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Drivers and Restraints in Adopting Information Technology in Firms in E-Business: A Chinese Perspective

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Abstract

This paper studies factors in information technology adoption, on both firm level and individual level, to help further understand organizational innovativeness. Especially, business-strategic and tactical factors affecting the adoption, and particular assimilation-related factors, are studied among interactive firms, also the ways the factors are related. This paper adds to the earlier literature in recognizing and combining factors behind reasoning for and against adopting new technology innovations, on various reasoning-levels. Literature, so far, has been scattered among those, while adoption and assimilation in general have been well modelled. We need to better understand what is significant as the driving and hindering forces for firms when making decisions about adopting new technology and assimilating it. This study is part of a wider, intercultural research and presents findings of our study in China. It shows the meaning of issues related to spreading new technology. We should look at negative factors affecting new technology adoption as the most important issue.

Keywords

IT-Adoption, drivers, restraints, business, China

INTRODUCTION

This paper reports a quantitative study on driving and restraining factors in firm adoption of new information technology [IT], and the role of particular factors in IT-assimilation within firms, further detailed later, for electronic, interactive business. The study reported here addresses a context differing from most of the earlier research, taking a perspective of organization-level IT-adoption and assimilation in firms, combined with the individual-level perspective. This is to provide a view on factors that are important in firm management to consider. Although having started from our view of a research gap and our interests, this study acts as a response to Venkatesh et al. (2007) who call for an alternative perspectives to largely social-psychology –based research for studies on technology adoption.

Decreased firm performance has been found a consequence of shortcomings in firm interactivity (McMillan 2002). In addition to environment-related considerations of Zhu, Kraemer and Xu (2006), we see that employee health and well-being effects (Day et al. 2010) can be turned to positive through developed IT/IS. IT solutions can help create sustainable interactive business for more secured future both economically and environmentally, also for better potential for future customers and employees (Day et al. 2010), and value creation for a business (Zhu et al. 2006).

The paper is structured as follows: The present section gives an overview of the research, its aim, need and completion, as well as benefits from it. The next section reviews literature relevant to the research, and discusses prominent theories as grounding this study. The fourth section reports and discusses methodology, and the fifth, our findings. Lastly, conclusions are drawn and further research ideas and -conduct are discussed. This study is a

part of a wider research conducted in various countries and reported elsewhere; here, we provide results of an analysis on survey data on one country. The data was gathered through a survey among Chinese firms during winter 2013 – 14. Conclusions are here made based on these one-country results. China is an interesting context for the study with its long high growth-rate in economy and increasing opening to world trade. The study in different context (for example in Europe) may produce different results, because ICT adoption is significantly associated with cultural factors (Erumban and de Jong 2006).

LITERATURE REVIEW

The academic society already knows much about the state of e-Business that, defined by Ahlfors (2005, 2010), is interactive business which, through information and communication technology, includes, supports and enables e-commerce and information and relational exchange. We also know of Internet adoption (Lam et al. 2005; Soliman and Janz 2004; Poon and Swatman 1997), and of diffusion of innovations (Rogers 1962; 2003). Rogers' theory sees the adoption of an innovation as a social process, taking an individual level decision-making perspective in a social setting.

Technology diffusion (Rogers 1962; 2003) is generally viewed in the context of society, population, and following Fichman (2000), across the population of organizations. Also a term used widely in business studies, penetration of an innovation in the markets, depicts the same phenomenon (Ahlfors 2005; 2010; Dewan et al. 2005). Assimilation of [technology] innovations is viewed either as a process within organizations (Agarwal and Tanniru 1992; Fichman 2000; Zhu et al. 2006) or as an outcome state of an adoption (Davis 1989, Fischbein and Ajzen 1975) process, the width and depth of an innovation spread in an organization (Fichman and Kemerer 1997). E-business assimilation has been found to be lacking or incomplete in many firms in spite of organizational adoption of computer-aided business (Fichman et al. 1997). The use of diffusion theory in understanding assimilation in Zhu et al. (2006) may, with all its merits that we are glad to acknowledge, be somewhat confusing the reader at times, in the conceptual mix, and also on the level of discussion between organization and country-environments. A clear distinction between the concepts however is made in Fichman (2000), and also Fichman and Kemerer (1999).

