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## Article

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Journal of Risk and Financial Management

## Provided in Cooperation with:

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*Suggested Citation:* Stjepić, Ana-Marija; Pejić Bach, Mirjana; Bosilj Vukšić, Vesna (2021) : Exploring risks in the adoption of business intelligence in SMEs using the TOE framework, Journal of Risk and Financial Management, ISSN 1911-8074, MDPI, Basel, Vol. 14, Iss. 2, pp. 1-18, <https://doi.org/10.3390/jrfm14020058>

This Version is available at:

<https://hdl.handle.net/10419/239474>

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Article

# Exploring Risks in the Adoption of Business Intelligence in SMEs Using the TOE Framework

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**Abstract:** The business success of small- and medium-sized enterprises (SMEs) increasingly relies on the adoption of various technological innovations. For today's unpredictable business operations, business intelligence systems (BISs) represent one of the most prominent tools with a significant impact on business performance. However, different internal and external risks may influence BIS adoption. The goal of this paper is to investigate the risks that impact BIS adoption in SMEs, using the Technology, Organization, and Environment (TOE) framework. For that purpose, we develop the logistic regression model, using data collected by a questionnaire survey using a sample of 100 Croatian SMEs. The results indicate the applicability of the TOE theoretical framework for examining BIS adoption in SMEs. Given the results obtained, the sampled SMEs should take into account the internal risks related to the organizational dimension and external risks related to the environmental dimension. Our research did not reveal the significant impact of technological risks that encompass characteristics of considered technological innovation related to the technology dimension.

**Keywords:** business intelligence systems; adoption; risk; TOE framework



**Citation:** Stjepić, Ana-Marija, Mirjana Pejić Bach, and Vesna Bosilj Vukšić. 2021. Exploring Risks in the Adoption of Business Intelligence in SMEs Using the TOE Framework.

*Journal of Risk and Financial Management* 14: 58. <https://doi.org/10.3390/jrfm14020058>

Academic Editors: Jakub Górk and Malte Krueger

Received: 30 December 2020

Accepted: 23 January 2021

Published: 2 February 2021

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## 1. Introduction

Currently, business success is mainly correlated with adopting innovations, especially innovations in the context of information technology (Haseeb et al. 2019; Basole et al. 2013; Wu et al. 2015). According to Grauer (2001) and Hughes (2016), each of these emerging technology innovations improves and upgrades enterprises' overall business activities (Kusuma et al. 2020). Enterprises are encouraged to change their business models into electronic-based business models. Consequently, a large number of business processes, such as a large number of business transactions, brought out the problem of accumulating a large amount of business data (Kusuma et al. 2020). This challenge has brought out the development of innovative technologies in the context of data management in the form of numerous solutions designed for storing and analyzing accumulated business data. Consequently, for enterprises that generate large amounts of structured and unstructured data by using different technologies, while operating their daily businesses (Xu et al. 2020), it is crucial to establish a reliable solution for storing, analyzing, and distributing those data (Mola et al. 2020).

Enterprises adapt their products and services to customer needs, using external and internal data sources. One of the best tools for using the various forms of internal and external data sources, and harmonizing them into the solution with relevant business value, is the business intelligent system (BIS), which allows enterprises to recognize and wisely use data to stabilize or improve their position on the market (Khan et al. 2020). Consequently, strategic decisions based on quality data analysis lead to higher financial gains for the enterprise's operations. In particular, the increasing use of technological innovations, such as the BIS, in conducting financial activities, the so-called FinTech, stands out (Muhammad et al. 2014; Marrara et al. 2019). Fintech represents a bridge between the achievements of technological innovation and product and service development in the

financial sector (Marrara et al. 2019). In this field, the BI technology as data mining supports the enterprise to predict future financial opportunities and risks, create client-need-tailored products and services, and, finally, achieve financial prosperity (Marrara et al. 2019).

