



Internet-based ICT adoption: evidence from Malaysian SMEs

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Abstract

Purpose – The purpose of this paper is to investigate the innovative characteristics, benefits, and barriers influencing internet-based information and communications technology (ICT) adoption among the small and medium enterprises (SMEs).

Design/methodology/approach – A questionnaire-based survey was used to collect data from 406 managers or owners of SMEs in the southern region of Malaysia.

Findings – The results suggest that internet-based ICT adoption provides a low cost yet effective communication tool for customers. However, security continues to be a major barrier. Finding on cost as a barrier is mixed. The inferential statistics reveal that relative advantage, compatibility, complexity, observability, and security are significant factors influencing internet-based ICT adoption.

Research limitations/implications – The study focuses only on the SMEs in the southern region of Malaysia.

Practical implications – The findings offer valuable insights to policy makers in general and to the SMEs in particular on the significance of the measured characteristics and the associated benefits and barriers of internet-based ICT adoption.

Originality/value – The study is perhaps one of the first to comprehensively address internet-based ICT adoption among the SMEs through the use of a wide range of variables.

Keywords Internet, Communication technologies, Small to medium-sized enterprises, Malaysia

Paper type Research paper

Introduction

The information and communication technologies (ICTs), particularly the use of internet to conduct online business is quickly changing the conventional way of doing business among brick and mortar companies. With the strong waves of globalization and liberalization across the world, ICT is believed to be the most cost-efficient tool to help companies gain bigger markets and the ability to compete with larger organizations in attracting customers to their products, services and information (Tan *et al.*, 2009). This is in light with the advantages inherent in internet such as speed, user-friendliness, low cost and wide accessibility which has allowed electronic



commerce (e-commerce) to be increasingly diffused globally, bringing countries together into a global networked economy (Gibbs and Kraemer, 2004).

The continuous and growing interest in ICT adoption is also attributed to the exponential growth in the number of internet users worldwide, with a bigger increase reported from users in developing countries especially in the Asia Pacific as compared to the USA and the European regions (International Telecommunication Union, <http://itu.int/ITU-D/ict/statistics>). Specifically, it has been discovered that countries with higher GDP per capita, literacy rate, well-established telecommunication infrastructure and political stability will enjoy higher dispersion of internet. That is the reason why advanced economies such as Hong Kong, Singapore, South Korea, and Taiwan lead Asia in internet development, followed by countries like Malaysia, Brunei, and Thailand (Hao and Chow, 2004).

In Malaysia, for instance, it has been reported in the Malaysian Communications and Multimedia Commission's web site (www.mcmc.gov.my) that the penetration of internet in 2007 is about half the size of the population (47.8 percent of 28,294,120 people) as opposed to only 3,700,000 users in 2000 (International Telecommunication Unit, www.itu.int). The strong growth is due to the initiatives undertaken by the Malaysian government. For example, the Seventh Economy Plan (1996-2000) serves as testament to the country's serious attention on the necessary development of infrastructure and environment of ICT so as to ensure that they are in place to enable the country to move rapidly into the information age. In fact, investment in ICT in Malaysia has expanded at a rate of 9.2 percent per annum from RM 3.8 billion in 1995 to RM 5.9 billion in 2000 (Economic Planning Unit, 2001). Such efforts have been continued and expanded to the small and medium enterprises (SMEs) in the Ninth Malaysian Plan (2006-2010) where various funds have been made available for ICT development in these enterprises.

In addition, the National Information Technology Agenda was formulated in 1996 to help provide an ICT framework to develop Malaysia into an information and knowledge-based society by 2020 (www.nitc.org.my/index.shtml). The ICT industry received further boost when the Multimedia Super Corridor Malaysia (MSC Malaysia) project was conceptualized in 1996 to expedite the transformation process [for more information, see Chong (2006)]. The MSC Malaysia offers an ideal growth environment for the ICT SMEs to transform themselves into world class companies through various incentives provided under the Promotion of Investment Act 1986. As of March 2008, there are 2,006 MSC Malaysia-status companies, in which more than 70 percent of them are locally-owned, largely SMEs (MSC Malaysia web site, www.msomalaysia.my).

It can thus be concluded that in many countries, the roles played by the government and the growing number of internet users have far-fetched implications to SMEs contemplating on using internet-based ICT to reach larger pool of potential customers locally and worldwide. While several authors have identified various factors affecting the adoption or non-adoption of web sites and e-commerce, there remain gaps to be addressed. It has been reported that studies conducted so far provide narrow focus on SMEs adopting e-commerce and that they are all fragmented. Tan *et al.* (2009) in their analysis of prior studies concluded that while diffusion of innovation (DOI) remains a popular model in investigating the behavior of users in adopting new technological innovation, there are tendencies for researchers to combine the constructs of different models, such as the theory of reasoned action, theory of planned behavior, and the

technology acceptance model (Benham and Raymond, 1996; Limthongchai and Speece, 2003; Tan and Teo, 2000). This has resulted in different outcomes. In fact, it has been identified that studies using DOI alone yielded different results (Kendall *et al.*, 2001; Limthongchai and Speece, 2003; Hussin and Noor, 2005) although the countries studied shared close geographical proximity. Further, there is paucity of research combining the variables of the DOI model and the benefits and barriers of internet-based ICT adoption.

The significance of such a study in a developing country such as Malaysia is another factor not to be discounted. While the government has been actively investing in the development of necessary infrastructure which has contributed to the growing number of internet users and promoting the provision of internet-based services, it has been reported that SMEs face technology constraints due to the lack of education and technical skills, which is an important means to garner competitive advantage in this global marketplace. A study conducted on the public listed companies in Malaysia revealed that most of the companies have web sites which are solely for informational purposes and that only a handful of them use web sited for e-commerce transactions (Adham and Ahmad, 2005). Interestingly, ignorance on the usefulness of technology has also been identified as a factor leading to lower rate of technology adoption (Kogilah *et al.*, 2008).

This research is therefore undertaken to respond to the issues above. Through the use of a comprehensive set of variables, this study aims to determine which perceived innovation characteristics, benefits, and barriers of internet-based ICT that influence their adoption by the SMEs. Any subsequent gaps identified would allow recommendations to be made on how the SMEs can adopt internet-based ICT for their business success and improved competitiveness.