Zhu et al. (2006) define assimilation as a three stage process of initiation, adoption and routinization, approaching this assimilation process (Agarwal et al. 1992), from a diffusion perspective, yet as diffusion as assimilation at the firm level (Zhu et al. 2006). This view can be seen as taking an organizational level approach toward technology innovations. Managerial issues and global scope in their work are such that our paper includes in "organizational reasoning", firm size we see as a contextual factor that is out of the scope of this study. We deploy a view of decision-making and action when addressing individual and corporate-level reasoning on adoption, which is much the approach of also Gallivan (2001). Contextual factors in Zhu et al. (ibid.) are competition intensity and regulatory environment. In this study, we include these in the organizational reasoning level, including also other external and internal environment-related topics, following literature as detailed in the subsection "Corporate-level reasoning".

Technology assimilation, as an outcome of an adoption process at organizational and individual levels, is the widespread use of technology, as said earlier, which represents our definition of assimilation. This widespread use can be defined through share of innovation usage of all activity in a particular setting (Zhu et al. 2006) or through general deployment of the innovation (Cooper and Zmud 1990), which is seen as prominent share of individuals regularly using it. Assimilation requires an individual adoption process that may take a shorter or longer time, for the organization-adopted innovation to become an integral part of the firm's value creation (Cooper and Zmud 1990). Jaspersen et al. (2005) state that most IT users apply a narrow band of features, operate at low levels of feature use, and rarely initiate extensions of the available features in their work systems.

Table 1 depicts research approaches on IT adoption and assimilation, on different levels of inquiry or reasoning. In this table 1, assimilation is divided based on approaches of researchers, into process and state.

Table 1 Research on IT adoption and/or assimilation, by approach

Research approaches on IT adoption and assimilation *)									
Author(s)	Approach, perspective			Conceptual approach		Level			
	IT/ IS	Business	Other	Adoption	Assimilation		Individual	Firm	Other
					Process	State			
Agarwal and Tanniru 1992	x				x			x	
Ajzen, 1971; 1985			x	x			x		
Ajzen & Fischbein 1980			x	x			x		
Ajzen & Sheikh 2013			x	x			x		
Ajzen 1991		x	x	x				x	
Bhattacharjee and Lin 2014	x	x		x			x		
Cooper & Zmud 1990		x			x			x	
Davis 1989; Davis et al. 1989	x			x			x		
Dewan et al. 2005	x			x					x
Durbin et al. 2004		x		x			x	x	
Fichman 2000	x				x			x	
Fichman & Kemerer 1997	x				x			x	
Fichman & Kemerer 1999	x				x			x	x
Fischbein & Ajzen 1975				x			x		
Jasperson et al. 2005	x			x			x	x	
Kearns & Lederer 2004	x	x		x				x	
Lee et al. 2004		x		x				x	
Rogers 1962;2003		x	x					x	x
Smith and Kumar 2004		x	x					x	
Soliman and Janz 2004	x	x	x					x	
Swanson 1994		x		x				x	x
Venkatesh and Davis, 2000	x	x		x	x		x		
Venkatesh et al. 2003	x			x			x		
Venkatesh et al. 2007	x	x		x			x		
Zhu et al. 2006	x	x		x	x			x	x

*) The size of marks shows major perspective if applicable, when more than one is applied.

Citing Fichman (2000), in companies, the task of deciding when and how to innovate is not an easy one. It follows from the previous discussions that we see a need to understand both organizational and individual level factors in adopting new technology, to understand factors in firm technology innovation, and in adopted technology assimilation as an integral part of firm activity. The level of approach in studies in Table 1, may or may not differ in semantics from the level of reasoning that we address next; the level on which the decision or action takes place.

RESEARCH OBJECTIVES AND EMPIRICAL STUDY

An objective in this study is to clarify and analyse factors affecting, and characteristics of, adopting new IT innovations. Increased understanding of the factors in adoption decisions and technology assimilation is sought. Based on our integrative literature study on scientific fields of business, information technology and communications, we formulated two research questions. A suggestive theoretical model is formed through factors in firm IT adoption, which is addressed in research question 1. TPB is made use of, with its categorization of behavioural outcomes into positive and negative. Also TAM-versions are made benefit of and modified into a suggestive conceptual model, described through question 2 concerning key factors in assimilating new IT. Evaluation of item-factors for this was made based on literature, which helped reduce probability of potential bias.

The leading research problem here is to find out what is significant to consider in firm IT-adoption and assimilation. Following the literature study, we see it important to find out which factors of those found in the literature affect positively and/or negatively, and which are significant on firm level decision-making on IT-adoption. Also, which factors are significant in assimilating IT within the firm processes and among personnel. Following from that, the next two research questions are derived from this main research problem:

Q1: Which are significant factors in firm decision-making on IT-adoption, and in assimilating IT?