However, the implementation of complex information systems is often prone to risks related to various sources, such as lack of management support or lack of sufficient resources in terms of finance and workforce. Therefore, it is strongly advised for enterprises to consider all the internal and external factors that could impact the success of adopting the BIS.

A theoretical framework Technology–Organization–Environment (TOE) framework, designed by Tornatzky and Fleischer (1990), has been widely used for the investigation of the adoption of various technologies. The name of this theoretical framework rests on three dimensions in which it explores the success factors of adopting various technological innovations in enterprises: technology, organization, and environment context of business. The technology dimension includes internal and external technology infrastructure available for the enterprise. Characteristics of the market, such as competitive forces, are included within the environmental context. The organizational context, such as management support, comprises relationships and mechanisms that exist within the enterprise and that are relevant for the technology adoption (Tornatzky and Fleischer 1990).

Taking into account the need for the assessment of relevant factors that would support the implementation of BIS, this study aimed to examine the determinants that could affect BIS adoption in small- and medium-sized enterprises (SMEs) through the identification of the determining factors within the selected Technology, Organization, and Environment (TOE) framework. For this aim, we conducted a survey on a sample of 100 Croatian SMEs that operate in the sector and developed a logistic regression model. Our results reveal that the organizational and environmental factors are relevant for the implementation of BIS in SMEs, while the technological factors did not have a significant impact. Practical and theoretical implications of our work emerge from these results.

The paper is structured as follows. After the introduction, a theoretical background is presented, emphasizing the key ideas for examining the potential risk of innovative technology adoption, as well as the BIS adoption process in SMEs. The third part of the paper describes the methodology, and the fourth part presents the research results. In the fifth part of this paper, a brief discussion based on obtained results is given. In the concluding part of the paper, final thoughts, as well as limitations of this research, and recommendations for further research are given.

## 2. Theoretical Background and Research Model

### 2.1. SMEs and Technology

Technological innovation can represent an upgrade of existing products or services according to market expectations or lead to the introduction of new products or services in enterprises (Hisrich et al. 2017). According to different authors (i.e., Pavitt 1987; OECD 2005; Diaconu 2011), technological innovations can be defined as processes or products. Such innovations impact daily life, business, government, and the environment. Expansion, adoption, and the appliance of technological innovations can lead to better productivity, purchasing power, increased employment rates, and reduced environmental pollution, but it can also lead to changes in the behavior of existing society and reduce social disparities among people (Kusuma et al. 2020; Viswanathan and Sreekumar 2019). According to various authors, innovative technologies rapidly change the service sector, as well as the existing seller–buyer relationship (Jeon et al. 2020; Iqbal et al. 2018).

Currently, SMEs are becoming crucial in the economic progress of many countries worldwide, as well as in the Republic of Croatia (Zhen 2013; Casanova et al. 2018; da Silva et al. 2020; CEPOR 2019). Notwithstanding that SMEs are representing the driving force of many countries, they still face many risks that challenge their sustainability in today's turbulent market. SMEs often encounter a lack of financial and human resources, as well as technology infrastructure insufficiency, competition on the market, and other

internal and external barriers that limit their full business accomplishment (da Silva et al. 2020). According to Ploh (2017), it is crucial to support Croatian SMEs in development and networking by preparing a more suitable legal framework for their establishment, supporting their participation in various types of education, and using different IT innovations. Accordingly, SMEs need to consider investing in different technological innovations which could enhance their efficiency in terms of process performance, preserve sustainability, and encourage their competitive advantage development (da Silva et al. 2020).

## 2.2. Technology Adoption Models

Many theoretical models, frameworks, and theories for investigating successful technology adoption paths in businesses are developed over time. Thus, different authors examined various technological innovation adoption within enterprises using the Theory of reasoned action (TRA) (i.e., Tran et al. 2014), Technology acceptance model (TAM) (i.e., Najib and Fahma 2020), Unified Theory of Acceptance and Use of Technology (UTAUT) (i.e., Abu et al. 2015), Theory of planned behavior (TPB) (i.e., Seol et al. 2016), Diffusion of innovation (DOI) (i.e., Tehrani and Shirazi 2014), and the TOE framework, just to name as the most important.

