THE TECHNOLOGICAL, ORGANIZATIONAL AND ENVIRONMENTAL FRAMEWORK OF IS INNOVATION ADAPTATION IN SMALL AND MEDIUM ENTERPRISES. EVIDENCE FROM RESEARCH OVER THE LAST 10 YEARS

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Abstract:
This paper relies on the technological innovation adoption literature and uses the technological-organizational-environmental (TOE) framework to analyze the factors influencing new information systems (IS) adoption in small and medium-sized enterprises (SMEs). Even though the TOE framework has not seen much development in the last years, research on the TOE framework can take a number of directions in the future, because novel contexts of adoption and new technologies are persistently being developed. This paper undertakes a review of the literature on IS adoption in SMEs during the last decade (2004 to 2015) and identifies the main variables influencing the adoption process. In doing so, we try to see if any changes in the patterns of IS adoption from SMEs are present and look for emerging research topics and gaps in the field of SME and IS innovation adoption in the last decade.

Keywords:
SME, technology innovation, information systems adoption, technology-organization-environment framework

JEL Classification: L21, O32, M15

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Introduction

Small and Medium-sized Enterprises (SMEs) cannot ignore the technological advancements taking place rapidly. In the knowledge society, firms need to develop competitive advantages based on adequate and intensive use of information systems (IS), which are essential sources of innovation and success in today’s market. The innovation orientation of enterprises is an important aspect that encourages the IS adoption process. SMEs face tremendous challenges in their efforts to pursue technological innovations and their survival depends often on the use they make of information systems to develop new organizational models, compete in new markets or enhance their internal and external communication relationships. IS are considered to be an important and fast growing technological innovation providing to businesses the opportunity to improve their efficiency and effectiveness and even gain competitive advantage (Porter and Millar, 1985), (Ives and Learmonth, 1984). Comparing to large businesses, small business have been slow in adopting technological innovations. Large firms can take greater risks associated with innovation adoption, because they have more resources and greater economies of scale (Thong, 1999), (Kuan and Chau, 2001), (Zhu et. al., 2003). It is critical for small businesses to benefit from new IS, because small businesses constitute the large majority of all business in many economies (Thong Y.L., 1999). The large number of SMEs reveals their importance as an essential source of jobs. According to Ritchie and Brindley (2005), SMEs are significant because of their entrepreneurial spirit and adaptive capabilities and as drivers of economic growth and innovation by fostering competitiveness (Levy and Powell, 2005). Through their knowledge SMEs are able to innovate on products or processes that help them create a competitive advantage and generate more profits (Loh and Koh, 2004). Information systems provide mechanisms for getting access to new market opportunities and specialized information (Fulantelli and Allegra, 2003). Benefits of SMEs that adopt IS are increased productivity, increased efficiency of internal business operations and more easily and cheap connection to external contacts. Other benefits are increased business competitiveness, vertical integration with other related business, stakeholder and institutions, improved networking with other parties etc. (Levy and Powell, 2005). According to Stockdale and Standing (2004), the benefits of participating in e-marketplaces are the product differentiation and supply chain entry. Besides the positive aspects of IS adaption, employees often refuse to adopt a new technologies because of the perceived danger of job loss or unwillingness to change their working practices. As a consequence, SME owners are often reluctant to bring their business through a learning curve which proves to be difficult, disruptive and costly (Love et al., 2001). One of the major criticisms of technology adoption research is that adoption is mainly viewed as a dichotomous outcome (either the innovation is adopted or not adopted). However, the adoption versus non-adoption approach does not fully address the issue of technology adoption (Hovav et. al., 2004), (Daniel et. al., 2002). This paper helps to increase understanding why some SMEs choose to innovate their information systems, while seemingly similar ones facing similar conditions do not.

We investigate the impact of a number of factors, extracted from the technological innovation literature that influence IS adoption in SMEs. Based on the theoretical background of technological
innovation, we provide a review and analysis of different articles. These articles are then compiled in a summary table and sorted according to the methodology, type of research (qualitative or quantitative) and the context and factors that influence IS adoption in SMEs. An additional classification is undertaken based on the variables identified from the technology-organization-environment (TOE). Finally, we discuss the observations and include recommendations for future research.

