Survey of the Determinations of Business Intelligence Systems Adoption in SMEs

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Abstract. *Business Intelligence Systems (BISs) are a technological innovation, therefore it is essential to understand the determinants of information technology (IT) adoption. This paper is focused on the technology, organization, and environment (TOE) framework and BISs. The aim of the research is to compare a number of scientific papers within two fields (BISs and IT adoption).Based on the results of a comprehensive literature review, several determinants were selected as comparison variables. The expected contribution is in increasing scientific public awareness on the topic and on the potential of research in the field of the determinants of BISs adoption in SMEs.*

Keywords. Business intelligence systems, adoption, technological innovations, technology-environment-organization framework determinants, small and medium enterprises.

1 Introduction

These days, it is accepted that IT and related technological innovations are an essential tool for achieving competitive advantage and improving decision-making in a company. The benefits that a company can achieve from the use of technological innovations are diverse and important for achieving business success. These benefits cannot be fully achieved if the innovations are not properly and widely adopted (Zhu, Kraemer and Xu, 2006). Therefore, it is crucial to understand the determinants of technological innovation adoption (Karahanna et al., 1999).

The aim of the paper is three-fold: (1) to conduct a comprehensive literature review in order to identify the factors relevant for the success of BIS adoption; (2) to establish a list of TOE determinants for BIS-specific adoption factors in SMEs and (3) to compare the most emphasized determinants within two research fields (BISs and IT/IS innovation adoption) that were found in the literature.

After a short introduction, business intelligence (BI) and BISs are defined and their definitions

analysed. (Section 2).Furthermore, the importance of using BISs in SMEs is presented. In Section 3 the most important determinants of TOE framework are identified and described. The comparison between the number of papers in the field of BIS adoption and other IT/IS adoption through the TOE dimensions is presented and elaborated in Section 4. Finally, the conclusions and proposals for future research are given.

2 BIS and SMEs

Precise, timely and quality information represents a key factor for companies wanting to attain and retain their competitive advantage and to achieve their goals. The immense measure of data generated on a daily basis is a direct consequence of an expanding number of business transactions. Therefore, it is of utmost importance for an organization to transform the acquired transaction data into invaluable information with the help of information technology (IT).

2.1. BI: an Overview

The apparent need for data transformation into valuable information resulted in an increased interest for the study of BI and its capabilities. A large number of publications published over the last ten years indicates that a large number of researchers and practitioners are interested in BI. (Chuah and Wong, 2011, Zulkifli Abai, Yahaya and Deraman, 2016, Neely, 2007).

Regardless of the emphasis on the importance of BI in the academic literature, a universally accepted definition of this concept cannot be found there. Taking into consideration various approaches, BI can be described as a group of different abilities that enable the company to cope with new market conditions (Patil, 2016; Pavkov, Poščić and Jakšić, 2016; Koupaei, Mohammadi and Naderi, 2016; Muan Sang, Xu and de Vrieze 2017). In order to improve business decisions, BI exposes previously concealed knowledge or information altered by information

technology (IT) in the collected internal or external business data (Panian, 2007). BISs aim to provide a comprehensive insight into business data, company performance and user needs, with the goal of boosting the quality of decision making in the company (Muan Sang, Xu and de Vrieze, 2016). BISs diagnose the state of the current business environment and the reasons why something happened, what should be done, and what is the next appropriate step in a business strategy. These are the essential functions of BI (Panian, Klepac, 2003). BIS can be described as set of tools, technologies and solutions that support gathering, organizing and analysing data from different sources, such as data warehousing, data mining, online analytical mining (OLAM) and on-line analytical processing (OLAP) (Elbashir, Collier and Davern, 2008).

Since a large number of successful companies implemented the concept of BI, the adoption and use of the BIS became the focus of many authors (Muan Sang, Xu and de Vrieze, 2017, Koupaei, Mohammadi and Naderi, 2016, Patil, 2016, Hejazi, Abdovland and Harandi, 2016). However, Puklavec, Oliveira and Popovič (2016) point out the lack of research in the field of the BIS adoption at the level of the entire company, emphasizing the need for further research in this area.

2.2. SMEs needs for BISs

Since the most common organizational size in each country are SMEs, the research area of this paper focuses on the adoption of BISs in SMEs. According to Vrdoljak Raguž, Krželj Čolović and Milić Beran (2015), new working positions, in large number of countries, are mainly created by SMEs. In Croatia, the value of SMEs is evident from the greater representation and higher employment rate in relation to large companies, present even in periods of negative GDP growth (CEPOR, 2015).