According to Kim and Eunil (2020), user resistance, privacy concerns, trust, perception of technology usage and benefits, accessibility, and perception of costs are recognized as potential challenges in the adoption process. Similarly, technical complexity, prediction, and consequences of the consumer technology usage perception and financial risks are also recognized as potential risks for successful technological innovation adoption (Jeon et al. 2020). Inadequate data management is also classified as a perceived risk for the adoption process (Khan et al. 2020). Najib and Fahma (2020) accentuate the difficulty to set up a technology and costs of the project as one of the main risks that could make the innovational technology adoption unsuccessful and later usage of planned technology ineffective. Igwe et al. (2020) emphasize organizational capabilities, like insufficient technical, human, time, management resources, and top-management support deficiency, as potential challenges of successful conduction of technological innovation adoption project within the enterprise. Moreover, competitive and supplier pressure is stressed as a potential risk that could slow down or stop the adoption of the new technology adoption project (Igwe et al. 2020). The TOE framework includes the above-stated factors as the determinants for successful technology adoption. The TOE framework is the most recognized and used in the scientific field of examining the potential factors that could affect the technological innovation adoption process in enterprises and therefore prevent the potential risks that could cause the failure of the adoption project. Moreover, determinants within this framework can be simultaneously observed as constraining factors and influencing factors of particular technological innovation adoption within the enterprise (Bijker and Hart 2013).

## 2.3. BIS Adoption

BIS has become crucial for modern business, as it provides companies with information and new knowledge that, if used on time and for the right problem, can bring many positive effects to the business results. BIS refers to a set of different tools, methods, and applications used to store, analyze, and visualize business data relevant for successful decision-making (Agiu et al. 2014). However, BIS is one of the most demanding technological innovations for adopting in the enterprise, especially since it requires employee's training and additional time to acquire knowledge on how to use the obtained information, thus how to analyze the business data (Nelke 2012).

The examination of the BIS adoption process using the TOE framework within different businesses worldwide is conducted by numerous papers. In their research, different authors have focused on diverse stages of BIS adoption in business. For example, Hung et al. (2016) investigated the BIS implementation success factors, using TOE determinants, within Taiwan's enterprises that participated in the BIS implementation process.

In their paper, [Hung et al. \(2016\)](#) observed two main effects of BIS implementation on (1) user satisfaction and (2) overall system effectiveness. On the other hand, [Lautenbach et al. \(2017\)](#) researched the business intelligence and analytics (BI&A) usage level among 72 enterprises in South Africa that already used BI&A in their businesses. [Lautenbach et al. \(2017\)](#) investigated the impact of six TOE determinants on the BIS usage, half of which proved to be significant, i.e., determinants as data-related infrastructure capabilities, top management support, and external market impact. [Owusu et al. \(2017\)](#) investigated the TOE determinants' impact on the overall BIS adoption process among 120 private universities in Malaysia. [Owusu et al. \(2017\)](#) focused on TOE determinants by observing five BIS adoption stages: (1) basic information system (IS) usage, (2) data warehouse (DW) usage, (3) DW and analytics usage, (4) DW, analytics and strategic tools usage, and (5) real-time use of all previously mentioned BIS tools and methods. [Puklavec et al. \(2018\)](#) distinguished 11 potentially influencing TOE determinants on the overall BIS adoption process by conducting an extensive literature review and qualitative research based on ten in-depth interviews among BIS and IT experts employed within diverse European SMEs.

