovation is seen to be keeping up with previous experiences. This is not only concerned with the processes followed with the existing systems but also relates to the compatibility of the new system or innovation with the existing values of the business (Teo & Tan, 1998). Such compatibility with existing systems, culture, and values of the business ensures the smooth adoption of new technologies with minimal resistance (Grover, 1993; Teo & Tan, 1998), whereas incompatibilities were seen to not only cause hindrances in the adoption of such new technology but also was seen as detrimental to the workflows and overall efficiency of the business organization. Therefore, SMEs and business owners/managers would only tend to adopt systems and technologies that are compatible with their existing systems (Kendall et al., 2001; Thong, 1999).

Compatibility ensures the easy integration of technology into existing systems and is the key to determining whether the new technology will be adopted by the company or not.

Perceived Complexity

Perceived complexity refers to the degree to which the technology to be adopted is seen as being difficult to understand, implement, and used in business operations. (Le *et al*., 2012). According to (Seyal & Rahman, 2003; Grover, 1993), the level of adoption of technology will be significantly reduced based on how complex the technology under question is seen to be by the owners/managers of the decision-makers of a business organization. Such complexity comes in the form of the initial requirement of technical-knowhow (Le *et al*., 2012), the degree of difficulty in integrating the new system into the organization, training, and development required to obtain the optimal benefits of the introduced system, whereas the failure to do so would result in the under-utilization of the adopted technology (Song and Mueller-Falcke, 2006).

As per (Greenhalgh et al., 2004), for technology to be adopted without much resistance, it should be sufficiently simple and user-friendly. Meaning that the people who are using it should feel that the technology is simple enough to be understood and used (Rogers, 2003)

Trialability

Trialability can be described as the degree to which new technology or

innovation is able to be tested before its adoption on a limited frame of time. Tan et al. (2009) expressed Trialability is the degree to which the innovation or the technology could be experimented on. This too has a positive relationship with the level of adoption of a given technology where the more of an opportunity is granted to the adopter to test out the technology prior to the adoption, the higher the rate of such Adoption (Tan *et al*., 2009).

Observability

Observability refers to the degree of visibility of the innovation results (Tan *et al*., 2009). It is also the ability of the adopted technology to be modified and its changes viewed as a response to the comments and requests that are being presented to the system or technology (Hayes *et al*., 2015). The rate of adoption of technology will be higher when its immediate and latent (direct and indirect) benefits are apparent to the adopter. While creating a higher level of confidence in the technology itself, this will also act as a justification of the adoption of the technology in the case of enterprises, especially in the case of Small and Medium Scale enterprises in which resources are limited, and each investment and purchase are usually carefully screened.

Table 1: Studies that have adopted the DOI Model

IT Adoption	Author(s)
Material requirements planning (MRP)	(Cooper and Zmud 1990)
IS adoption (uses at least one major software application: accounting; inventory control; sales; purchasing; personnel and payroll; CAD/CAM; EDI; MRP), and extent of IS (number of personal computers and the number of software applications)	(Thong 1999)
Intranet	(Eder and Igbaria 2001)
Web site	(Beatty *et al*. 2001)
Enterprise resource planning (ERP)	(Bradford and Florin 2003)
E-procurement	(Li 2008)
E-business	(Zhu *et al*. 2006a)
E-business	(Hsu *et al*. 2006)