Q2: Are technology compatibility, training, personal experience, visual features of technology, usefulness, and user-friendliness of technology key factors for technology assimilation within firms?

A survey was designed for China in winter 2013 – 2014. Our conceptual framework from the integrated literature review above formed a basis for detailed questions. The questionnaire was translated from English into Chinese, and a test survey resulted in two types of corrections. All organizational levels were sought as respondents, to avoid biases from using merely key informant sampling on organizations. Data was collected by administering the questionnaire among Chinese firms in an event where firm representatives were gathered. Respondents rated their level of agreement or view of importance of factors, on five main topics. A 5-point Likert scale was used; the scale-items are depicted further in the text.

Respondent Profile

Our sample included 46 firm responses, two of which contained no background information (Table 2). The respondents represented typically big companies (~ 55 %). Small companies are represented by less than one tenth and SMEs by roughly one third. Three types of positions in firms are represented; the managerial, specialist and staff member positions. Managers and specialists form together a 57-percent subsample and staff members about a 41-percent subsample. About two thirds or respondents use IT for more than half of their working time, one third for over 75 percent of their time. (Table 2.)

Table 2 Descriptive respondent statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Personnel number	44	2	8	5,82	1,920
Respondent position in company	44	2	5	4,02	1,131
IT-use, % of work hours	44	1	4	3,05	,888
Valid N (listwise)	44				

Measurement Items

The *first*, dependent, variable Business Development addresses the development of the business, based on 9 items: 1) We have a developed online website; 2) We have or are planning mobile-based e-business; 3) We do not use online or mobile applications, other than an online presentation website; 4) Information technology is used to run our important work processes; 5) We use an integrated information system to cover processes within the organization; 6) Our organization has acquired or plans to acquire security applications for our electronic

activities; 7) I use email as the only ICT-application; 8) I use a variety of applications; and 9) I use instant messaging in work-communications. Scale: 1 = strongly disagree; 5= strongly agree; N/A = non-applicable.

The *second*, independent, variable, Firm Approach to Customer and Supply Chain Interaction, is about the interaction of firms with their stakeholder environment and coordination for it, revealing the state of affairs and attitudes. The variable-claims are: 1) Our organization uses multiple technologies for citizen-initiated communication; 2) Our customers do not need multiple channels for communicating with our organization; 3) End-users in our organization are usually adopters of mobile communication technologies; 4) Online activity is not important to us; 5) Our partners use the same information & communication technologies as we do; 6) Our partners co-align their technologies with us; and 7) We need to coordinate our internal technologies better (Ahlfors 2005; McMillan 2002). Scale: 1 = strongly disagree; 5= strongly agree; N/A = non-applicable.

The *third*, independent, variable Positive Impact Factors in Firm new IT Adoption contains suggestive drivers for adopting new IT into organizations, based on the literature. The 24 items included are 1) productivity, 2) internal capabilities, 3) alignment of processes, 4) economies of scale, 5) availability of resources, 6) price offer, 7) being up-to-date, 8) co-operation (between entities), 9) partner/peer use, 10) differentiation, 11) citizen demand, 12) new possibilities, 13) security of information, 14) security of technology, 15) technology compatibility, 16) management percept-ion of technology importance, 17) number of actors in society, with similar or related tech-based products/ services, 18) training, 19) smoothness of work flow, 20) flexibility in working hours, 21) continuity management of tasks, 22) occupational integrity, 23) environmental considerations, such as energy, waste, storage, recycling, etc., 24) health and safety. (Ahlfors 2005; 2010; Cooper and Zmud 1990; Fitzpatrick and Burke 2003; Fuglseth and Groenhaug 1994; Heikkilä and Heikkilä 2003; Hoogeweegen et al. 1999; Kearns and Lederer 2004; Longstaff et al. 2000; McMillan 2002; Poon and Swatman 1997; Scarpetta and Tressel, 2004; Weber and Kantamneni 2002; Zhu et al. 2006.) Scale: 1 = not important; 5= very important; N/A = non-applicable.