In the context of this study, the definitions of internet-based ICT adoption by Tan *et al.* (2009) and Kogilah *et al.* (2008) are adopted. Tan *et al.* (2009) provided a rather simple definition of how the internet can be adopted as a new innovation in conducting business. Kogilah *et al.* (2008) expanded the definition where organizations use the internet through web sites as a platform of communications within and between the organizations and their stakeholders. Further, if a web site is made into a platform for e-commerce technology, its interface can enable virtually any type of ordering by a customer, as well as facilitating other parts of the shopping, selecting and purchasing process. The internet-based ICT adoption is further referred to in this study as the usage of ICT such as computer hardware, software and network to connect to the internet. While internet-based ICT adoption is considered new innovation, the terminology is not as it has been used by numerous researchers when conducting technology-related researches (Chapman *et al.*, 2000; Hsieh *et al.*, 2008; Lucchetti and Sterlacchini, 2004; Lettieri and Masella, 2006; Kumbakara, 2008). In this paper, the terminologies of internet-based ICT adoption and ICT adoption will be used interchangeably.

Literature review

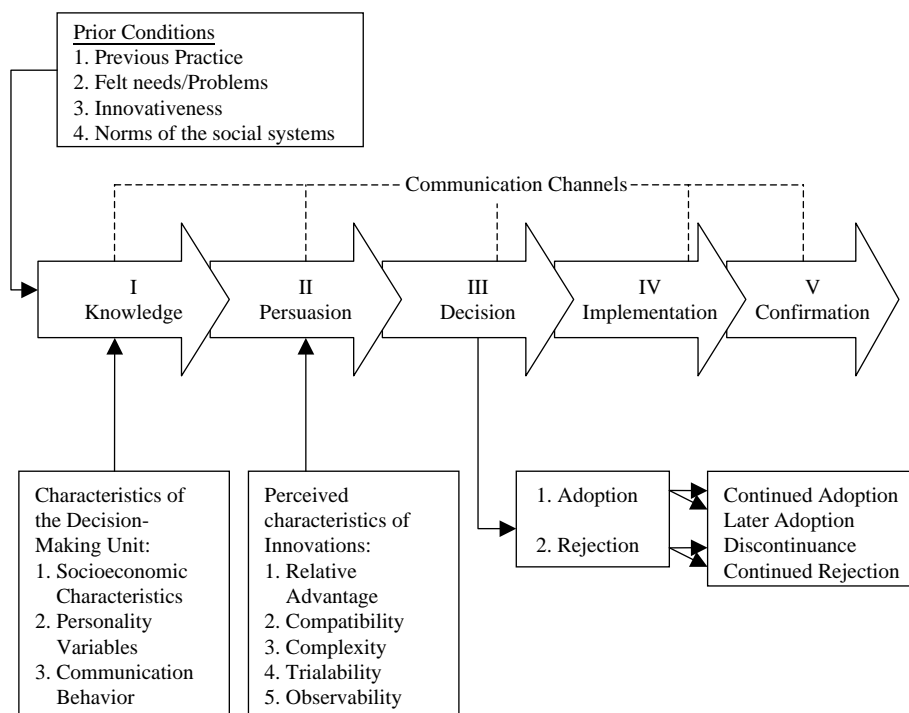
Diffusion of innovation theory (DOI)

The DOI model, introduced by Rogers (1983), remains a popular model in the investigation of the behavior of users in adopting new technological innovation. The DOI is a broad psychological or sociological theory used to describe the patterns of

adoption, explain the mechanism and assist in predicting whether and how a new invention will be successful. Specifically, diffusion is defined as a process by which an innovation is communicated through certain channels over a period of time among the members of a social system. Innovation, on the other hand, is defined as an idea, practice, or object that is perceived to be new by an individual or other unit of adoption. Communication is a process in which participants create and share information with one another to reach a mutual understanding (Rogers, 1983). In short, the DOI is concerned with the manner in which new technological ideas migrate from creation to use and that technological innovation is communicated through particular channels, over time, among the members of a social system. Figure 1 depicts the DOI process channel.

Based on the DOI model, Rogers (1983) proposed five important perceived characteristics of innovation. They are:

- (1) *Relative advantage* – the degree to which the innovation is perceived to be better than what it supercedes.
- (2) *Compatibility* – the degree to which the innovation is consistent with existing values, past experiences and needs.
- (3) *Complexity* – the degree to which the innovation is difficult to understand and use.



Source: Diffusion of Technology Innovation Model by Rogers (1983)

Figure 1.
Diffusion of technology
innovation model

- (4) *Trialability* – the degree to which the innovation can be experimented on a limited basis.
- (5) *Observability* – the degree of visibility of the new innovation results.

Many researchers have adopted this model along with its characteristics to study innovation (Benham and Raymond, 1996; Brancheau and Wetherbe, 1990; Hussin and Noor, 2005; Kendall *et al.*, 2001; Limthongchai and Speece, 2003; Slyke *et al.*, 2004a, b, 2005; Syed *et al.*, 2005; Tan and Teo, 2000; Teo and Pok, 2003) with three studies which adopted constructs from different models such as the theory of reasoned action, theory of planned behavior and the technology acceptance model (Benham and Raymond, 1996; Limthongchai and Speece, 2003; Tan and Teo, 2000). Tan *et al.* (2009) have attempted to compile and summarize the studies and their findings in chronological order as shown in Table I.

From Table I, it is obvious that the DOI remains a popular model in investigating DOI in different sectors of the economy, including the SMEs. Since the DOI model is inclined towards investigating new technological adoption and diffusion (Rogers, 1983), it is therefore aligned to the main focus of this study where it attempts to identify innovative characteristics rather than the whole innovation process.

In addition to the five characteristics, many studies have identified ICT security or confidentiality and costs as significant factors influencing ICT adoption (Aljitri *et al.*, 2003; Asia Pacific Economic Cooperation, 1999; Beale, 1999; Bhimani, 1996; Bird, 1997; Chou *et al.*, 2008; Ernst & Young, 2001; Hill and Jones, 2001; Hoi *et al.*, 2003; Hussin and Noor, 2005; James, 2003; Koong *et al.*, 2008; Light, 2001; Limthongchai and Speece, 2003; Organization for Economic Cooperation and Development, 2000; Ratnasingam, 2001; Rose *et al.*, 1999). All these seven measures are therefore integrated to form the independent variables of this study.

In addition, Wymer and Regan (2005) have provided a comprehensive list of incentives and barriers to the adoption and use of e-commerce and e-business information technology by the SMEs. The basic assumption is that internet-based ICT adoption offers benefits to SMEs in terms of cost reduction, speedy, and reliable communication between and within businesses and customers, efficient coordination among firms, closer relationship among business partners, facilitate management and organization of businesses; access to market information as well as the identification of new business opportunities. Among the barriers identified comprise of the unsuitability of ICT adoption for business, unavailability of ICT personnel and network infrastructure, high ICT cost, expensive software, imbalanced investment costs and returns, uncertainties with ICT laws, and lack of confidence in ICT security. The benefits and barriers of ICT adoption constitute two additional independent variables of the study.