2 The theoretical background and characteristics of technological innovation adoption

In this paper, we use the technological innovation literature as a theoretical reference. Research indicates that technologically innovative companies may outperform their competitors (Geroski et al., 1993). Technological innovation has been subject of extensive theoretical and empirical studies and is now widely acknowledged as an important determinant of sustained superior performance (Blundell et al., 1999). An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 2003, p.12). An innovation in ICT, does not refer only to a technology renewal, but it refers also to renewal in terms of thought and action (Thong 1999, p.190). Technological innovation consists of two related but distinct factors:

(1) Finding innovation in existing ICT,

(2) If unsuccessful, deciding to adopt more advanced (ICT) innovations.

On the other hand, the adoption of technological innovations per itself may be described as consisting of a sequence of 3 stages: initiation, adoption and implementation (Pierce and Delbecq, 1977), (Thompson, 1965). In the initiation stage the information about the technological innovation is gathered and evaluated. During the adoption stage a decision regarding the adoption of the technological innovation is made and in the third stage, if the decision goes in favor of the adoption, the implementation of the technological innovation in the enterprise takes place.

Researchers suggest that there are also some functional parallels between IS adoption and technological innovation adoption (Thong Y. L., 1999). Four are the dimensions along which the characteristics of an innovation differ (Poutsma et. al., 1987). We distinguish between product innovations, process innovations, as well as radical and incremental innovations. Product innovations involve the development, production and dissemination of new consumer and capital goods and services. Process innovations improve the production process by introducing new methods, machines and production systems which apply not only to the traditional definition of production but also to distribution, data processing and services. IS adoption falls under the category of process innovation (Poutsma et. al., 1987). Incremental innovations encompass minor improvements or simple changes in current technology. Contrary to that, radical innovations represent fundamental and revolutionary changes in technology (Dewar and Dutton, 1986). IS innovations represents radical innovations. Moreover, innovations may occur because of technology-push or market-pull. Technology-push implies developing and offering an innovation in
a matured form in the capital-goods market. The market absorbs the innovation because of the superiority of the new innovation as well as the pressure and the competing suppliers. In a market-pull the new technology is developed because of an acknowledged social need. Both, technology-push as well as market-pull are also influencers of IS adoption (King et. al., 1994). Another differentiation can be made based on the way in which an innovation takes place. Hereby we distinguish between planned and incidental innovations. Planned innovations are carried out according to plan from the business side that aims to control the market through the innovation, while incidental innovations occur as a specific reaction of a business to a new market demand. Both approaches apply in the adoption of IS.

**Figure 1: Dimensions and characteristics of technological innovations**

| Dimension                | Characteristics                  |
|--------------------------|----------------------------------|
| Nature of Innovations    | Process vs. Product              |
| Complexity of Innovations| Radical vs. Incremental          |
| Motivation of Innovations| Technology-push vs. Market pull   |
| Timing of Innovation     | Planned vs. Incidental           |

*Source: Own adjustment based on (Rogers E. M., 2010), (Thong, 1999) and (Kuan and Chao, 2001).*