The *fourth*, independent, variable Negative Impact Factors in Firm new IT Adoption, addresses negative impact factors on adopting new information technology into organizations: 1) productivity; 2) internal capabilities; 3) alignment of administrative processes; 4) availability of resources; 5) price; 6) co-operation (between entities); 7) partner/peer use; 8) citizen demand; 9) security of information; 10) security of technology; 11) technology compatibility; 12) management perception of technology importance; 13) number of actors in society, with similar or related tech-based products/services; 14) training (requirements); 15) smoothness of work flow; 16) other; what? (Heikkilä and Heikkilä 2003; Longstaff et al. 2000; Reijonen and Heikkilä 2000; Scarpetta and Tressel 2004; Weber & Kantamneni 2002; Zhu et al. 2006). Scale: 1 = not important; 5= very important; N/A = non-applicable.

The *fifth*, independent, variable to measure, Key Factors in Assimilating IT is a construct of suggestive factors in individual adoption of technology in firms, for IT- assimilation. The survey question reads: "Please, consider the importance of factors in spreading the new technology into use within the organization (considering cross-functional but also employee/end user concerns", with 1) technology compatibility; 2) training, 3) personal experience with particular technology, 4) visual features of technology; 5) perceived usefulness of technology; 6) perceived user-friendliness of technology; 7) other; what? The variables chosen are based on the differing TAM model versions in literature study and researcher considerations on their potential importance/applicability, based on researcher prior knowledge. Scale: 1 = not important; 5= very important; N/A = non-applicable.

Analysis

The tests consist of descriptive statistics, ANOVA-tests and correlation tests. For the first merged variable, Business Development, in Table 3, reliability testing brought a satisfactory Cronbach's coefficient ($\alpha = .7$) on inter-item consistency.

Table 3. Merged Variable 1: Business Development

Developing online website
Planning mobile-based e-business
Using only online presentation websites
Using information technology to run important work processes
Using an integrated information system to cover processes within the organization
Acquiring or planning to acquire security applications for our electronic activities. Using email as the only ICT-application
Using a variety of applications
Using instant messaging in work-communications

In merged variable 2, Firm Approach to Customer- and Supply Chain Interaction (Table 4), the dimensions for two items were reverse-coded. For acceptable internal consistency, the coding was changed on the second and fourth item. The resulting alpha level ($\alpha = .65$) is a satisfactory inter-item coefficient (Sekaran and Bougie 2013).

Table 4. Merged Variable 2: Firm Approach to Customer- and Supply Chain Interaction

Use of multiple technologies for citizen-initiated communication
Not needing multiple channels for communicating with our organization
Adopting mobile communication technologies End-users in our organization
Having online activity less important to us
Using the same information & communication technologies with our partners
Co-aligning technologies with our partners
Coordinating our internal technologies better

The merged variable 3 in Table 5, Positive Impact -Factors in Firm new IT Adoption, has 24 components that are grouped according to their internal, external, or both internal and external characteristics. Cronbach's alpha for this construct is very high ($\alpha = .95$).

Table 5. Merged Variable 3: Positive Impact -Factors in Firm new IT Adoption

<u>Internal</u>	<u>External</u>	<u>Internal & External</u>
Productivity	Price offer	Security of information
Internal capabilities	Being up-to-date	Security of technology
Alignment of administrative processes	Co-operation (between entities)	Technology compatibility
Economies of scale	Partner/peer use	Number of actors in society, with similar or related tech-based products/services
Availability of resources	Differentiation	Continuity management of tasks
Management perception of technology importance	Citizen demand	Environmental considerations (such as energy, waste, storage, recycling, etc.)
Training	New possibilities	
Smoothness of work flow		
Flexibility in working hours		
Occupational integrity		
Health and safety		

Table 6 presents the level of importance of negative impact factors on adopting new ICT technologies into organizations. This Merged Variable 4 was created from the item-variables in the question and, as in the previous, its components are grouped in the table according to their internal, external, or both internal and external character. Also here, the Cronbach's coefficient alpha is very high ($\alpha = .97$).

Table 6. Merged Variable 4; Negative Impact -Factors in Firm new IT Adoption

<u>Internal</u>	<u>External</u>	<u>Internal & External</u>
Productivity	Price	Security of information
Internal capabilities	Co-operation (between entities)	Security of technology
Alignment of administrative processes	Partner/peer use	Technology compatibility
Availability of resources	Citizen demand	Number of actors in society, with similar or related tech-based products/services
Management perception of technology importance		Other; what?
Training (requirements)		
Smoothness of work flow		

Next, we created the merged variable 5, Key Factors in Assimilating IT, as in Table 7. Cronbach's alpha for this merged variable, also, is high ($\alpha = .88$).

Table 7. Merged Variable 5: Key Factors in Assimilating IT

Technology compatibility
Training
Personal experience with particular technology
Visual features of technology
Perceived usefulness of technology
Perceived user-friendliness of technology
Other; what?

