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# **THE TECHNOLOGICAL, ORGANIZATIONAL AND ENVIRONMENTAL FRAMEWORK OF IS INNOVATION ADAPTION 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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## 1 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 adaption**

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 adaption (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.

**Figure 2: Review and categorization of articles**

<i>Author and Year</i>	<i>Type of study</i>	<i>IS/IT adaption</i>	<i>Focus and influencing factors</i>	<i>Methods</i>	<i>Data and context</i>
(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 SME	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 determinant factors 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 adaption 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 & Kawealek, 2009)	Quantitative	ERP, CRM, SCM and e-procurement adaption	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 adoptin	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)	Qualitative and Quantitative	ERP adoption	ex postevaluation of an ERP system adoption. Collection of actual achievement, advantages and context/project characteristics	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. Resource-based view as a theoretical foundation	email survey to the owner of the small business	217 small manufacturers and financial services firms in the USA
(Zeiller and Schauer, 2011)	Qualitative	adaption of social media initiatives for team collaboration	analyze the adoption, implementation, motivation of team members, benefits and success factors of social media utilization for team collaboration.	in-depth analysis of multiple case studies	6 case studies of european SMEs
(Esteves, 2009)	Qualitative	ERP usage	develop a benefits realisation 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, and defenders	contingency theory perspective, correlation analysis	107 Canadian manufacturers
(Loh and Koh, 2004)	Qualitative	ERP implementation	examine critical elements of successful ERP implementation in SMEs	literature review and interviews	8 SMEs in the UK
(Aguila-Obra and Padilla-Melendez, 2006)	Qualitative and Quantitative	Internet adoption	explore factors affecting the implementation of Internet technologies and the extent to which company size, as an organizational factors, influences the process.	innovation adaption theory, questionnaire	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
(Doom 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	principal component analysis, empirical analyses (t-tests), linear probability model, logit model	survey of 1200 Korean SMEs
(MacGregor and Vrazalic, 2005)	Qualitative and Quantitative	E-commerce adoption and implementation	develop a basic model of E-commerce adoption barriers to small businesses located in regional areas of developed countries	empirical survey, data analysed by correlation matrices and factor analysis	477 small businesses in Sweden and Australia
(Gibbs and Kraemer, 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)
(Alshamaila, 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)	Quantitative	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 SME

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:

**Figure 2: Identified elements of the TOE framework**

<i>Technological</i>	
<b>1. Relative advantage</b>	Degree to which an innovation is perceived as being better than the idea it supersedes
<b>2. Compatibility</b>	Degree to which an innovation is perceived as consistent with existing values, past experiences and adopter needs
<b>3. Complexity</b>	Degree to which an innovation is perceived as relatively difficult to understand and use
<i>Organizational</i>	
<b>1. Top management support</b>	Support of the top management (CEO) to the IS adoption initiative
<b>2. Organizational readiness (size) cost/financial and technical resources)</b>	Comparing to large businesses small businesses face resource poverty and thus difficulties in innovation adaption. Ressource poverty manifests itself also in financial constraints and lack of professional expertise.
<b>3. Information intensity and product characteristics</b>	Degree to which information is present in the product or service of a business, reflects the level of information intensity of that product or service
<b>4. Managerial time</b>	Time required to plan and implement the new IS.
<i>Environmental</i>	
<b>1. Industry pressure (competition)</b>	Competition and high rivalry increases the likelihood of innovation adaption for the purpose of gaining competitive advantage
<b>2. Government pressure/support</b>	Government strategies or initiatives that encourage SMEs to adopt new IS.
<b>3. Consumer readiness</b>	Lack of customer readiness Influences the adoption process and is an inhibitor towards IS use

Source: Own adjustment

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 (Abeyasinghe, 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
<i>Technological</i>		
1. Relative advantage	(Alam & Noor, 2009), (Grandon & Pearson, 2004), (Ramdani & Kawealek, 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)
<i>Organizational</i>		
1. Top management support	(Ghobakhloo et. al., 2011), (Parker & Castleman 2009), (Scupola, 2009), (Ramdani & Kawealek, 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 & Kawealek, 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)	
<i>Environmental</i>		
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)	(Oh et. al., 2009)
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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