3 Literature review

To identify the focus and influencing factors of the adoption of new IS in SMEs, we have performed a literature review that covers articles published from 2004 to 2014. Literature reviews represent a well-established method for accumulating existing knowledge within a domain of interest. Abstracts and contents of 87 articles were carefully read to check for their relevance. The selected articles were published in scientific journals and conference proceedings. An initial search of the articles was performed in Google Scholar and ProQuest using the keywords: SME, information systems, innovation adoption, technology-organization-environment (TOE) framework. The keywords for the search are used in different combinations. After identifying the relevant literature, only articles directly addressing IS adoption in SMEs were selected. The selection process was based on the author, year of publishing, type of study (qualitative or quantitative), type of IS being adopted, methodology, data, context of the study, focus and influencing factors. We have used a review approach with explicit procedures and conditions that minimize bias. The analyzed articles are illustrated in a summary table as illustrated below.
| Author and Year | Type of study | IS/IT adaption | Focus and influencing factors | Methods | Data and context |
|-----------------|---------------|----------------|------------------------------|---------|-----------------|
| (Alam & Noor, 2009) | Qualitative and Quantitative | IT adoption and usage | relationship between ICT adoption in SMEs and perceived benefits & cost, ICT knowledge, external pressure and government support | cross sectional survey addressed to the owner and/or manager of SMEs | 180 SMEs in Malaysia |
| (Buonanno et al., 2005) | Quantitative | ERP adoption | identification of business and organizational factors (such as: business complexity and organizational change) influencing ERP adoption | questionnaires and interviews addressed to top managers | 366 companies of any size (SMEs & large) |
| (Grandon and Pearson, 2004) | Quantitative | E-commerce adoption | examination of determinants of adoption such as: operational support, managerial productivity, and strategic decision | Internet survey of top managers | 100 surveys in USA |
| (Scupola, 2009) | Qualitative | B2B E-commerce adoption and implementation | proposing a TOE model of E-commerce adoption and implementation | Literature review, questionnaire and face to face interviews with CEOs | 4 Danish and 4 Australian SMEs |
| (Ramdani & Kavalek, 2009) | Quantitative | ERP, CRM, SCM and e-procurement adoption | develop a model that can be used to predict which (SMEs) are more likely to become adopters of enterprise systems | Direct interviews, logistic regression | 102 SMEs in Northwest England |
| (Oh et al., 2009) | Qualitative and Quantitative | E-trade adoption | examine what factors are associated with the adoption of E-trade by Korean SMEs | Questionnaires, regression, factor analysis, cronbach alpha, discriminant analysis | 193 SMEs in South Korea |
| (Shiau et al., 2009) | Quantitative | ERP adoption | development of measures to assess the ERP adoption of SMEs | survey data were analysed by structural equation modelling (SEM) | 126 SMEs in Taiwan |
| (Haug et al., 2011) | Qualitative | IT readiness/IT adoption | presenting a framework for analyzing IT readiness' | 3 longitudinal case studies, Literature review | 3 SMEs |
| (Federici, 2009) | Quantitative and Quantitative | ERP adoption | ex post evaluation of an ERP system adoption. Collection of actual achievement, advantages and context/characteristics of ERP systems | Direct interviews with SMEs’ managers | 50 SMEs in Italy |
| (Gutierrez et al., 2009) | Quantitative | IT and business alignment | 5 attributes are ranked for each of the following alignment factors: communication, competency, value measurement, governance, partnership, architecture and scope and skills. | Online and telephone survey, ANOVA | 104 surveys from organisations all over the globe |
| (Chao and Chandra, 2012) | Quantitative | IT adoption and strategic alignment | impact of owner’s knowledge of IT on business, IT strategic alignment and use in the small firm context | email survey to the owner of the small business | 217 small manufacturers and financial services firms in the USA |
| (Zeller and Schauer, 2011) | Qualitative | adoption of social media initiatives for team collaboration | analyze the adoption, implementation, motivation of team members, benefits and success factors of social media utilisation for team collaboration. | in-depth analysis of multiple case studies | 6 case studies of European SMEs |
| (Esteves, 2009) | Qualitative | ERP usage | develop a benefits realization road map for ERP usage in SMEs | direct interviews | 48 MBA students and 87 business managers |
| (Raymond and Bergeron, 2008) | Qualitative and Quantitative | e-business and business strategy alignment | e-business and business strategy alignment in SMEs in terms of Miles and Snow’s strategic typology, including prospectors, analyzers, defenders | contingency theory perspective, correlation analysis | 197 Canadian manufacturers |
| (Loth and Koh, 2004) | Quantitative | ERP implementation | examine critical elements of successful ERP implementation in SMEs | literature review and interviews | 8 SMEs in the UK |
| (Angelis-Oria and Padilla-Melendez, 2006) | Quantitative and Qualitative | Internet adoption | explore factors affecting the implementation of Internet technologies and the extent to which company size, as organizational factors, influences the process. | Innovation adoption theory, questionnaire, online survey, structured interviews | 280 companies |
| (Kaynak et al., 2005) | Quantitative | E-commerce adoption | factors affecting the willingness of SMEs to adopt E-commerce usage | composite index of the usage frequency of 14 EC application tools (managers were asked) | 237 manufacturing SMEs in Turkey |
| (Doorn et al., 2010) | Qualitative | ERP implementation | examine the critical success factors of ERP implementations in Belgian SMEs and to identify those success factors that are specific to a SME environment | survey + multiple case study, Structured interview technique | 4 SMEs in Belgium |
| (Jeon et al., 2006) | Qualitative and Quantitative | adoption of E-business | Determining factors for the adoption of E-business in Korea | survey of 1200 Korean SMEs | survey of 1200 Korean SMEs |
| (MacGregor and Vazalic, 2005) | Quantitative and Qualitative | E-commerce adoption and implementation | develop a basic model of E-commerce adoption barriers to small businesses located in rural areas of developed countries | empirical survey, data analysed by correlation matrices and factor analysis | 477 small businesses in Sweden and Australia |
| (Gibbs and Krzemien, 2004) | Quantitative and qualitative | E-commerce use | determinants of scope of use among E-commerce adopters | telephone survey, stratified random sample | 2,139 establishments from three industries across 10 countries |
| (Evangelista et al., 2010) | Qualitative and Quantitative | Adoption of Knowledge Management Systems | shed light on the KM/practices in small firms. | empirical investigation, questionnaire survey through interviews with managers | 18 SMEs located in Naples City (Italy) |
| (Alshamali, 2013) | Qualitative | Cloud computing adoption | contribute to a growing body of research on cloud computing, by studying the small to medium-sized enterprise (SME) adoption process | semi-structured interviews | 15 SMEs and service providers in the north east of England |
| (Wamba S.F. and Carter L., 2014) | Qualitative | Social Media adoption | assess the impact of organizational, manager and environmental characteristics on SME utilization of the Facebook Events Page | hierarchical logistic regression | survey of 453 SMEs |