FINDINGS

All five merged variables agreed with the normal distribution. Descriptive statistics on these are as follows (Table 8):

Table 8. Descriptive Statistics on Merged Variables

	Business Development	Firm approach to customer- and supply chain interaction	Positive impact - factors in adopting new IT/ICT into organizations	Negative impact - factors in adopting new IT/ICT into organizations	Key factors in assimilating IT
n	44	46	46	46	46
Minimum	1.89	1.29	1.79	1.13	2.14
Maximum	4.67	5.00	5.00	5.00	5.00
Mean	3.58	3.25	3.87	3.31	3.95

The lowest mean-value is found for firm approach to customer- and supply chain interaction. The highest values, meaning most importance given by respondents, by descriptive means, are found for the importance of factors in assimilating IT within the firm. Data agreed with the normal distribution.

In Table 9, p-values produced by the ANOVA tests are presented. The highest significance ($p = .009$) is for difference between negative factors in adoption decision and key factors in assimilating new technology, through their importance.

Table 9. ANOVA p-values

	Firm approach on customer- and supply chain interaction	Positive impact - factors in adopting new IT/ICT into organizations	Negative impact - factors in adopting new IT/ICT into organizations	Key factors in assimilating IT
Business Development	.213	.056	.033	.144
Firm approach on customer- and supply chain interaction		.062	.811	.050
Positive impact -factors on adopting new IT/ICT into organizations			.511	.577
Negative impact -factors on adopting new IT/ICT into organizations				.009

Correlation tests on particular item-variables related to SN in TRA/TPB produced the significant results for associations between the subjective norms –related and business development –related variables (see Table 10 on the next page).

Table 10. Significant SN-related Pearson correlations and p-values

Level	Firm	Firm	Individual	Individual	Firm	Firm	Firm	Firm
Variable	Using IT to run important work processes	Using integrated IS to cover processes	Using a variety of apps	Using instant messaging in work-communication	Being up-to-date	Co-operation	Partner/peer use	Citizen demand
Using IT for important work-processes	1	.490** .001		.530** .000				
Using integrated IS to cover processes	.490** .001	1	.325* .038					
Using a variety of applications		.325* .038	1			.345* .029		
Using instant messaging in work communication	.530** .000			1	.580** .000	.451** .004	.397** .009	.356* .021
Being up-to-date				.580** .000	1	.778** .000	.471** .001	.540** .000
Co-operation			.345* .029	.451** .004	.778** .000	1	.625** .000	.550** .000
Partner/peer use				.397** .009	.471** .001	.625** .000	1	.368* .012
Citizen demand				.356* .021	.540** .000	.550** .000	.368* .012	1

CONCLUSIONS

The paper contributes in showing that the variables related to assimilating new information technology and positive impact factors in IT adoption are the most important issues when evaluating IT adoption. While looking at the ANOVA analysis we can find that there are significant differences between merged variable 1, Business Development, and merged variable 4, Negative Impact –Factors, and also between merged variable 4, Negative Impact –Factors, and merged variable 5, Key Factors in Assimilating IT. This shows the significance of understanding the meaning of negative factors that will restrain firms from adopting new IT solutions.

The paper shows that SN of TRA/TPB is a significant factor also in firm-level IT-adoption; it has been studied earlier on individual-level. Also internal/external factors of TRA/TPB are in line with our study, and such have not been studied earlier. The study aids managerial decision-making, adding knowledge of IT/ICT providers as well as customer-side managers in IT-adoption issues. Managers can see what affects and which reasons are in interplay in arguments for and against initializing new technology adoption.

This study also shows that we should understand issues affecting the spreading of new technology and the positive factors affecting IT and ICT adoption in organizations. As this study is based on one data source, China, with a relatively small sample of 46 firm responses, more research and data are needed to better see what is motivationally important for firms in adopting and assimilating new IT. A note on the made correlation tests on SN-related associations in this study is in place: these tests act, as said, to find associations between the subjective norms –related and business development –related variables; they do not try to measure causality. We will continue our research, on a bigger sample and various tests, also extending our research from a Sino culture to Western cultures. This will include using multiple statistical methods (for example regression analysis) and interviews. Several topics need more understanding, in addition to the mentioned cultural issues. One of those is whether personnel position and/or their age affect in what is significant in assimilating adopted information technology.

Various positional and age groups among personnel responses should be analysed on the factors affecting technology assimilation within firms.

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