Even though the BIS adoption topic within various businesses is getting more attention within scientific circles, investigation of potential BIS adoption risks within SMEs is sparse. Prior studies are mostly focusing on the TOE determinants that encouraged BIS implementation or usage in different sized enterprises. While discussing their results and explaining the importance of obtained results for each determinant, some researchers also glinted on the opposite, the negative impact of observed determinants on BIS adoption (i.e., [Hung et al. 2016](#); [Lautenbach et al. 2017](#)) Therefore, it would be advisable to observe the adoption of determinants from the BIS adoption risk perspective. Moreover, few studies focus only on BIS adoption within individual business sectors.

Due to the emphasized economic-driving importance of SMEs for the Republic of Croatia, the SMEs' need to adopt technological innovations, such as BIS, that contribute to better decision-making, higher profits, and meeting growing customer needs must not be neglected. In the Republic of Croatia, the BI usage within enterprises of all sizes is getting more attention over time. According to [Bilandžić et al. \(2012\)](#), 57% of all sized enterprises in the Republic of Croatia were doing some part of BI in their business, while only 19% had separate BI departments. Moreover, [Bilandžić et al. \(2012\)](#) argued that Croatian enterprises had not reached the BI usage level as in other countries. [Dubravac and Bevanda \(2015\)](#), concluded that Croatian SMEs lag behind other countries in the process of BI adoption due to insufficient financial resources, lack of technological knowledge, and fear of security vulnerabilities and data loss.

Since there is no similar research that would examine the BIS adoption risks in the Croatian tertiary SMEs and that is known to us, the authors of this paper decided to observe the potential BIS adoption determinants from the risk perspective.

#### 2.4. Technological Context

According to [Tornatzky and Fleischer \(1990\)](#), the technology dimension includes technologies and tools already in use or available for the enterprise. Therefore, based on previous research and the importance of each determinant within the technology dimension for technological innovation adoption perception of the comparative advantage ([Pan and Pan 2019](#)), perception of the BIS's complexity ([Gupta and Bhatia 2019](#)), BIS compatibility with enterprise information system ([Pan and Pan 2019](#)), and key personnel ability to assess the BIS benefits ([Acheampong and Moyaid 2016](#)) are observed in this study as potential risks for successful conduction of BIS adoption project. The perception of the comparative advantage of BIS is the level of the user perception of how BIS usage is better for achieving higher business performance than some other technological innovation ([Pan and Pan 2019](#)). [Wang and Wang \(2016\)](#) found that relative advantage significantly influences knowledge management systems, while [Boonsiritomachai et al. \(2016\)](#) also noted that perception of relative advantage has a significant impact on BI adoption.

Therefore, this study hypothesized that Croatian SMEs within the tertiary sector would more likely adopt BIS in their businesses if there were no barriers in their perception of the comparative advantage associated with BIS. Accordingly, the first hypothesis is proposed as follows:

**Hypothesis 1.** *Perception of the comparative advantage of BIS has a positive impact on SMEs' adoption of BIS.*

Furthermore, [Ahmad and Siraj \(2018\)](#) define complexity as the user perception level of how difficult technological innovation is for understanding or usage. According to [Ramamurthy et al. \(2008\)](#), a higher level of technological innovation complexity will result in a lesser adoption of that technology in business. [Boonsiritomachai et al. \(2016\)](#) proved the significant correlation of complexity determinant with BI adoption. Similarly, [Yeoh \(2011\)](#) mentioned how the complexity of BIS process of adoption can be too demanding and therefore cause a decline in the number of enterprises willing to conduct the BIS project.