The dependent variable of this study consists of adoption or rejection as shown in the DOI model. Adoption has been explained as a decision to make full use of an innovation as the best course of action whilst rejection is a decision not to adopt an innovation (Rogers, 1983). By applying this theory in the present study, adoption is seen as a decision by the SMEs to use internet-based ICT to communicate and/or conduct businesses with the stakeholders. On the other hand, rejection means the decision not to adopt internet-based ICT in the business operations of the SMEs.

Researchers	Descriptions
Brancheau and Wetherbe (1990)	Used DOI to study adoption of spreadsheet among 500 professionals from manufacturing and service businesses based on the respondents' backgrounds. Found that early adopters are those who are younger, highly educated, more attuned to mass media, more involved in interpersonal communication and more likely to be opinion leaders
Benham and Raymond (1996)	Conducted research to disclose IT adoption of voice mail in university campus. Combined theory of planned behavior (Ajzen, 1991), technology acceptance model (Davis, 1989) and Rogers (1983) DOI model. Employed three characteristics from DOI: relative advantage, compatibility, and trialability. Found that relative advantage and compatibility are indistinguishable that significantly influence attitude towards voice mail adoption. Trialability did not appear to influence behavioral control. The combination of variables from different models made the research complicated
Tan and Teo (2000)	Conducted an online survey on online newsgroups on factors influencing adoption of internet banking using constructs from the theory of planned behavior and DOI model. All DOI characteristics were used except for observability because it is considered irrelevant. Privacy and security were added as additional dimensions. The multiple linear regression results indicate that relative advantage, compatibility with respondents' values, trialability, experience, needs and risk factors influenced the adoption of internet banking
Kendall <i>et al.</i> (2001)	Investigated e-commerce as new innovation among SMEs in Singapore using DOI. Results indicate that relative advantage, compatibility, and trialability are factors affecting e-commerce adoption. Observability and complexity are found to be insignificant
Limthongchai and Speece (2003)	Studied e-commerce adoption among owners, presidents and CEOs of SMEs in Thailand using DOI. Together with the five DOI characteristics, security or confidentiality is added. Relative advantage, compatibility, security or confidentiality, and observability are positively correlated to the rate of e-commerce adoption while complexity which recorded a negative correlation. Compatibility emerged as the most important factor. The respondents opined that e-commerce is still insecure and lacks confidentiality
Teo and Pok (2003)	Conducted an online survey on the adoption of the new wireless application protocol (WAP)-enabled mobile phones among internet users. The DOI model is used along with theory of reasoned action, technology acceptance model and theory of planned behavior which resulted in a new model proposed. Only two constructs of DOI; relative advantage and compatibility were used. Relative advantage was found to significantly correlate with WAP-enabled mobile phone adoption

(continued)

Table I.
Prior research works
adopting DOI and
summary of results

Researchers	Descriptions
Slyke <i>et al.</i> (2004b)	Conducted a survey on the influence of culture on consumer-oriented e-commerce adoption on universities in four countries; India, Hong Kong, China, and the USA. They generated a model with seven constructs, i.e. relative advantage, compatibility, ease of use, result demonstrability, image, trust, and computer-based media support index. Culture, trust, perceived relative advantage, compatibility, complexity (ease of use) and observability (result demonstrability) are all significant. Perceived image is not significant. Prior online purchasing is also significant but computer experience is not
Slyke <i>et al.</i> (2004a)	Investigated the impact of trust as a factor that influences web-based shopping in three public north American universities. They modified the DOI model (e.g. observability was divided into result demonstrability and visibility) and included three constructs on trust in web merchants, image and voluntariness. Perceived compatibility is found to have the strongest impact on user intention, followed by perceived complexity, relative advantage, and image. Trust in web merchants is found to be a significant predictor but not as strong as the three perceived innovation characteristics
Slyke <i>et al.</i> (2005)	Adopted the DOI to understand gender-based differences in consumer e-commerce adoption. Trust and ease of use were added as two important constructs. Their findings acknowledged the existence of gender differences in influencing e-commerce adoption. Their findings indicate that emphasis on relative advantages and result demonstrability can attract men's attention and visibility of e-commerce may be more effective in drawing women. Perceived compatibility and visibility has greater impacts for women. No difference is found for perceived ease of use and web merchant trustworthiness
Syed <i>et al.</i> (2005)	Investigated the perceived benefits of e-commerce adoption in Malaysian electronic manufacturing companies. The study discovered that major factors affecting the adoption of e-commerce in Malaysia include internet communication costs, easy links with suppliers and customers, tool for future business, time barriers omission and global presence
Hussin and Noor (2005)	Used DOI to explore the willingness of Malaysian SMEs in adopting e-commerce among the CEOs or managers of Malaysian SMEs. Relative advantage, observability, and complexity are found to be significantly related to e-commerce adoption. Trialability and compatibility are insignificant. The descriptive statistics revealed that security of payment and virus are ranked highest in the list of barriers to e-commerce adoption. Insignificant trialability indicates that SMEs generally are not aware of the grants provided by government. Insignificant compatibility reflects that the CEOs lack of strategic thinking ability. Relative advantage is found to be the most important factor

Table I.

Source: Tan *et al.* (2009)

Based on the review of literature, this study hypothesized significant positive relationships between relative advantage (*H1*), compatibility (*H2*), trialability (*H3*), observability (*H4*), security (*H6*), benefits (*H8*), and internet-based ICT adoption. In contrast, significant negative relationships are posited between complexity (*H5*), ICT cost (*H7*), barriers (*H9*), and ICT adoption. Further, Rogers (1983) also concludes that positive perception of the usage of innovation can lead to early use of this innovation and vice-versa. It is therefore posited that SMEs with positive perception of internet-based ICT adoption may adopt this innovation earlier than those with negative perception who might also not be adopting the innovation at all. Figure 2 shows the research framework of this study.

The next section describes the methodology used in this study.

Methodology

The sampling frame of this study consists of all SMEs located in the two states in the southern region of Peninsular Malaysia, namely the states of Melaka and Johor. According to the National SME Secretariat (2005), about 14.6 percent or 75,735 SMEs in Malaysia are located in these two states. The list of SMEs was obtained from the web site of the Small and Medium Industries Development Corporation (SMIDEC) of Malaysia (www.smidec.gov.my). Based on the list, the information of SMEs located within the states of Melaka and Johor were retrieved.