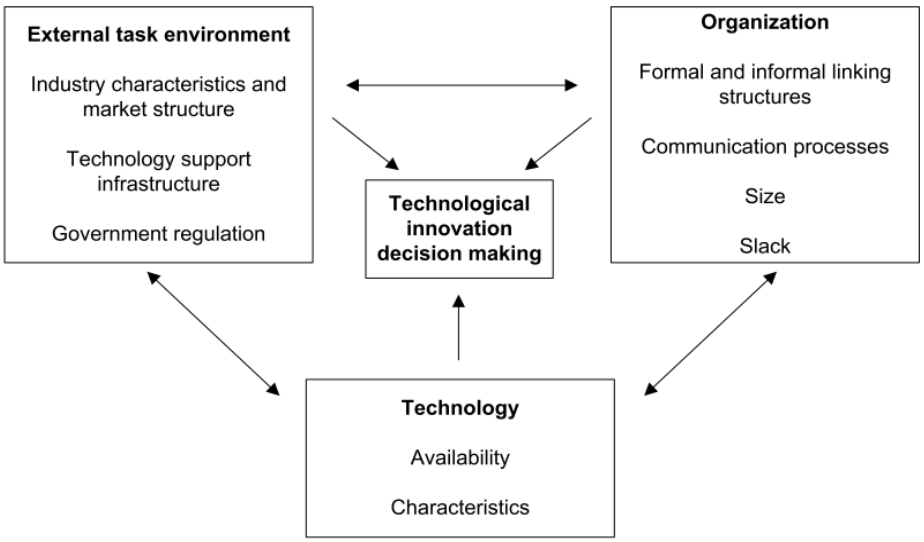
Source: Oliveira, Martins and Lisboa (2011)

Technological, Organizational and Environmental (TOE) Model

The Technology, Organizational and Environmental (TOE) Model (Fig. 4), developed by Tornatzky and Fleischer in 1990, showed the importance of information technology adoption in firms while providing a means of evaluating such adoption of technology. Since then, the TOE model has widespread adoption and provides a more comprehensive framework on the Adoption of Information and Communication Technology among organizations (Zhu *et al*., 2004). The TOE model, which provides a basis for the development of further models such as the Innovation Diffusion in enterprises, consists of three aspects of an organization that influences the adoption, implementation, and usage of information technology within the organization.

The TOE model, which has solid theoretical and empirical support (Salwani *et al*., 2009), put forward Technological Context, Organizational Context, and Environmental Context as the main aspects that influence such adoption as described below. This inclusivity has made the TOE Framework superior to other similar frameworks to measure the adoption and the implementation of Technology within organizations (Zhu and Kraemer, 2005; Ramdani, Kawalek and Lorenzo, 2009; Oliveira and Martins, 2010; Hossain and Quaddus, 2011)

Figure 4: Technology, organization, and environment framework



Source: Tornatzky and Fleischer (1990)

Technological Context

Technological context involves the description of both internal and external technologies applicable to the organization, including all equipment, competencies, currently practiced protocols and procedures that are intrinsic to the organization (Starbuck, 1976), as well as all available technologies that are available beyond the boundaries of the organization (Thompson 1967, Khandwalla 1970, Hage 1980).

Technology Competence

According to (Salwani *et al*., 2009), competence or organizational competence refers to all existing and future technologies that are relevant to a business organization. This also implies the ability of the organization and its members, which constitutes the firm, to adopt the use of new technological elements such as e-commerce.

Therefore, the Technology competence of a firm directly correlates with the adoption of technology as well as having a direct impact on all decisions relating to such adoption. Tan, Tyler, and Manica (2007) explained technology competence as the organizational readiness, which is the owners' or managers' perception and the degree to which they believe that the organization has the necessary resources, commitment, governance, and the awareness to adopt and properly implement ICT in their organizations. This has been indicated through two factors: Financial Readiness which includes the financial capability of the organization to purchase, implement, and successfully meet ongoing expenses relating to ICT and Technological Readiness which includes the necessary human capital and the underlying infrastructure to adopt and implement ICT within the organization (Oliveira and Martins, 2010; Musawa and Wahab, 2012)

Organizational Context

Organizational context involves the descriptive measures relating to the organization, such as the scope, scale, management, and organizational structure. (Oliveira, Martins and Lisboa, 2011)

Environmental Context

The Environmental context in the TOE Framework refers to the arena inside of which an organization conducts its business activities. This includes the larger external environmental factors such as the industry, government, and the task environmental factors such as competitors (Tornatzky and Fleischer 1990).