The key to success is based on well-chosen decisions about the adoption and use of BISs (Zhu, Kraemer and Xu, 2006). Choosing and applying the best adoption determinants is crucial for a company's success (Puklavec, Oliveira and Popovič, 2014).

However, large companies are natural nominees for BISs implementation because of their financial ability and their better reaction on adopting technological innovation.

While business practitioners recognized that stronger efforts must be put into the BISs implementation in SMEs, a lack of academic research in this area is evident. Academic researches in the field of BISs adoption in SMEs are worryingly neglected since researches are being focused only on large companies. (Popovič et al., 2012; Wixom and Watson, 2010; Yeoh et al., 2008; Muang Sang, Xu and de Vrieze, 2016).
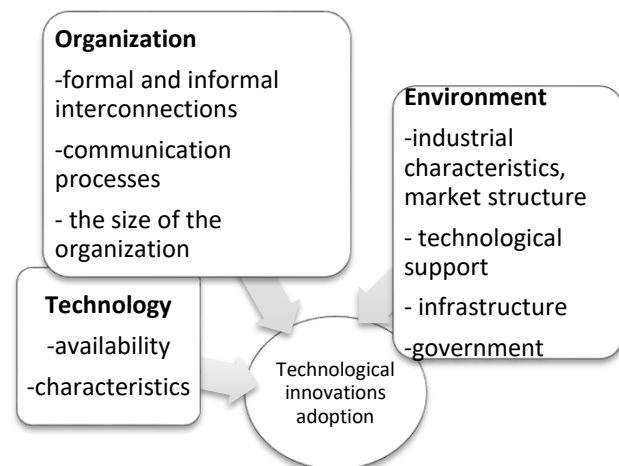
3. TOE Framework

For several decades, business practices and scientific literature have been indicating the importance of technological innovations for a successful business. At the same time, researchers have shown interest for exploring the factors that affect the success of adopting and using technological innovations in companies.

TOE framework describes the influence of technology, organization and environment on the adoption and use of technological innovations (Baker, 2012). TOE framework was developed by Rocco DePietro, Edith Wiarda and Mitchell Fleischer in a book "The Processes of Technological Innovation" (1990) edited by Tornatzky and Fleischer. There are three dimensions of this framework: technological, organizational, and environmental (Figure 1).

The technological dimension includes all technologies that are important for the implementation of planned innovations, whether they are technologies that are already in use within the company or technologies that will be adopted in the future. This includes the company's current practices and internal equipment, as well as a set of available external technologies. (Khandwalla 1970, Hage 1980).

The organizational context is determined by the company's size, features, resources, organizational structure, and communication processes. The organizational context refers to the company's size, degree of formalization and centralization, managerial structure and amount of slack and human resources, and linkages among employees (Acheampong and Moyaid, 2016).

The environmental dimension includes the impacts of the macroeconomic policy, size and structure of the company's business industry, changes in regulatory and legislative policy, and a degree of infrastructure development (Baker, 2012; Tornatzky and Fleischer, 1990).

Figure 1. TOE framework (source: Tornatzky and Fleischer, 1990)

4 TOE and BISs adoption in SMEs

This section analyses specific determinants within 3 dimensions of the TOE framework for which the impact on the adoption and use of technological innovations is recognized in both fields: BIS adoption and IT/IS innovations adoption in general.

4.1. Data Collection, Research Method and Results

For this study, the literature review was done on relevant extant academic studies covering fields of BIS adoption and IT/IS innovation adoption. The main reason and sequence of creating the following tables is: (1) to specify the most frequently mentioned variables for each of the 3 dimensions of the TOE framework (the first column of the table) based on previously researched literature; (2) to specify the papers that are described in the context of IT / IS implementation in general (the second column of the table) for each of these variables and (3) to find and list papers describing the impact of the variables on the success of the BISs implementation (the third column of the table) for each of these variables.

Afterwards, a comparison of the number of found papers describing the mentioned variables in general, i.e. in the context of IT / IS innovation, has been made with the number of papers describing the TOE variables in the context of BIS implementation. The results of the comparison are also presented in the table in subsection 4.2. Research results: analysis and discussion.