Only owners or managers of the SMEs are targeted as respondents of this study because they own or oversee the entire operations of their firms and are therefore in better positions to understand the current operations and future trends of their enterprises. The respondents were first contacted by telephone and explained the nature of the study. Their participation was then sought. About 406 owners or managers of the SMEs agreed to participate in the survey, of which 237 of SMEs are from Johor and the remaining from Melaka. Since Sekaran (2003) opines that a sample size of 384 is enough for a population of 1 million, the 406 random responses are thus considered to be adequate for the survey and for the results to be generalized. Table II presents the profiles of the SMEs participated in this study.

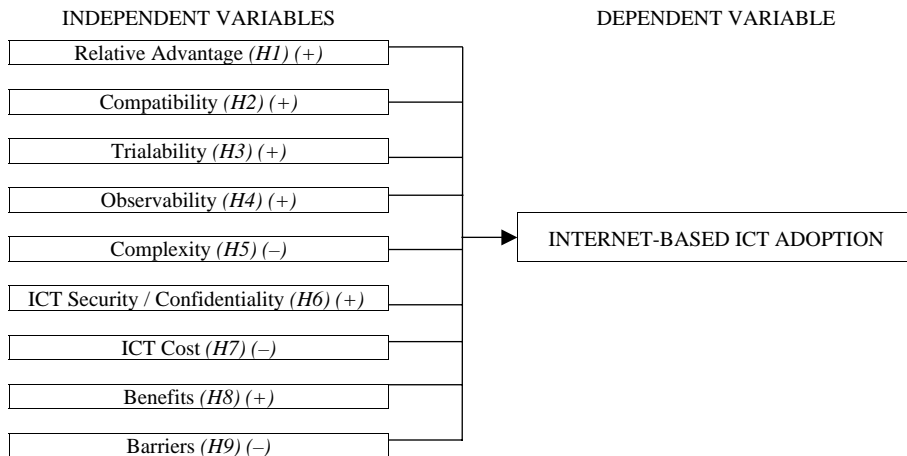


Figure 2.
Research framework

Table II.
Companies' profiles

	Percent	Percent
Types of industry	34.5 65.5	Manufacturing industry: <5 5-50 51-150
Types of company ownership	82.3 1.7 3.9 12.1	Services industry: <5 5-19 20-50
Year of start-up	61.8 38.2	
Annual sales turnover		
Types of company internet connection		
Years of using internet for business purpose		

Upon receiving their consent, a set of questionnaire with self-stamped envelope was sent to the owners or managers. The items in the questionnaire were derived from the literature and prior surveys. All the variables used in this study are interval-scaled. The dependent variable (ICT adoption) employs a five-point Likert scale, ranging from 1, more than five years; 2, next four-five years; 3, next two-three years; 4, use within one year; and 5, current user. The seven independent variables employ a six-point Likert scale, ranging from 1 = strongly disagree to 6 = strongly agree while the benefits and barriers of internet adoption are scaled from 1 = least important to 5 = most important. In order to establish face validity of the questionnaire, it was piloted on 25 owners or managers of the SMEs in the state of Melaka. Some minor amendments were made on the questionnaire prior to its final dissemination. Calls were made to the respondents after the dissemination of questionnaires to encourage participation among them. This explains the encouraging response rate obtained.

The constructs used in this study have been found to have high internal consistency reliability. Table III shows that all the variables have Cronbach α values of more than 0.70, which is higher than the value recommended Malhotra (2004) and Nunnally (1978).

Factor analyses with the principal axis factoring method were performed on the questions to insure good construct validity. Since this study involves a fairly large sample size, a loading of 0.30 and above is used (Child, 1970; Hair *et al.*, 1995; Norman and Streiner, 1994). Seven factors from the innovative characteristics (Table IV) and two factors measuring benefits and barriers of ICT adoption (Table V) with eigenvalues of 1.00 or higher were extracted and all the items were included since they load above 0.30 on any one factor. The results explained 62.01 percent and 49.25 percent of the independent variables, implying a satisfactory degree of construct validity.

In addition, the results of the variance inflation factor (VIF) analysis presented in Table VI shows that the VIF values for all the factors range from 1.101 to 2.632. The values are lower than ten, indicating that the variables are not highly collinear (Chatterjee *et al.*, 2000; Kleinbaum *et al.*, 1988) and therefore will not pose a problem to regression analysis.

Table VII shows the mean and SD scores of the independent and dependent variables. The high SD scores in some of the variables suggest inconsistencies in the respondents' answers. The mean score of 4.37 with a SD of 0.95 for ICT adoption

Variables	α	Items
Relative advantage	0.8046	6
Compatibility	0.8496	6
Trialability	0.7406	4
Observability	0.8115	6
Complexity	0.8328	5
Security	0.8134	4
ICT cost	0.8136	4
ICT adoption	0.8604	7
Benefits of ICT adoption	0.8433	8
Barriers of ICT adoption	0.8107	8

Table III.
Coefficient α values and
number of items of all the
variables

Items	Factors						
	1	2	3	4	5	6	7
REL1	0.579						
REL2	0.768						
REL3	0.326						
REL4	0.459						
REL5	0.658						
REL6	0.580						
COM1		0.724					
COM2		0.734					
COM3		0.526					
COM4		0.710					
COM5		0.638					
COM6		0.525					
TRI1			0.547				
TRI2			0.782				
TRI3			0.707				
TRI4			0.596				
OBS1				0.389			
OBS2				0.462			
OBS3				0.548			
OBS4				0.569			
OBS5				0.493			
OBS6				0.624			
CLX1					0.837		
CLX2					0.770		
CLX3					0.882		
CLX4					0.252		
CLX5					0.743		
SEC1						0.522	
SEC2						0.428	
SEC3						0.427	
SEC4						0.526	
COS1							-0.470
COS2							-0.836
COS3							-0.772
COS4							-0.853
Eigenvalue	8.68	3.64	2.12	1.68	1.92	1.18	1.02
Variance	25.99	37.40	44.74	50.50	54.80	58.64	62.01

Table IV.
Factor analysis results
for the items measuring
innovative characteristics
of ICT adoption

implies that the majority of respondents have consistently agreed that they will be adopting ICT in the next one year or so.

Taking a closer look, Table VIII shows the mean and SD scores specifically for all the items measuring benefits and barriers of ICT adoption. Five of the eight benefits and three out of eight barriers were found to score above the average mean scores with SD scores of below one. The respondents cited, among others, new business opportunities, access to market information and knowledge, speedy, and reliable business communications as among the benefits of ICT adoption. ICT security, high cost and expensive software have been cited the main barriers to ICT adoption.