Table 2: Studies that have adopted the TOE Framework

IT Adoption	Author(s)
EDI	(Kuan and Chau 2001)
Open systems	(Chau and Tam 1997)
Web site	(Oliveira and Martins 2008)
Web site **E-commerce**	(Oliveira and Martins 2009)

Source: Oliveira, Martins and Lisboa (2011)

Table 3: Summary of ICT Adoption Factors in SMEs using the TOE Framework

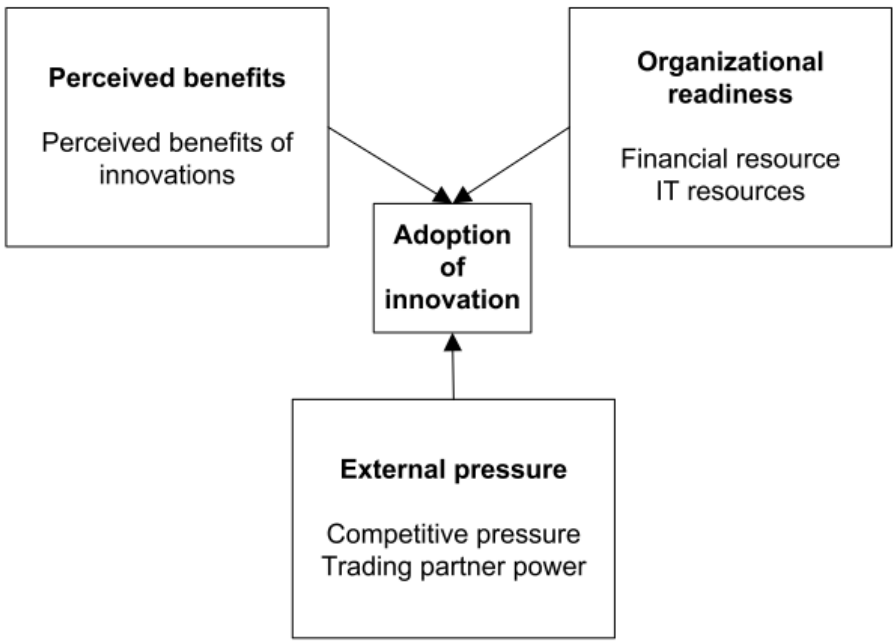
Influencing Factors	ICT Adoption	SME Size	Authors
Technology context, organizational context, environmental context	E-commerce adoption	926 SMEs (n/a)	Huynh et al (2012)
External pressure, perceived benefits, organizational readiness	EDI adoption practices	7 SMEs (n<200)	Iacovou et al (1995)
Technology, organization, environment	EDI adoption	575 SMEs (n<100)	Kuan & Chau (2001)
Technology context, organizational context, environmental context	Internet, web site and e-commerce adoption	3155 small firms	Martins & Oliveira (2008)
Perceived benefits, organizational readiness, external pressure	Internet adoption	7 SMEs (n<200)	Mehrtens et al (2001)
Relative advantage, top management support, organizational size, external competitive pressures	Online data access, e-mail, and the Internet	78 SMEs (n<90)	Premkumar & Roberts (1999)
CEO characteristics, IS characteristics, organizational characteristics, environmental characteristics	IS adoption	166 SMEs (n<100)	Thong (1999)

Source: Adopted from Grandon & Pearson (2004)

Iacovou et al (1995) model

The Iacovou et al. model (Fig. 5) is yet another model designed to explain the adoption of technology among businesses. This model is derived from the TOE Framework and consists of several additions that are helpful in explaining the reasons behind the adoption of technology and innovation among businesses.

Figure 5: Iacovou et al. (1995) model



Source: Iacovou et al. (1995)

Although the model was developed to explain the Adoption of Electronic Data Interchange (EDI) system adoption among firms through the analysis of inter-organizational systems (IOSs), the same can be used as a model to explain the factors affecting the adoption of innovation among businesses organizations as well. (Oliveira, Martins and Lisboa, 2011). As such, the model employs three factors as stated below;

Perceived benefits

This factor is different from the TOE framework and includes the benefits that the innovation adoption perceives to obtain through the adoption of such innovation. Perceived benefits refer to the level of recognition of the relative advantage that EDI technology can provide the organization (Iacovou et al., 1995).