The variables are categorized into three distinct dimensions based on the three elements from the TOE framework. These elements are technological, organizational and environmental factors and each of them creates one of the following tables. Within each dimension a variable was chosen due to the frequency of appearance in scientific papers, being a significant variable in the process of adopting BIS or IT / IS innovations. Each of them is attached to a scientific paper in which the variable is mentioned as crucial for adopting BIS or IT/IS in general.

For the purposes of this study, a preliminary literature analysis was conducted. The key words "BIS adoption + TOE + SMEs", "IT/IS adoption + TOE + SMEs" "technological innovation + adoption + TOE + determinants + SMEs" were searched for in the title, abstract, key words and body text of all papers through the Google Scholar database. The searching process is limited to the papers published from 1990 to 2017. Any paper published before 1990 was not included in the process. In the next step, some of the available databases such as ScienceDirect, Emerald, Hrcak, SpringerLink, ProQuest will be researched.

The search was conducted using the Google Scholar database in May and June 2017. Given the limited availability of full versions of papers in the Republic of Croatia, and considering this was an initial collection of data on selected determinants of BIS adoption, author considered best to use Google Scholar database in this initial phase of research. Also, it is planned to conduct the research in some of the aforementioned databases in later phases of this study. Since the IT/IS adoption and the adoption of technological innovations are very broad concepts, author decided to focus only on those papers closely related to the selected determinants within the TOE framework in this study. Considering the availability of full versions of articles and their closeness to the topic discussed in this paper, 50 articles have been selected in this initial phase of research.

The results of the literature review are presented in Tables 1-3.

Table 1. Technology dimension

Variable	General IT/IS innovation	BIS	Definition
Relative advantage	Ifinedo , 2011; X. L. Li et.al., 2011; Oliveira and Martins, 2011; Oliveira et.al., 2014; Premkumar i Roberts, 1999; Tsai et.al., 2010; Chong i Chan, 2012; Chong et.al., 2009; Quaddus i Hofmeyer, 2007; Moore and Benbasat, 1991; Grandon and Pearson, 2004; Cragg and King, 1993; Iacovou, Benbasat and Dexter 1995; White et.al., 2007	Acheampong and Moyaid, 2016; Puklavec et.al., 2014; Hatta et. al., 2015; Ipomai, 2016; Boonsiritom achai, 2014;	The degree to which an innovation is perceived to be better than the idea it supersedes or existing systems (Acheampong and Moyaid, 2016; Rogers, 2003).
Complexity	Chong and Chan, 2012; Rogers, 2003; Chong et.al., 2009; Premkumar and Roberts, 1999; Grandon and Pearson, 2004; X. L. Li et al., 2011; Ifinedo, 2011; White et.al., 2007	Acheampong and Moyaid, 2016; Puklavec et.al., 2014; Boonsiritom achai, 2014; Hatta et. al., 2015;	The degree to which an innovation is perceived as difficult to understand and use (Acheampong and Moyaid, 2016; Rogers, 2003).
Compatibility	Chong and Chan, 2012; Chong et.al., 2009 Grandon and Pearson, 2004; Ifinedo, 2011; Oliveira et.al., 2014; White et.al., 2007	Hatta et. al., 2015; Acheampong and Moyaid, 2016; Puklavec et.al., 2014; Boonsiritom achai, 2014; Rostek, 2013	The degree to which an innovation is perceived as being consistent with existing values, past experiences and needs of potential adoption (Acheampong and Moyaid, 2016; Rogers, 2003).
Trialability	Ling, 2001; Moore i Benbasat 1991; Park and Chen 2007;	Hatta et. al., 2015; Boonsiritom achai, 2014; Puklavec et.al., 2014	The degree to which and innovation can be pilot tested or experimented (Ling, 2001).
Observability	Moore and Benbasat 1991; Ling, 2001; Oliveira, 2014; Mehrtens et al., 2001; Igbaria et al., 1997; Hsu et al., 2006;	Hatta et. al., 2015; Boonsiritom achai, 2014; Puklavec et.al., 2014	The extent to which relative advantage or gains of an innovation are clear (Ling, 2001).
Financial resources and costs	Grandon and Pearson, 2004; Premkumar and Roberts, 1999; Chong i Chan, 2012 ; Chwelos et al., 2001; Y. Lee and Larsen, 2009; Hameed et al., 2012; Caldeira and Ward, 2002	Hatta et. al., 2015; Puklavec et.al., 2014; Rostek, 2013	Cost effectiveness, i.e. where the benefits of adopting new technology exceed the costs of such technology (Premkumar and Roberts, 1999).