Items	Factors		Internet-based ICT adoption
	1	2	
BEN1	0.692		235
BEN2	0.700		
BEN3	0.461		
BEN4	0.570		
BEN5	0.752		
BEN6	0.589		
BEN7	0.701		
BEN8	0.614		
BAR1		0.552	
BAR2		0.822	
BAR3		0.578	
BAR4		0.635	
BAR5		0.739	
BAR6		0.636	
BAR7		.454	
BAR8		0.612	
Eigenvalue	2.48	1.40	Table V. Factor analysis results for the items measuring benefits and barriers of ICT adoption
Variance	44.20	49.25	

Independent variables	Tolerance	VIF	Table VI. Results of VIF analysis
Composite relative advantage	0.380	2.632	
Composite compatibility	0.577	1.732	
Composite trialability	0.909	1.101	
Composite observability	0.461	2.171	
Composite complexity	0.856	1.168	
Composite security	0.482	2.073	
Composite ICT costs	0.693	1.444	
Composite benefits	0.520	1.960	
Composite barriers	0.560	1.830	

Analysis and results

The results of the multiple regression analysis between the independent variables measuring the seven innovative characteristics; benefits and barriers; and ICT adoption are presented in Tables IX and X, respectively. In Table IX, the adjusted square multiple correlation coefficient (adjusted R^2) value indicated that 76.1 percent of the variances associated with ICT adoption can be explained from the seven innovative characteristics. The F -statistic is also significant ($F = 185.327$) which confirms that all the variables collectively make a significant contribution to the fitness of the regression model. A comparison made with Rogers (1983) DOI's model showed an adjusted R^2 value of 60.9 percent and F -value of 127.149. This implies that ICT security and cost account for 15.2 percent of the variation of SMEs' willingness in adopting internet-based ICT. Thus, the current model is deemed to be more comprehensive in addressing the issue of ICT adoption.

Table VII.
Descriptive statistics of independent variables and ICT adoption

No.	Variables	Type	Mean	SD
1	ICT adoption	DV	4.37	0.9521
2	Relative advantage	IV	3.69	1.2166
3	Compatibility	IV	3.58	1.0736
4	Trialability	IV	3.69	1.2855
5	Observability	IV	3.65	1.2539
6	Complexity	IV	3.22	1.1175
7	Security	IV	3.74	0.9657
8	Cost	IV	2.97	1.2927
9	Benefits	IV	3.53	0.8600
10	Barriers	IV	3.45	0.8800

Notes: DV, dependent variable; IV, independent variable

Table VIII.
Mean and SD scores for benefits and barriers of ICT adoption

No.		Mean	SD
<i>Benefits of ICT adoption</i>			
1	Business costs reduction	3.31	0.845
2	Speedy and reliable business communications	3.58	0.904
3	Efficient coordination among firms	3.38	0.779
4	Close relationship among trading partners	3.47	0.891
5	Better customer communications	3.58	0.909
6	New business opportunities	3.72	0.826
7	Access to market information and knowledge	3.67	0.880
8	Business management and organization facilitation	3.54	0.805
<i>Barriers of ICT adoption</i>			
1	Unsuitability for business	3.24	0.842
2	Unavailability of ICT personnel	3.30	0.894
3	Unavailability of network infrastructure	3.38	0.811
4	High ICT cost	3.58	0.812
5	Expensive ICT software	3.48	1.037
6	Unbalanced investment costs and returned benefits	3.43	0.834
7	Uncertainties with ICT laws	3.32	0.887
8	Confidence lacking in ICT security	3.85	0.944

Table IX.
Multiple regression results between the seven innovative characteristics and ICT adoption

Variable	B	SE	β	T	Sig.
Relative advantage	0.289	0.029	0.342	10.056	0.000*
Compatibility	0.146	0.029	0.149	3.561	0.000*
Complexity	-0.099	0.019	-0.138	-5.248	0.000*
Trialability	0.010	0.027	0.010	0.392	0.695
Observability	0.146	0.036	0.132	4.058	0.000*
Security	0.481	0.031	0.509	15.316	0.000*
ICT cost	-0.018	0.022	-0.023	-0.823	0.411

Notes: * $F = 185.327$ ($p = 0.000$); $R^2 = 0.761$

Variable	<i>B</i>	SE	β	<i>T</i>	Sig.
<i>Benefits</i>					
Potential to reduce business correspondence costs	0.208	0.069	0.184	3.019	0.003*
Increase speed and reliability of business communication	0.089	0.067	0.085	1.326	0.186
Reduce inefficiencies resulting from lack of co-ordination between firms	0.010	0.066	0.008	0.151	0.880
Build closer relationship among trading partners	0.027	0.061	0.025	0.437	0.663
Effective tools for better communication with customers	0.303	0.067	0.290	4.555	0.000*
Create new business opportunities	0.123	0.065	0.106	1.879	0.061
Enhance access to market information and knowledge	-0.095	0.068	-0.088	-1.408	0.160
Facilitate new ways of managing and organizing businesses	-0.001	0.063	-0.001	-0.021	0.984
<i>Barriers</i>					
Unsuitability for business	-0.157	0.059	-0.139	-2.651	0.008*
Unavailability of ICT qualified personnel in company	-0.003	0.069	-0.003	-0.041	0.968
Unavailability of company's network infrastructure	-0.049	0.071	-0.041	-0.685	0.494
High cost of ICT equipment and network setup	-0.020	0.068	-0.017	-0.294	0.769
Software prices are expensive	-0.082	0.056	-0.089	-1.448	0.149
Imbalanced between investment costs and returned benefits	0.015	0.063	0.013	0.240	0.810
Uncertainties with ICT laws	-0.094	0.055	-0.088	-1.714	0.087
Lack of confidence in ICT security	-0.227	0.054	-0.225	-4.192	0.000*

Notes: **F* = 10.634 (*p* = 0.000); *R*² = 0.276

Table X.
Multiple regression results between benefits, barriers, and ICT adoption

The table shows that five independent variables, namely:

- (1) relative advantage;
- (2) compatibility;
- (3) complexity;
- (4) observability; and
- (5) security

are significantly associated with ICT adoption with complexity recorded a significant negative association. As such, *H1, H2, H4, H5,* and *H6* are accepted while *H3* and *H7* are rejected. ICT security appears to be the most important characteristic that affects the willingness of SMEs to adopt ICT, followed by relative advantage, observability and compatibility and complexity. Trialability and ICT cost are not significant predictors of ICT adoption.