Higher managerial understanding of the relative advantage of EDI increases the likelihood of allocation of the managerial, financial, and technological resources necessary to implement an integrated EDI system (Benbasat et al., 1993). It is therefore expected that small firms with management that recognize the benefits of EDI will be more likely to adopt EDI and enjoy higher impacts compared with firms with management that do not recognize the benefits of EDI.

Organizational Readiness

Organizational Readiness is a combination of the Technological and Organizational Contexts from the TOE framework where the similarity lies between IT Resources and Technological Context and Financial Resources and Organizational Context (Oliveira, Martins and Lisboa, 2011). This again refers to the resource availability of SMEs.

External Pressure

This refers to the influences of the external environment on the business. External pressure is a result of two main sources: competitive pressures and trading partners. Competitive pressures are the degree of influence the business faces from the industry in which it operates in while the pressures from trading partners refer to the relative power with the partners that the business deals with in order to push the adoption of ICT (Kuan and Chau, 2001). As for SMEs, they arguably encounter a higher pressure from the external environmental agents such as competitors, suppliers, and buyers, and it plays a key role in the adoption and implementation of technology (ICT) in their businesses (Daniel & Wilson, 2002; Dasgupta, 2000; Lai & Hsieh, 2007; Scupola, 2003)

Discussion

Both the DOI Model and TOE Framework are considered popular theories of ICT Adoption at the firm level (Taylor, 2015). These models, while all are explaining the different aspects that affect the adoption of technology/innovations within organizational systems, take different approaches in doing so.

The DOI Model explains the Psychology behind the decision-making process when adopting innovations within an organization. However, the characteristics of the individual (leaders/decision-makers) and the characteristics of the organization, both with regard to its internal aspects as well as how it deals with external parties, are all characteristics of the organization itself and do not regard the external environment.

The TOE framework, on the other hand, remedies this issue with the introduction of the External (Task) Environment, which includes institutional support, competitive pressures, which makes it a more complete model than the DOI model.

The Iacovou et al (1995) model then combines the DOI and TOE Framework to highlight the Perceived Benefits of the Technology, the readiness of the organization when it comes to implementing change, and the external pressures faced by the organization when trying to explain

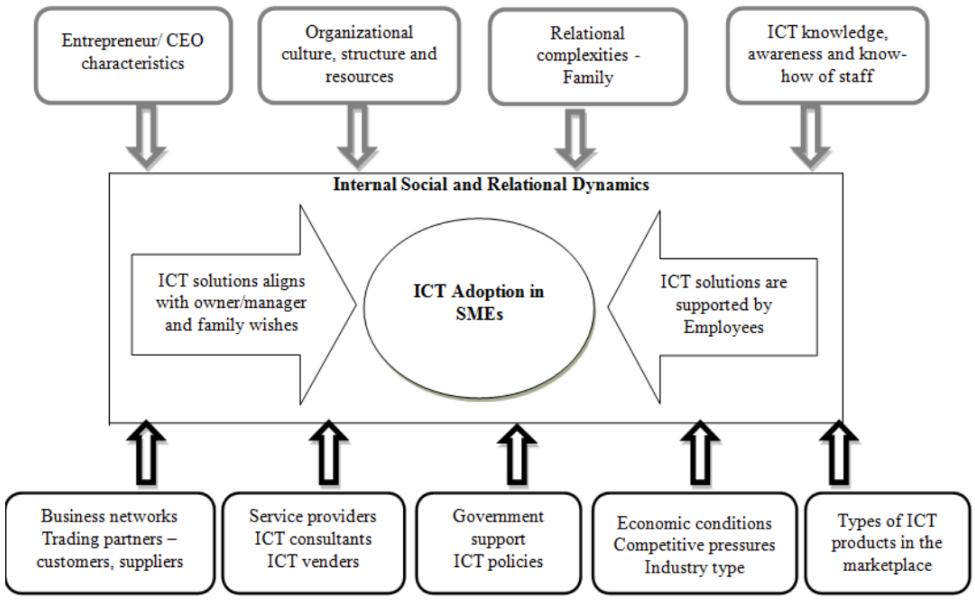
the Adoption of ICT within an organization.