According to the aforementioned suggestions, it is supposed that SMEs are less likely to adopt BIS if they perceive it as complicated to understand or use. Hence, the second hypothesis is proposed:

**Hypothesis 2.** *Perception of the BIS's complexity has a negative impact on SMEs' adoption of BIS.*

[Pan and Pan \(2019\)](#) define the compatibility determinant as the level of competence with infrastructure, technologies, tools, and business practices already existing in the enterprise. [Yoon et al. \(2014\)](#) state that it is more likely for the enterprise to reject the new technology adoption plan if it finds it incompatible with current technology or business procedures. [Acheampong and Moyaid \(2016\)](#) also suggest the importance of observing compatibility as a determinant in the case of the BIS adoption investigation. Based on the mentioned findings, this study proposed that SMEs are more likely to adopt BIS if it is compatible with their existing infrastructure, technologies, tools, business values, and procedures. Hence, the authors propose the third hypothesis as follows:

**Hypothesis 3.** *BIS's compatibility with enterprise information system has a positive impact on SMEs' adoption of BIS.*

[Ghobakhloo and Ching \(2019\)](#) describe the key personnel ability to assess the BIS benefits as their level of clarity and understanding of values and benefits that they can achieve by adopting BIS. According to [Tornatzky and Fleischer \(1990\)](#), the constantly growing number of new technology solutions on the market can cause various difficulties for the enterprise to understand its need and recognize the proper technological solution for their business. As well as compatibility, BIS observability and trialability are positively related to the BIS adoption ([Acheampong and Moyaid 2016](#)). Accordingly, this study proposes that SMEs are more likely to adopt BIS if the key personnel can easily understand and recognize BIS adoption values and benefits within their business. Therefore, the fourth hypothesis is proposed:

**Hypothesis 4.** *Key personnel ability to assess the BIS benefits has a positive impact on SMEs' adoption of BIS.*

## 2.5. Organizational Context

The organizational dimension observes formal and informal relationships among employees and the existing organizational mechanisms within the enterprise ([Tornatzky and Fleischer 1990](#)). According to previous research in the field of new technologies' adoption within enterprises, top management organizational support ([Ahmad and Siraj 2018](#)), organizational readiness ([Acheampong and Moyaid 2016](#)), and data management

(Puklavec et al. 2014) are identified as significant determinants within the organizational context, for the adoption process. Acheampong and Moyaid (2016) define top-management organizational support as its active involvement during the overall BIS adoption process. Wang and Wang (2016) found a high level of top-management support within the enterprises that adopted KMS. Similarly, Yeoh (2011) noted that highly dedicated management, as well as sponsorship within the enterprise, will cause a higher rate of BIS adoption. In light of the mentioned suggestions, this study hypothesized that SMEs in which top management actively participate in the overall adoption process will be more likely to adopt BIS. Hence, the fifth hypothesis of this paper is proposed as follows:

**Hypothesis 5.** *Top management organizational support has a positive impact on SMEs' adoption of BIS.*

Organizational readiness can be defined as a sufficient amount of resources (e.g., human, financial, technical, knowledge, skills, etc.) that an enterprise possesses (Puklavec et al. 2014). Boonsiritomachai et al. (2016) found that the availability of organizational resources is a significant determinant when observing the BIS adoption process within the enterprise. Similarly, Acheampong and Moyaid (2016) identified organizational readiness as a determinant that has a significant impact on BIS adoption. Hence, this study contends that SMEs are less likely to adopt BIS if they do not have sufficient resources. Accordingly, the sixth hypothesis of this study is proposed:

**Hypothesis 6.** *Organizational readiness has a positive impact on SMEs' adoption of BIS.*

According to Olexova (2014), DW and data marts are two crucial elements of BIS. Thus, data management is crucial for the data-dependent technologies adoption such as BIS, since it prevents subjective data definition, defines data dictionary standards, enables data security, ensures enterprise integrity and credibility, and manages database modeling and operation (Ramamurthy et al. 2008). Puklavec et al. (2014) treated the organizational data environment as an influential determinant on the BIS adoption. For example, Olexova (2014) stated that the data dictionary establishment was crucial for the further conduction of the BIS adoption process. Because of that, it is expected that SMEs with better data management as a backbone for decision-making processes will be more likely to adopt BIS. Therefore, the seventh hypothesis of this study is proposed as follows:

**Hypothesis 7.** *Data management as a backbone for decision-making processes has a positive impact on SMEs' adoption of BIS.*

## 2.6. Environmental Context

Environmental context includes everything within the business environment that surrounds the business operating field of the enterprise (Tornatzky and Fleischer 1990). Inspired by today's competitive business market, as well as a growing number of new technologies and their providers, competitive pressure (Acheampong and Moyaid 2016) and BIS vendors' quality (Boonsiritomachai et al. 2016) are identified as crucial determinants within this TOE dimension. Competitive pressure is defined as the competitiveness intensity present on the market in which enterprise participates (Tornatzky and Fleischer 1990). Boonsiritomachai et al. (2016) found competitive pressure to be a determinant that has a significant impact on the BIS. Similarly, Wang and Wang (2016) also proved that higher competitive pressure leads to a higher likelihood of KMS adoption. Consequently, SMEs that have greater competitive pressure in their market are more likely to adopt the BIS. Therefore, the next, i.e., the eighth, hypothesis in a row is proposed as follows:

**Hypothesis 8.** *Competitive pressure has a positive impact on SMEs' adoption of BIS.*

BIS vendors' quality includes timely adoption project attainment, the post-adoption vendor support, as well as their marketing activities (Puklavec et al. 2014; Boonsiritomachai et al. 2016). According to Puklavec et al. (2014), if enterprises are familiar and satisfied with the work and the competencies of their service providers, it is very likely that they will adopt the BIS. Similarly, Boonsiritomachai et al. (2016) noted that BIS vendors' quality significantly influences the BIS adoption. Therefore, it is expected that SMEs which are satisfied with the way of how their potential vendors complete and support their projects will be more likely to adopt BIS. Thus, ninth, and final, hypothesis of this study is proposed:

**Hypothesis 9.** *BIS vendors' quality has a positive impact on SMEs' adoption of BIS.*

### 3. Methodology

#### 3.1. Sample Description

We tested our model on the sample of Croatian SMEs, for which relevance for the Croatian economy is noticeable through several indicators: employment rate, productivity rate, total income and export, and financial efficiency (CEPOR 2019). According to the Accounting Act (2020) and The Small Business Development Promotion Act (2020), Croatian SMEs are enterprises that do not exceed boundary indicators in two of the following three conditions: total assets EUR 4,000,000.00; turnover EUR 8,000,000.00; the average number of workers during the business year is 50 workers (small enterprises) and total assets EUR 20,000,000.00; turnover EUR 40,000,000.00; the average number of workers during the business year is 250 workers (medium-sized enterprises). SMEs in the Republic of Croatia occupy 99.7% of the total structure of all-sized enterprises (CEPOR 2019) and operate mostly in the sector (Hrvatska.eu 2017). Several employees in SMEs are constantly growing. For example, the employment rate in Croatian small enterprises increased by 3.8% and by 6.1% in medium-sized enterprises in 2018, compared to 2017 (CEPOR 2019). In the Republic of Croatia, SMEs are showing a positive trend in innovating their businesses (CEPOR 2019). In 2018, 13.8% of them offered new products that were new for anyone, 17.9% of them were innovative for only some businesses on the market, and 68.3% offered products that were not new to any business, which are slightly better results than the year before (CEPOR 2019).

To test the empirical model, we used the survey research approach. To gather as many enterprises as possible to participate in the research, we used the snowball approach as a sampling method. The chosen sampling method is mostly used in the studies in which the aiming sample is not easy to approach. It is also advisable to use this sampling method when investigating perceptions of respondents via survey, as is the case in this research (Dragan and Isaic-Maniu 2012). The snowball method is also known as the chain method since existing respondents are finding new respondents, mostly their contacts, which are suitable for the research sample that is difficult to identify (Naderifar et al. 2017). Respectively, the chosen sampling method involves giving recommendations for contacts of potential members of the selected research sample, with the purpose to achieve the sample growth as a snowball. It is most often used in hidden populations, which is the case with this research in which BIS is rarely used in SMEs in the Republic of Croatia. In this research, experts within the BIS field were asked to recommend their contacts who would participate in the research. This method was carried out until the moment when the recommendations of the respondents started to repeat (Etikan et al. 2016). Using this method, a total of 110 responses were collected, of which 100 answers were valid.