Table 2. Organizational dimension

Variable	General IT/IS innovation	BIS	Definition
Availability of organizational resources	Duan, Deng and Corbitt 2012; Kim and Garrison 2010; Iacovou, Benbasat and Dexter 1995; Oliveira and Martins, 2011	Boonsiritomachai, 2014; Hatta et. al., 2015; Puklavec et.al., 2014	Partial synonym for the readiness of the company to adopt innovation, i.e. to measure the degree of availability of financial and technological resources in the company (Duan, Deng and Corbitt 2012; Kim and Garrison 2010; Lee and Cheung 2004; Iacovou, Benbasat and Dexter 1995).
Customer demand	Ifinedo, 2011, Mehrtens, Cragg and Mills, 2001; Daniel and Grimshaw, 2002	Hatta et. al., 2015	Refers to the pressure of clients for adopting technological innovations (Ifinedo, 2011, Mehrtens, Cragg and Mills, 2001) as well as the company's desire to provide improved customer service with the help of new technology solutions (Daniel and Grimshaw, 2002).
Top management support	Premkumar i Roberts, 1999; Grandon and Pearson, 2004; Ling, 2001; Tsai et.al. 2010; Quaddus i Hofmeyer, 2007; Igbaria et al., 1997; Al-Qirim, 2014; Reich and Benbasat, 1990; Hwang et.al., 2004; Thong et.al., 1999; Jarvenpa i Ives, 1991; Bruque Camara et.al., 2004; Damanpour and Schneider, 2006	Acheampong and Moyaid, 2016; Hatta et. al., 2015; Puklavec et.al., 2014; Boonsiritomachai, 2014; Rostek, 2013	The degree of "active engagement of top management with IS implementation" (Thong et.al., 1996.)
Organizational readiness	Hameed et.al., 2012; Ifinedo, 2011; Grandon and Pearson, 2004; Iacovou, Benbasat and Dexter 1995; Oliveira and Martins, 2011; Quaddus i Hofmeyer, 2007	Hatta et. al., 2015; Acheampong and Moyaid, 2016; Puklavec et.al., 2014	The degree of organizational readiness is defined as the availability of the necessary organizational resources for the adoption of the information system. It is measured through the level of organizational awareness, commitment, organizational resources and management for the adoption of BIS (Iacovou et al., 1995; Hameed et al., 2012).
Collaboration	Ling, 2001; Bruque Camara et.al., 2004; Oliveira and Martins, 2011;	Hatta et. al., 2015; Puklavec et.al., 2014	It represents internal and external communication and cooperation for the dissemination and acquisition of knowledge necessary for the adoption of BIS (Puklavec 2016; Ling, 2001).

Table 3. Environmental dimension

Variable	Other IT/IS innovation	BIS	Definition
Business partners	Chwelos et.al., 2001; Ifinedo, 2011; Iacovou et al., 1995; Soares-Aguiar and Palma-dos-Reis, 2008; Oliveira and Martins, 2011; Wymer and Regan, 2005	Puklavec et.al., 2014; Hatta et. al., 2015	Refers to the potential strength of a business partner to encourage the adoption of technological innovations (Chwelos et al., 2001).
Competitive pressure	Chan and Chong, 2012 ; Grandon and Pearson, 2004; Chong et.al., 2009; Chwelos et.al., 2001; Premkumar and Roberts, 1999; Soares-Aguiar and Palma-dos-Reis, 2008; Wymer and Regan, 2005; Oliveira and Martins, 2011; Zhu et.al., 2003	Acheampong and Moyaid, 2016; Puklavec, 2016; Hatta et. al., 2015; Ipomai, 2016; Rostek, 2013	Competitors is the group that reflects competitors' pressures to adopt an innovation. Intense competition can cause a company to look for new ways of doing business (Ifinedo, 2011; Puklavec, 2016).
Providers availability	Chaveesuk 2010; Hwang et al. 2004	Boonsiritomachai et.al. , 2014; Puklavec et.al., 2014; Hatta et. al., 2015	Defines the criteria for selecting companies that produce/sell ICTs and provide education and customer support services (Boonsiritomachai et al., 2014).
Availability of technological infrastructure	Premkumar and Roberts, 1999; Lee and Larsens, 2009; Quaddus and Hofmeyer, 2007; Wymer and Regan, 2005	Hatta et. al., 2015; Rostek, 2013	Refers to the development of the existing technological infrastructure as well as the degree of external support in the implementation and use of innovative technological solutions (Premkumar and Roberts, 1999, Quaddus and Hofmeyer, 2007).
Market trends	Chan and Chong, 2012; Chong and Ooi, 2008; Chong et.al., 2009; Wymer and Regan, 2005	Puklavec et.al., 2014; Hatta et. al., 2015	Different market trends that can influence the company to adopt technological innovations (Chong et al., 2009).
Regulatory body	Ling, 2001; Quaddus and Hofmeyer, 2007; Ifinedo, 2011; Grandon and Pearson, 2004; Teo et.al., 1997; Bose and Luo, 2011; Wymer and Regan, 2005	Acheampong and Moyaid, 2016; Hatta et. al., 2015	Refers to the level of assistance provided by government institutions to encourage the expansion of IT innovations into the businesses (Ifinedo, 2011).
Collaboration with other companies	Premkumar and Roberts, 1999; Oliveira and Martins, 2011	Hatta et. al., 2015	Refers to the vertical relationships with affiliated companies. It includes situations in which the parent company introduces technological innovations and then transfers them to their affiliates (Premkumar and Roberts, 1999).