Integrating Model of ICT Adoption in SMEs

Through the analysis of literature and various ICT Adoption models, an integrated model of ICT adoption in SMEs detailing the factors influencing adoption decisions was proposed by Taylor, 2014. This model explains the factors that influence the adoption of ICT among SMEs. It breaks down the factors as internal and external of which, internal factors include the personal preferences of the SME (owner's wishes and/or family wishes) and the preference of the Employees. While the External Factors contains a collection of elements from a variety of ICT Adoption Models. It should be noted that major aspects of the DOI Model (Owner Characteristics, Organizational Structure, External Characteristics of the Organization) are integrated into this model. Similarly, it is observed that the components of the TOE Framework are also present in this model.

This model can be used to summarize the components of the ICT adoption models and how they can be explained in the context of SMEs. Therefore, it can be stated that the TOE Framework and the DOI Model too is capable of explaining the ICT Adoption among SMEs. This also highlights the fact that the best approach to explain ICT Adoption [especially among SMEs] is through a combination of the elements from different Models, whereas a single model would fail to encompass all the important aspects

Figure 6: Integrating Model of ICT Adoption in SMEs



Source: Taylor (2015)

The summary of the models discussed in this paper are as follows.

Table 4: Summary of Models

Model/Framework	Main Factors	Other Factors
1. Diffusion of Innovation Model	Individual (Leader) characteristics	Relative Advantage
	Internal characteristics of organizational structure	Compatibility
	External characteristics of the organization (System Openness)	Complexity
		Trialability
		Observability
2. Technology, Organization, Environment Framework	Technology	
	Organization	
	External Task Environment	
3. Iacovou et al (1995) model	Perceived Benefits	
	Organizational Readiness	
	External Pressure	

Source: Compiled by Author

Conclusion

This paper reviewed the literature on the Adoption of Information and Communication Technology among Small and Medium Scale Enterprises. Out of the models used in the explanation of such adoption, the *DOI Model* and the *TOE Framework* can be considered as the most frequently adopted by most empirical studies. These models are equally competent to explain the Adoption of ICT among SMEs as they are with larger organizations. However, this universality should be further explored in future studies through empirical data.

Each model reviewed explains an aspect of technology not covered by the others. *TOE Framework* includes the Environmental context, which is absent in the *DOI Model*. Therefore, in some instances, the best course of action is to combine two or more models when trying to explain the adoption of technology in a more complex setting. *The Iacovou et al (1995) model* is a valid example of this. Therefore, this concludes that it is more practical to modify the model to fit the context of the study and the subject that is under consideration in order to obtain the optimal results.

This study contributes to the field through the collection and the summarization of various literature and Models of ICT Adoption. This study also explores the subsequent

studies that have been conducted that supports these individual models and highlights its merits and the applicability of these models in varying contexts especially how these models can work together or individually to explain the ICT adoption among SMEs.

References

Achrol, R.S. and Kotler, P (1999). "Marketing in the Network Economy." Journal of Marketing, 63 (Special Issue): 146-163.

Barba-sánchez, V., Martínez-ruiz, M. P. and Jiménez-zarco, A. I (2007) 'Drivers , Benefits and Challenges of ICT Adoption by Small and Medium Sized En ...', Problems and Perspectives in Management, 5(1), pp. 103–114.

Brady, M., Saren, M. and Tzokas, N (2002) 'Integrating Information Technology into Marketing Practice – The IT Realize of Contemporary Marketing Practice', Journal of Marketing Management, 18, pp. 555–577.

Corbitt, B.J (2000). 'Developing Intra organizational electronic commerce strategy: an ethnographic study', Journal of Information Technology, 15 (2), pp. 119-130.