The questionnaires were sent online, directly to the respondents via email or through social networks (LinkedIn). The respondents are top management, IT professionals, and employees that understand the functionalities of BIS within the small- and medium-sized enterprises in the Republic of Croatia. Therefore, the sample includes companies engaged in service activities, financial activities, wholesale and retail trade, etc. (Biere 2010), whose business success is assumed to be mostly based on well-organized and used information. The sample consisted of 37% of small-sized and 38% of medium-sized enterprises.



The largest number of enterprises (49%) within the sample is engaged in information and communication activities. Enterprises participating in wholesale and retail trade comprise 15% of the research sample. About 10% of enterprises are engaged in professional, scientific, and technical activities; 6% are engaged in financial and insurance activities; and 3% provide transport and storage services. Merely 1% of enterprises are included in providing accommodation, food preparation, serving, administrative and support services, and educational activities, while a total of 7% of enterprises did not want to classify their businesses. Most enterprises answered that they employ around 11–250 per year (79%), while 58% of enterprises answered that they earn between EUR 0.7 million and EUR 40 million of average annual income. In this research, enterprises operating on the market from 11–50 years (70%) mostly participated. They are followed by 16% of enterprises conducting their businesses from 6–10 years and 12% operating businesses for over 50 and less than 5 years. Only 2% of respondents did not answer the question about their enterprises' operation years. Most enterprises operate in the European Union (45%), while 38% operate in national markets of several or all countries in the region. An equal number of respondents of 24% are employed in enterprises operating in a part of the market within Bosnia and Herzegovina, Croatia, or Serbia and in the entire area of the national market of Bosnia and Herzegovina, Croatia, or Serbia. The enterprises that participated in the survey are domestic, mostly private companies (72%). They are followed by foreign privately owned companies (19%). Only 4% of enterprises are domestic enterprises, classified as semi-private and semi-state, while 3% of enterprises are predominantly state-owned. When asked about the ownership structure of the company, only 2% of respondents did not answer. Most enterprises do not operate as part of a larger multinational company (77%), while a small number participate as a subsidiary of a multinational company (21%). Only 2% did not answer this question.

Regarding the respondents' education level, most of them have a graduate degree (74%), followed by those who have an MBA or PhD (15%). Just 4% of respondents have an undergraduate degree, while only 2% of them have completed high school. To this question, 5% of respondents did not want to give their answer. Among the respondents, the largest number are IT experts (28%), top managers (24%), and department managers (15%). A total of 4% of BI specialists participated in the study, while only 2% were supervisors. Moreover, 20% of respondents declared themselves as other occupations, while 7% of respondents did not answer this question. Most respondents work in their current workplace for two to three years (26%), more than 10 (21%), or less than 1 (19%). Almost the same percentage of respondents work in their current workplace from four to five years (15%) and five to ten (14%), while only 5% of respondents did not answer this question.

### 3.2. Research Instrument

The dependent variable is defined as the BIS's adoption with enterprises divided into two groups: BIS is not yet implemented in the enterprise, and BIS is fully implemented in the enterprise (Tornatzky and Fleischer 1990; Puklavec et al. 2018).

Independent variables comprise the determinants within the TOE framework that could influence the adoption process in Croatian SMEs. (i) The technology dimension is perception of the comparative advantage of BIS, BIS's complexity, BIS's compatibility with the enterprise information system, and key personnel ability to assess the BIS benefits. (ii) The organizational dimension refers to top-management organizational support, organizational readiness, and data management as a backbone for decision-making processes. (iii) The environmental dimension is the BIS vendors' quality and competitive pressure. Table 1 presents the research instrument in detail.