Table X shows that 27.6 percent of the variances associated with ICT adoption can be explained from the benefits and barriers of ICT adoption. There are two benefits and two barriers that are significantly associated with ICT adoption. The two benefits of ICT is that it is an effective tool for business communication with customers and that it has the potential to reduce business correspondence costs. However, lack of



confidence in ICT security and unsuitability of ICT for business have been negatively associated with ICT adoption and the relationships are significant. As such, *H8* and *H9* are accepted for these significant items.

Discussions and implications

This study has implications for both research and practice. Rogers' (1983) DOI model was expanded to include security and ICT cost. Besides, the constructs measuring benefits and barriers were added to the model. The model was tested and proven to be both valid and reliable. The factor analyses results have confirmed that the responses generally support the theoretical and conceptual distinctions of the factors influencing ICT adoption. This might be one of the very first studies that attempted to study ICT adoption in a comprehensive manner. Further, the demographic profiles of the respondents, i.e. types of industry, ownership, annual turnover, and years of internet usage were found to be reflective of the reality of SMEs in Malaysia, and thus allow the generalization of the results obtained.

Tables VII and VIII imply that on an overall, the respondents were somewhat indifferent in their responses toward the independent variables. Security was found to score the highest mean, followed by relative advantage, trialability, observability, compatibility, complexity, and cost. However, the respondents seem to agree that security, relative advantage, compatibility, observability, and complexity are important factors influencing ICT adoption. In other words, the presence of these characteristics leads to quicker ICT adoption. The finding is very much in line with prior literature. In fact, it has challenged prior findings (Hussin and Noor, 2005; Kendall *et al.*, 2001) as far as the results are concerned. To some extent, the result is supported by the findings in Table X where security has been cited a major barrier to ICT adoption.

It is interesting to note that trialability and costs have no significant associations with ICT adoption. As reported by Tan *et al.* (2009), many of the SMEs think that trialability of software is not an important indicator to ICT adoption as pirated software are widely available and are believed to be used by the enterprises. Anis (2007) reported that 50 percent of the 23 companies raided in Malaysia in 2006 were using pirated software. This is further supported by their indifferent response to the prices of software even though expensive software has been cited a barrier to ICT adoption. In addition, many of the SMEs disagree that cost is a significant factor influencing ICT adoption. This corroborates the findings in Table X where there are no significant associations between high investment in ICT infrastructure, return on ICT investment and ICT adoption. This may imply that many of the SMEs are aware of the financial incentives and grants provided by the government although many of them are not sure of the forms of incentives available, as evident from the indifferent responses.

One could safely conclude from the findings that many of the SMEs surveyed have not adopted ICT in their businesses, judging from their overall collective responses on the timeframe of adoption. Lack of security has been identified as an obvious reason. Besides, lack of education and technical skills might have contributed to the lower rate of adoption (Kogilah *et al.*, 2008). However, their indifferences to the issues surveyed, including cost imply that the respondents do not know exactly the reasons leading to their specific needs of ICT adoption.

It is clear from the findings that ICT will be adopted in a shorter timeframe for the purpose of communication with customers and to reduce business correspondence costs although the SMEs cited new business opportunities, access to information and knowledge as well as intra-and inter-organizational benefits as some of their priorities. Communication and information sharing are the most appropriate activities in business alliances for the application of internet-based information system. On the other hand, lack of security has been cited a major barrier despite the cyber laws available to protect the business environment. The SMEs either have no confidence or have no idea of their existence in view of their indifference in the uncertainties of ICT law. The SMEs also remain indifferent on the unsuitability of ICT adoption to business which has been found to be significantly negatively related to ICT adoption. On an overall, their indifferences in the innovation characteristics and to the benefits and barriers against the shorter timeframe of ICT adoption imply the importance of educating the SMEs on the various facets of ICT adoption in a holistic picture while keeping in mind the important ICT characteristics necessary that facilitates adoption.

The results draw the attention of the SMEs and policy makers. First of all, the importance of ICT adoption to the SMEs's success cannot be overemphasized. Many researchers have reached a consensus that investment in, and proper utilization of ICT is a major way of improving productivity and financial performance of the SMEs (Abouzeedan and Busler, 2002; Beal, 2001). The SMEs must realize that ICT adoption is no longer merely a choice, but a must in today's globalized world. Technology advances at a much faster rate which has undoubtedly offer vast opportunities to SMEs for international market access (Fillis *et al.*, 2004) and to participate in international supply chain provided that they adopt ICT. To be able to do this, the owners and/or managers must equip themselves with sufficient ICT knowledge.

Besides, ICT adoption has the benefits of strengthening organizational communication with their stakeholders which include customers, suppliers, business partners, and competitors at lower cost. Looking at the benefits, the SMEs should be prepared to invest in ICT in order to improve upon the features of their websites, enhance security and increase bandwidth for business transactions. Although investment in ICT can be significantly huge, the long-run benefits can be tremendous to the SMEs.

In addition, the policy maker plays an important role in disseminating information effectively across all SMEs. Many SMEs are either unaware or are ignorant to the information provided by the government agencies. Thus, one effective way is to make it mandatory for SMEs to attend a briefing prior to the renewal or registration of businesses. An intensive itinerary which includes ICT usage and adoption can be drawn for this purpose.

It is not surprising that the issue of security is one of the main considerations that the SMEs have to deal with when adopting ICT. It has been reported that the Malaysian SMEs feel insecure while performing transactions over the internet. In addition, there are also fears of theft of information that are put online in addition to hackers, spy ware and the like (Kogilah *et al.*, 2008). It is therefore important for the SMEs to be convinced that internet-based ICT is highly secured. The government plays an important role to ensure that the passed cyber laws could effectively regulate the online transaction activities and to eliminate the problem of virtual thieves and hackers. The internet service providers, on the other hand, should provide anti-virus

systems or firewall to prevent spy ware, viruses as well as hackers. At the same time, the SMEs have to play a proactive role too to ensure that their systems are firewall-enabled so as to prevent leaking of important information.

As far as the issue of software is concerned, many ICT firms have developed internet-based technologies for the SMEs. It is imperative for the SMEs to seize the opportunity to identify and understand the technologies available and the compatibility of the proposed technologies with their existing business operations. In fact many of these ICT firms, particularly the MSC Malaysia status firms are also actively offering trial versions of software which allowed the SMEs to try the software before making a purchase decision. They also offer customization package that commensurate the requirements of the SMEs. This will not only discourage the use of pirated software but also increase the use of proprietary software that meet the specific needs of the enterprises.