Daniel, E., and Wilson, H., 2002. Adoption intention and benefits realized: A study of e-commerce in UK SMEs, Journal of Small Business and Enterprise Development 9(4), 331-348.

Dasgupta, S., 2000. Information technology adoption in the Greek banking industry, Journal of Global Information Technology Management 3(3), 22-30.

Evans, P. and Wurster, T.S (1999), "Getting real about virtual commerce", Harvard Business Review, November/December.

Greenhalgh, T., Macfarlane, F., Robert, G., Bate, P. and Kyriakidou, O (2004), "Diffusion of innovations in service organizations: systematic review and recommendations", The Milbank Quarterly, Vol. 82 No. 4, pp. 581-629.

Grover, V. & Goslar, M. D (1993). The initiation, adoption, and implementation of telecommunications technologies in US organizations. Journal of Management Information Systems, 10(1), 141-164.

Grover, V. & Goslar, M. D (1993). The initiation, adoption, and implementation of telecommunications technologies in US organizations. Journal of Management Information Systems, 10(1), 141-164.

Hage, J (1980) Theories of organizations: Forms, process and transformation, New York, John Wiley & Sons.

Hayes, K. J. et al (2015) 'Trialability, observability and risk reduction accelerating individual innovation adoption decisions', Journal of Health Organization and Management, 29(2), pp. 271–294.

Hoffman, D.I. and Novak, T.P (1996), "A new marketing paradigm for electronic commerce", The Information Society. 13 (1), pp. 43-54.

Hossain, M. A. and Quaddus, M (2011) 'The adoption and continued usage intention of RFID: an integrated framework', Information Technology & People, 24(3), pp. 236–256.

Iacovou, C.L., Benbasat, I. and Dexter, A.S (1995), "Electronic data interchange and small organizations: adoption and impact of technology", MIS Quarterly, December, pp. 465-85.

Javalgi, R. and Ramsey, R (2001). 'Strategic issues of e-commerce as an alternative global distributions system'. International Marketing Review, 18 (4), pp. 376-391.

K. Saxena, & S. S. Bhadu (Eds.), Managing global competition: A holistic approach (pp. 101-121). Delhi: Macmillan India Ltd.

Kendall, J.D., Tung, L.L., Chua, K.H., Ng, CHD and Tan, S.M (2001). Receptivity of Singaporean SMEs to electronic commerce adoption. The Journal of Strategic Information Systems.10 (3); 223-342.

Khandwalla, P (1970) Environment and the organization structure of firms, McGill University, Montreal, Faculty of Management.

Kuan, K. K. Y. and Chau, P. Y. K (2001) 'A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework', Information and Management, 38(8), pp. 507–521. DOI: 10.1016/S0378-7206(01)00073-8.

L.G. Tornatzky, K.J. Klein, Innovation characteristics and innovation adoption implementation: a meta-analysis of findings, IEEE Transactions on Engineering Management 29 (11), 1982, pp. 28-45.

Lai, F., and Hsieh, C.T (2007) On network external, e-business adoption and information asymmetry, Industrial Management & Data Systems 107(5), 728-746.

Le, V. H. et al (2012) 'An empirical Study of Determinants of E-commerce Adoption in SMEs in Vietnam an economy in transition An empirical Study of Determinants of E-commerce Adoption in SMEs in Vietnam: the case of a transition economy', Journal of Global Information Management, 20(3). Available at: http://www3.cis.gsu.edu/dtruex/courses/ib8710/articles/vietnan-ec-v27-gotoproof2-032612.pdf.

Azam, Md Shah (2015). Diffusion of ICT and SME performance. Advances in Business Marketing and Purchasing. 23. 7-290. 10.1108/S1069-096420150000023005.

Azam, M.S (2015 “Diffusion of ICT and SME Performance”. E-Service Adoption: Processes by Firms in Developing Nations, 7-290.