4.2. Analysis and Discussion of Research Results

Based on the review of previous studies, 18 specific determinants were extracted for BISs adoption within the TOE framework.

Six key determinants for BIS adoption were chosen within the technology dimension, five in the organizational dimension, and seven in the environmental dimension within the TOE framework.

Based on those specific determinants, the number of scientific papers focused on determinants in the BIS and IT/IS innovation adoption research field was compared. Table 4 presents the results of the comparison of scientific papers belonging to those two fields that were found while reviewing the literature according to the chosen fields of literature retrieval.

Table 4. Results of comparison between the fields of research

Variable	BIS	General IT/IS innovation
Relative advantage	5	14
Complexity	4	8
Compatibility	5	6
Trialability	3	3
Observability	3	6
Financial resources and costs	3	8
Availability of organizational resources	3	4
Customer demand	1	3
Top management support	5	13
Organizational readiness	3	6
Collaboration	2	3
Business partners	2	6
Competitive pressure	5	9
Providers availability	3	2
Availability of technological infrastructure	2	4
Market trends	2	4
Regulatory body	2	7
Collaboration with other companies	1	2

Several papers describing BIS adoption through the frame of chosen determinants were found, but their number is relatively small in comparison to the number of papers focused on other IT/IS innovation. From the results, it is obvious that the most common determinants in the BIS adoption research field are within the technology dimension, especially determinants such as "Relative advantage" and "Compatibility". It is followed by the environmental dimension "Competitive pressure" as the most common determinant. Within the organizational dimension the most common determinant is "Top management support".

In the scientific papers written about the general IT/IS innovation adoption determinants within the TOE framework, most important determinants are from technology, then environmental and finally from organizational dimension. Most common determinants in this field of research are very similar, as it was in the case of BISs adoption; these are: "Relative advantage" within the technology dimension and "Top management support" within the organizational dimension.

5. Conclusion

As it was mentioned before, benefits of BIS can be limited if it is not properly and widely adopted so it is crucial to understand the determinants of BIS adoption to achieve desired business success. The value of this paper is in the result of the literature review which identifies determinants for BISs adoption within the TOE framework. Besides, the comparison that has been made between the abovementioned two fields of research shows that there is a lack of papers in the BIS adoption field of research. Very similar results obtained by searching for determinants for BIS adoption and IT / IS adoption point to the need for additional research on the specificities associated with the use of BISs.

Limitation of this paper is that the papers have been searched on Google Scholar rather than on the databases of scientific papers. That will be done in the next research.

Hopefully, the determinants which will be tested in SMEs in Croatia, will examine the current state of BIS adoption in Croatia. The results which will be obtained through the future testing of these determinants within TOE framework would be beneficial for the academic researchers, BIS vendors and SMEs itself, so as for Croatian SMEs and both their opportunities and concerns regarding the BIS adoption.

For that reason, author encourages academics to focus more on exploring and analysing determinants for adopting BISs in SMEs. Hopefully, all the phases of this work will stimulate future efforts to develop more determinants for the successful adoption of BIS.

Acknowledgments

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