Source: Own adjustment
4 Models of technological innovation adaption and the TOE framework

There is a growing amount of theories and studies on technological innovation and technology adoption. The most common theories are the Technology Acceptance Model (TAM) (Davis 1986) (Davis et al. 1989), Theory of Planned Behavior (TPB) (Ajzen, 1985) (Ajzen, 1991), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), Diffusion of Innovation (DOI) (Rogers, 1995) and the Technology-Organization-Environment (TOE) framework (Tornatzky and Fleischer, 1990).

The review of the literature on technological innovation confirms that the majority of empirical studies refer to the “Diffusion of Innovation” or the DOI theory of Rogers as well as to the TOE framework. DOI is recognized by many researchers as being able to identify “perceived” critical characteristics of technological innovations (such as relative advantage, compatibility, complexity, observability and trialability) that may influence the attitude of potential adaptors or rejecters of IS. It was however argued that Rogers model should also be blended with other contexts or factors for a more holistic adoption approach. In line with this argument we found that the TOE framework includes the environment context (not included in the DOI theory), thus becoming better able to explain intra-firm innovation adoption and therefore more complete. The TOE framework has a solid theoretical basis and the potential for application in the IS adoption (Oliveira and Martins, 2011). It is developed by Tornatzky and Fleischer (1990) and it specifies 3 types of factors that influence the adoption and organizational usage of technological innovation. The technological context which includes both internal and external technologies that might be useful in improving organizational productivity. The organizational context, defined in terms of firm size and scope, complexity of the managerial structure, quality, characteristics and availability of firms technology and financial resources), as well as environmental (or institutional) context, which refers to the firm’s industry and dealings with business partners, competitors and government (Tornatzky and Fleischer, 1990).