Musawa, M. S. and Wahab, E (2012) 'The adoption of electronic data interchange (EDI) technology by Nigerian SMEs: a conceptual framework', Journal of Business Management and Economics, 3(2), pp. 55–68.

Oliveira, T. and Martins, M. F (2010) 'Understanding e-business adoption across industries in European countries', Industrial Management & Data Systems, 110(9), pp. 1337–1354.

Oliveira, T., Martins, M. F. and Lisboa, U. N. De (2011) 'Literature Review of Information Technology Adoption Models at Firm Level', 14(1), pp. 110–121.

PA.Seyal, A. H. & Rahman, M. N. N. A (2003). A preliminary investigation of e-commerce adoption in small and medium enterprises in Brunei. Journal of Global Information Technology Management, 6(2), 6-26.

Porter, M. E. and Millar, V. E (1985) 'How Information Gives You Competitive Advantage', Harvard Business Review, 63(4), pp. 149–174. Available at: https://hbr.org/1985/07/how-information-gives-you-competitive-advantage (Accessed: 28 May 2019).

Ramdani, B., Kawalek, P. and Lorenzo, O (2009) 'Predicting SMEs' adoption of enterprise systems', Journal of Enterprise Information Management, 22(1/2), pp. 10–24.

Rogers, E. M (1995). Diffusion of innovations (4th ed.). New York: Free Press

Rogers, E. M (2002). Diffusion of preventive innovations. Addictive Behaviors, 27(6), 989–993. doi:10.1016/s0306-4603(02)00300-3

Salwani, M. I. et al (2009) 'E-commerce usage and business performance in the Malaysian tourism sector: empirical analysis', Information Management & Computer Security, 17(2), pp. 166–185.

Scupola, A., 2003. The Adoption of Internet commerce by SMEs in the south of Italy: An environmental, technological and organizational perspective, Journal of Global Information Technology Management 6 (1), 3-18.

Song, G., & Mueller-Falcke, D (2006). The economic effects of ICT at firm-levels. In M. Torero & J. Braun (Eds.), Information and communication technologies for development and poverty reduction: The potential of telecommunications (pp. 166-184).

Starbuck, W.H (1976) Organizations and their environments, Chicago, Rand McNally.

Tan, J., Tyler, K. and Manica, A (2007) 'Business-to-business adoption of e-commerce in China', Information & Management, 44(3), pp. 332–351.

Tan, K. S. et al (2009) 'Internet-based ICT adoption: Evidence from Malaysian SMEs', Industrial Management and Data Systems, 109(2), pp. 224–244. DOI: 10.1108/02635570910930118.

Taylor, P (2015) 'The importance of information and communication technologies (ICTs): An integration of the extant literature on ICT adoption in small and medium enterprises.', International Journal of Economics, Commerce and Management, III(5), pp. 274–295.

Teo, H.H., Wei, K.K. and Benbasat, I (2003) Predicting intention to adopt inter-organizational linkages: An institutional perspective, "MIS Quarterly", Vol. 27, No. 1, pp 19-49.

Teo, T. S. H. & Tan, M (1998). An empirical study of adopters and non-adopters of the internet in Singapore. Information & Management, 34, 339-345.

Thompson, JD (1967) Organizations in action, New York, McGraw-Hill.

Thong, J.Y.L (1999) An integrated model of information systems adoption in small businesses, "Journal of Management Information Systems", Vol. 15, No. 4, pp. 187-214.

Tornatzky, L. and Fleischer, M (1990) The process of technology innovation, Lexington, MA, Lexington Books.

Vilaseca, J (drtor.) (2003). Las TIC y las transformaciones de la empresa catalana, Barcelona: FUOC.

Zhu, K. and Kraemer, K. L (2005) 'Post-adoption Variations in Usage and Value of E-business by Organizations: Cross-country Evidence from the Retail Industry', Information Systems Research, 16(1), pp. 61–84.

Zhu, K. et al (2004) 'he complementarity of information technology infrastructure and e-commerce capability: a resource-based assessment of their business value', Journal of Management Information Systems, 21(1), pp. 167–202.