The government has also been actively providing a wide range of financial assistance and grants through various ministries and government agencies, such as the SMIDEC, the Malaysian Technology Development Corporation, the National Bank of Malaysia and even the newly established SME Bank. In fact, it was reported in a local daily that the government has recently approved RM 1.2 billion financing facilities for SMEs, in which RM 500 million is meant for upgrade of facilities and modernize operations (The Star, 2008). These funds are easily accessible to the SMEs as long as they are able to improve their administrative, strategic and financial management and adopt an open approach to information disclosure.

Once the SMEs have decided to adopt ICT, an ICT-friendly policy ought to be developed. It is vital for the SMEs to offer proper ICT training and support for their employees (Robert, 1998) so as to bridge the gap between the development and successful development of technology (Singh, 2000). The SMEs must keep in mind that knowledgeable personnel of the ICT facilities are needed in order for the technology to generate value for the enterprises (Ong and Hishamuddin, 2008). Cost of training is not a significant issue as many of the training programs are offered and funded by the government agencies such as the National Productivity Corporation and the various skills development centers.

Conclusion and suggestions for future research

The SMEs have always been recognized as an important segment of the economy and will remain as the backbone of economic development in many economies throughout the world (Chong and Lin, 2008). The increasing liberalization and fierce competition of the world economy has demanded the SMEs to continuously look for ways to improve their competitive ability. The SMEs should not underestimate their capability to compete in a larger market and that ICT adoption and utilization can act as a strategic tool to help them to achieve just that. There is a certain need to create greater awareness among the SMEs on the importance of ICT adoption. This study contributes to providing various recommendations to the policy makers and SMEs in light of the findings. It is hoped that the suggestions shed some lights to the SMEs to further understand the importance and requirements for successful ICT adoption for business success.

Albeit the sufficient number of owners and/or managers surveyed in this study, it is imperative for future studies to consider SMEs throughout the country and in different

sectors. Since the reasons for adopting ICT can be culturally inclined, cross-cultural studies is also possible. It is also interesting for future studies to include more variables such as benefits and barriers and types of ICT applications, organizational, individual characteristics of the owners/managers, environmental characteristics such as government policies and network infrastructure and the like that may also affect ICT adoption.

References

- Abouzeedan, A. and Busler, M. (2002), "Information technology (IT) impact on performance of small and medium enterprises (SMEs)", *Proceedings of the RENT XVI, Research in Entrepreneurship and Small Business, Barcelona, Spain*.
- Adham, K.A. and Ahmad, M. (2005), "Adoption of web site and e-commerce technology among Malaysian public companies", *Industrial Management & Data Systems*, Vol. 105 No. 9, pp. 1172-87.
- Ajzen, I. (1991), "The theory of planned behavior", *Organizational Behavior and Human Decision Processes*, Vol. 50, pp. 179-211.
- Aljibri, H.A., Pons, A. and Collins, D. (2003), "Global e-commerce: a framework for understanding and overcoming the trust barrier", *Information Management*, Vol. 11 No. 3, pp. 130-8.
- Anis, M.N. (2007), "SMEs among main pirated software users", *The Star Online*, April 17.
- Asia Pacific Economic Cooperation (1999), *SME Electronic Commerce Study*, APEC Publishing, Singapore.
- Beal, T. (2001), "Government promotion and facilitation of ICT use by SMEs: APEC and New Zealand", *Asia Small Business Review*, Vol. 4 No. 1, pp. 85-109.
- Beale, M.W. (1999), "Consumer concern over e-commerce security", *E-Commerce Times*, available at: www.ecommercetimes.com/story/1981.html
- Benham, H.C. and Raymond, B.C. (1996), "Information technology adoption: evidence from a voice mail introduction", *ACM SIGCPR Computer Personnel*, Vol. 7 No. 1, pp. 3-25.
- Bhimani, A. (1996), "Securing the commercial internet", *Communications of the ACM*, Vol. 39 No. 6, pp. 29-35.
- Bird, J. (1997), "E-commerce is safety", *Management Today*, December, pp. 54-7.
- Brancheau, J.C. and Wetherbe, J.C. (1990), "The adoption of spreadsheet software: testing innovation diffusion theory in the context of end-user computing", *Information Systems Research*, Vol. 1 No. 2, pp. 115-43.
- Chapman, P., James-Moore, M., Szczygiel, M. and Thompson, D. (2000), "Building internet capabilities in SMEs", *Logistics Information Management*, Vol. 13 No. 6, pp. 353-60.
- Chatterjee, S., Hadi, A.S. and Price, B. (2000), *Regression Analysis by Example*, Wiley, New York, NY.
- Child, D. (1970), *Essentials of Factor Analysis*, Holt Rinehart Winston, London.
- Chong, S.C. (2006), "KM critical success factors: a comparison of perceived importance versus implementation in Malaysian ICT companies", *The Learning Organisation*, Vol. 13 No. 3, pp. 230-56.
- Chong, S.C. and Lin, B. (2008), "Exploring KM issues and KM performance outcomes: empirical evidence from Malaysian Multimedia Super Corridor companies", *International Journal of Technology Management*, Vol. 43 No. 4, pp. 285-303.
- Chou, T.T., Vassar, J.A. and Lin, B. (2008), "Knowledge management via ontology development in accounting", *Kybernetes: The international journal of cybernetics systems and management sciences*, Vol. 37 No. 1, pp. 36-48.

- Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13 No. 3, pp. 319-39.
- Economic Planning Unit (2001), *Eighth Malaysian Plan 2001-2005*, EPU Publication and Distribution, Putrajaya.
- Ernst & Young (2001), "Advancing with e-commerce", available at: www.noie.gov.au
- Fillis, I., Johannson, U. and Wagner, B. (2004), "Factor impacting on e-business adoption and development in the smaller firm", *International Journal of Entrepreneurial Behavior & Research*, Vol. 10 No. 3, pp. 78-191.
- Gibbs, J.L. and Kraemer, K.L. (2004), "A cross-country investigation of the determinants of scope of e-commerce use: an institutional approach", *Electronic Markets*, Vol. 14 No. 2, pp. 124-37.
- Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1995), *Multivariate Data Analysis*, Prentice Hall International Inc., Englewood Cliffs, NJ.
- Hao, X.M. and Chow, S.K. (2004), "Factors affecting internet development: an Asian survey", *First Monday*, Vol. 9 No. 2, pp. 1-21.
- Hill, C.W.L. and Jones, G.R. (2001), *Strategic Management – An Integrated Approach*, Houghton Mifflin Company, Boston, MA.
- Hoi, J.Y.Y., Shim, J.P. and Yin, A.K.L. (2003), "Current progress of e-commerce adoption: small and medium enterprises in Hong Kong", *Communications of the ACM*, Vol. 46 No. 9, pp. 226-32.
- Hsieh, C.T., Jones, C. and Lin, B. (2008), "The new business potential with mobile commerce", *International Journal of Mobile Communications*, Vol. 6 No. 4, pp. 436-55.
- Hussin, H. and Noor, R.M. (2005), "Innovating business through e-commerce: explore the willingness of Malaysian SMEs", *Proceedings of the 2nd International Conference on Innovations in Information Technology, Dubai, UAE*.
- James, J. (2003), "Sustainable internet access for the rural poor? Elements of an emerging Indian model", *Futures*, Vol. 35 No. 5, pp. 76-88.
- Kendall, J.D., Tung, L., Chua, K., Ng, D. and Tan, S. (2001), "Receptivity of Singapore's SMEs to electronic commerce adoption", *Journal of Strategic Information Systems*, Vol. 10 No. 3, pp. 223-42.
- Kleinbaum, D.G., Kupper, L.L. and Muller, K.E. (1988), *Applied Regression Analysis and Other Multivariate Methods*, Duxbury Press, Belmont, CA.
- Kogilah, N., Santhapparaj, A.S. and Eze, U.C. (2008), "An empirical study of website adoption among small and medium enterprises in Malaysia", *Proceedings of the 10th International Business Information Management Association (IBIMA) Conference on Innovation and Knowledge Management in Business Globalisation, Kuala Lumpur, Malaysia*, pp. 339-51.
- Koong, K.S., Liu, L.C., Bai, S. and Lin, B. (2008), "Identity theft in the USA: evidence from 2002 to 2006", *International Journal of Mobile Communications*, Vol. 6 No. 2, pp. 199-216.
- Kumbakara, N. (2008), "Managed IT services: the role of IT standards", *Information Management & Computer Security*, Vol. 16 No. 4, pp. 336-59.
- Lettieri, E. and Masella, C. (2006), "Measuring the value and sustainability of internet-based ICTs in healthcare organizations", *International Journal of Healthcare Technology and Management*, Vol. 7 Nos 3/4, pp. 319-32.
- Light, D.A. (2001), "Sure, you can trust us", *Sloan Management Review*, Vol. 43 No. 1, pp. 17-18.

- Limthongchai, P. and Speece, M.W. (2003), "The effect of perceived characteristics of innovation on e-commerce adoption by SMEs in Thailand", *Proceedings of the 7th International Conference on Global Business and Economic Development, Bangkok, Thailand*.
- Lucchetti, R. and Sterlacchini, A. (2004), "The adoption of ICT among SMEs: evidence from an Italian survey", *Small Business Economics*, Vol. 23, pp. 151-68.
- Malhotra, N.K. (2004), *Marketing Research: An Applied Orientation*, Prentice-Hall, Upper Saddle River, NJ.
- National SME Council Secretariat (2005), *Definitions for Small and Medium Enterprises in Malaysia*, National SME Council Secretariat, Bank Negara Malaysia, Kuala Lumpur.
- Norman, G.R. and Streiner, D.L. (1994), *Biostatistics: The Bare Essentials*, Mosby, St Louis, MO.
- Nunnally, J.C. (1978), *Psychometric Theory*, McGraw-Hill, New York, NY.
- Ong, J.W. and Hishamuddin, I. (2008), "Sustainable competitive advantage through information technology competence: resource-based view on small and medium enterprises", *Proceedings of the 10th International Business Information Management Association (IBIMA) Conference on Innovation and Knowledge Management in Business Globalisation, Kuala Lumpur, Malaysia*, pp. 57-65.
- Organization for Economic Cooperation and Development (2000), *Information Technology Outlook 2000: ICTs, E-Commerce and the Information Economy*, OECD, Paris.
- Ratnasingam, P. (2001), "Electronic commerce adoption in Australia and New Zealand", *Malaysia Journal of Computer Sciences*, Vol. 14 No. 1, pp. 223-42.
- Robert, J. (1998), "Small business IT hang-ups", *Computer Reseller News*, Vol 74 No. 2, pp. 26-32.
- Rogers, E.M. (1983), *Diffusion of Innovations*, Free Press, New York, NY.
- Rose, G., Khoo, H. and Straub, D. (1999), "Current technological impediments to business-to-consumer electronic commerce", *Communications of the Association for Information Systems*, Vol. 1 No. 16, pp. 1-74.
- Sekaran, U. (2003), *Research Methods for Business: A Skill Building Approach*, Wiley, New York, NY.
- Singh, M. (2000), "Electronic commerce in Austria: opportunities and factors critical for success", *Proceedings of the 1st World Congress on the Management of Electronic Commerce, Hamilton, Ontario, Canada*.
- Slyke, C.V., Belanger, F. and Comunale, C.L. (2004a), "Factors influencing the adoption of web-based shopping: the impact of trust", *Database for Advanced in Information Systems*, Vol. 35 No. 2, pp. 32-49.
- Slyke, C.V., Belanger, F. and Hightower, R. (2005), "Understanding gender-based differences in consumer e-commerce adoption", *Proceedings of the 2005 Southern Association for Information Systems Conference, Savannah, GA*.
- Slyke, C.V., Lou, H., Belanger, F. and Sridhar, V. (2004b), "The influence of culture on consumer-oriented electronic commerce adoption", *Proceedings of the 7th Annual Conference of the Southern Association for Information Systems, Savannah, GA*.
- (The) Star (2008), "SMEs can ride out hard times", available at: www.thestar.com.my/news/story.asp?sec = nation&file = %2F2008%2F8%2F18%2Fnation%2F22110974
- Syed, S.A., Ali, K., Hishamuddin, B.I. and Ismail, A. (2005), "Perceived benefits of e-commerce adoption in the electronic manufacturing companies in Malaysia", *Journal of Social Sciences*, Vol. 1 No. 3, pp. 188-93.
- Tan, K.S., Chong, S.C. and Uchenna, C.E. (2009), "Factors influencing the adoption of internet-based ICTs: evidence from Malaysian SMEs", *International Journal of Management and Enterprise Development* (in press).

-
- Tan, M. and Teo, T.S.H. (2000), "Factors influencing the adoption of internet banking", *Journal of the Association for Information Systems*, Vol. 1 No. 5, pp. 1-42.
- Teo, T.S.H. and Pok, S.H. (2003), "Adoption of WAP-enabled mobile phones among internet users", *The International Journal of Management Science*, Vol. 31 No. 6, pp. 483-98.
- Wymer, S. and Regan, E. (2005), "Factors influencing e-commerce adoption and use by small and medium businesses", *Electronic Markets*, Vol. 15 No. 4, pp. 438-53.

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