The TOE framework has found regular empirical support for factors of IS adoption such as “external pressure”, “organizational readiness” (in terms of technology and financial resources), and “perceived benefits” (Iacovou et al., 1995) (Chau and Tam, 1997) (Kuan and Chau, 2001). Zhu et al. (2003) studied data from 3,100 firms to understand how technological competence, organizational factors such as “firm scope” and “size” and the environmental context influence “consumer readiness”. Zhu et al. (2003) identified “trading partner readiness” as well as “competitive pressure” as influencing factors and antecedents in e-business adoption. The TOE framework is also used to empirically validate the antecedent factors that influence EDI adoption (e.g., Iacovou et al., 1995) (Kuan and Chau, 2001) (Lippert and Govindarajulu, 2006). The identified variables are defined and summarized in the below given table:
A lot of authors used the TOE framework to understand the adoption of different IS such as: Electronic Data Interchange (EDI) (Kuan and Chau, 2001), Open Systems (Chau and Tam, 1997); Website (Oliveira and Martins 2008); E-Commerce (Liu, 2008, Martins and Oliveira, 2009), Enterprise Resource Planning (ERP), (Pan and Jang, 2008), Business to Business (B2B), E-Business (Zhu et al. 2003) (Zhu and Kraemer, 2005) (Zhu et al., 2006) (Lin and Lin, 2008) (Oliveira and Martins, 2010), Knowledge Management Systems (KMS) (Lee et al., 2009).

In the last 10 years (2004 to 2014), we encountered a growing body of research, focusing on SME adaption of new technologies such as social media, cloud computing and other Web 2.0 tools which are enjoying growing popularity. Although reports suggest that social media tools really enhance the development of SMEs, there is still little empirical evidence on their adoption and usage from this category of firms (Dixon, 2010). A TOE based framework for assessing the readiness of organizations prior to the adoption of social media has already been proposed and validated for usage in large organizations (Abeysinghe, 2013). It would be of research interest to identify critical success factors and specify alternative frameworks which would serve as guidelines for the adaption of social media in SMEs. Also a technology with great potential benefits is cloud computing. The term started to appear in Google searches in the third quarter of 2007, then
searches increased rapidly. Through the adoption of cloud computing, SMEs can lower their entry cost for powerful IT capabilities by reducing the cost of ownership for hardware and software and by reducing the IT staff. Startup expenses for SMEs may be particularly minimized through the idea of metered services. Cloud computing has also the potential to provide competitive advantage, because on-demand elasticity enables rapid scaling of resources as the SME grows (Kourik, J. L., 2011). These qualities make cloud computing another important technological innovation. Based on the reviewed literature we classified the articles according to the above specified variables of the TOE framework. The different variables were considered to be significant or insignificant to the IS adoption from various authors.

Table 3:

| Determining factors | Found significant | Found insignificant |
|---------------------|-------------------|---------------------|
| **Technological**   |                   |                     |
| 1. Relative advantage | (Alam & Noor, 2009), (Grandon & Pearson, 2004), (Ramdani & Kavealek, 2009), (Oh et al., 2009), (Shiau et al., 2009), (Esteves, 2009), (Raymond & Bergeron, 2008), (Kaynak et al., 2005), (Stockdale & Standing, 2004), (Jeon et al., 2006), (MacGregor & Vrazalic, 2005), (Gibbs & Kraemer, 2004), (Alshamaila, 2013) |                     |
| 2. Compatibility    | (Grandon & Pearson, 2004), (Doom et al., 2010), (Alshamaila, 2013) |                     |
| 3. Complexity       | (Grandon & Pearson, 2004), (MacGregor & Vrazalic, 2005) | (Buonanno et al., 2005) |
| **Organizational**  |                   |                     |
| 1. Top management support | (Ghobakhloo et al., 2011), (Parker & Castleman 2009), (Scupola, 2009), (Ramdani & Kavealek, 2009), (Shiau et al., 2009), (Haug et al., 2011), (Chao & Chandra, 2012), (Alshamaila, 2013) |                     |
| 2. Organizational readiness (size) (cost/financial and technical resources) | (Buonanno et al., 2005), (Ghobakhloo et al., 2011), (Parker & Castleman 2009), (Scupola, 2009), (Ramdani & Kavealek, 2009), (Oh et al., 2009), (Haug et al., 2011), (Aguila-Obra & Padilla-Melendez, 2006), (Kaynak et al., 2005), (MacGregor & Vrazalic, 2005), (Gibbs & Kraemer, 2004), (Evangelista et al., 2010), (Alshamaila, 2013) | (Alam & Noor, 2009), (Grandon & Pearson, 2004), (Shiau et al., 2009), (Jeon et al., 2006) |
| 3. Information intensity and product characteristics | (MacGregor & Vrazalic, 2005), (Evangelista et al., 2010) |                     |
| 4. Managerial time  | (MacGregor & Vrazalic, 2005), (Evangelista et al., 2010) |                     |
| **Environmental**   |                   |                     |
| 1. Industry pressure (competition) | (Ghobakhloo et al., 2011), (Parker & Castleman 2009), (Scupola, 2009), (Haug et al., 2011), (Stockdale & Standing, 2004), (Doom et al., 2010) | (Jeon et al., 2006), (Alshamaila, 2013) |
| 2. Government pressure/support | (Alam & Noor, 2009), (Grandon & Pearson, 2004), (Ghobakhloo et al., 2011), (Parker & Castleman 2009), (Scupola, 2009), (Jeon et al., 2006), (Gibbs & Kraemer, 2004) |                     |
| 3. Consumer readiness | (MacGregor & Vrazalic, 2005) |                     |
| 4. Support from technology vendors | (Ghobakhloo et al., 2011), (Parker & Castleman 2009), (Scupola, 2009), (Aguila-Obra & Padilla-Melendez, 2006), (Doom et al., 2010), (Evangelista et al., 2010), (Alshamaila, 2013) |                     |

Source: Own adjustment
Variables which could not be categorized (or didn’t fit) in the TOE framework, but found significant for the adaption from the respective authors are not depicted in the table. As such we identify the “CEOs/Employee knowledge of IS and innovativeness” which was found significant from several authors (Alam and Noor, 2009), (Scupola, 2009), (Shiau et. al., 2009), (Haug et. al., 2011), (Chao and Chandra, 2012), (Jeon et. al., 2006), (MacGregor and Vrazalic, 2005), (Alshamaila, 2013).

Conclusions

With new technologies and means of technology adaption that evolve constantly, there is a permanent need in understanding the organizational adoption of technological innovation, its dimensions and characteristics. The TOE framework of Tornatzky and Fleischer (1990) has proved that it is able to provide insights for researchers and practitioners interested in this topic. The adoption of IS innovations is clearly affected by the technological, organizational, and environmental contexts of the enterprise. The TOE framework has been useful in investigating a wide range of innovations and contexts. The major part of the research in the domain of IS innovation adoption in small and medium sized enterprises is concentrated on the adaption of technologies such as E-commerce, E-business, ERP, estimating the IT readiness of SMEs etc. However, for the period under investigation (2004 to 2014), we encountered a growing body of research, focusing on SME adaption of new technologies such as social media, cloud computing and other Web 2.0 tools which are enjoying growing popularity.

During the literature review, different factors that influence technological innovation adaption in SMEs could be identified and illustrated in a summary table. Among the most stated factors in the analyzed articles are the expected relative advantage, top management support, organizational readiness, IS knowledge and innovativeness. Because of the limited human resources, critical decisions in SMEs are taken from the CEO. Thong (1999) points out the importance of “characteristics of the organizational decision makers” (including CEO’s IS knowledge and CEO’s innovativeness) as a fourth element of context in the technological innovation literature beside “characteristics of the technological innovation”, “characteristics of the organization” and “characteristics of the environment”.

Concluding, for the period under investigation, we identify as a research gap the missing studies on the SME adoption of the new Web 2.0 technologies and how well their patterns of adoption do fit in the currently available frameworks of technological innovation adaption, such as the TOE framework. The ongoing technological innovation demand for permanent validation of existing frameworks and continued empirical research work. Findings presented in this study may have implications for the research community, SME managers and information and communication technology providers in terms of illustrating the status of research in this area as well as formulating better strategies and frameworks for the adaption of new IS in SMEs.
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