**Table 1.** Research instrument description.

Construct	Code	Measurement
Dependent variable		
BIS adoption (ABIS)	ABIS	0-BIS is not yet implemented; 1-BIS is fully implemented
Technology dimension (TD)		
Perception of the comparative advantage of BIS (TD1)	TD1_1	Using BIS allows you to avoid unnecessary costs and time savings.
	TD1_2	The cost-effectiveness of BIS is higher than that of other decision support systems (software).
	TD1_3	The use of BIS enables better decision-making.
	TD1_4	The use of BIS enables faster execution of actions and decision-making.
	TD1_5	Using BIS makes it easier to perform business tasks.
	TD1_6	The use of BIS allows greater control over the business.
Perception of BIS's complexity (TD2)	TD2_1	The process of getting acquainted with the work of the BIS is complex.
	TD2_2	The process of introducing the BIS is complex.
	TD2_3	Using BIS is complex and demanding for users.
	TD2_4	It is difficult to learn how to work with BIS.
	TD2_5	Resistance to the use of BIS is a consequence of the complexity of working with BIS.
BIS's compatibility with enterprise information system (TD3)	TD3_1	The use of BIS should be compatible with existing business values and beliefs embedded in enterprise information system (objectives and the tasks of the system support the mission, vision, and goals of the business)
	TD3_2	The changes brought about by the BIS adoption should be compatible with existing business practices executed by the enterprise information system (e.g., processes, procedures, organizational structure, and strategic goals).
	TD3_3	BIS should be compatible with existing enterprise technology infrastructure.
	TD3_4	BIS should be fully integrated with enterprise information systems, software tools, and software solutions.
Key personnel ability to assess the BIS benefits (TD4)	TD4_1	Key personnel are aware of the expected results of the BIS adoption
	TD4_2	Key personnel understands that the benefits of implementing BIS are clear and easily measurable.
	TD4_3	Key personnel are aware of the existence of the BIS in the software market.
	TD4_4	Key personnel have the opportunity to see BIS being used in other enterprises.
Organizational dimension (OD)		
Top management organizational support (OD1)	OD1_1	Top management supports the implementation and adoption of the BIS.
	OD1_2	Top management actively participates in establishing the vision and shaping the strategy of BIS adoption.
	OD1_3	Top management is ready to take the possible risks of adoption and use of BIS.
	OD1_4	There is a person at the management level who strongly advocates the implementation of the BIS (warns the importance of implementing the system).
	OD1_5	There is a person at the management level who shows great enthusiasm in initiating the BIS adoption (motivates to adopt the system).
	OD1_6	There are one or more people at the management level who constantly emphasizes the benefits of BIS.
Organizational readiness (OD2)	OD2_1	Managers and employees know how to use BIS for business support.
	OD2_2	Managers and employees understand well how to use BIS in business.
	OD2_3	We have enough technical, managerial, and other skills required to adopt the BIS.
	OD2_4	We have enough financial, technological, and other resources required to adopt the BIS.
Data management as a backbone for decision-making processes (OD3)	OD3_1	The data we currently use in our business is reliable.
	OD3_2	There is an agreement on clearly defined business rules and a set of data definitions.
	OD3_3	The search for and use of data/information to support decision-making is encouraged.
	OD3_4	Decision-making processes involving quantitative/numerical analysis are encouraged.

Table 1. Cont.

Construct	Code	Measurement
Environmental dimension (ED)		
Competitive pressure (ED1)	ED1_1	The competition degree in our business brought the pressure that has influenced the decision on the BIS adoption necessity.
	ED1_2	Our enterprise had to start using BIS to maintain its competitive advantage in the market.
	ED1_3	I am aware that competitors already use BIS in their business.
	ED1_4	For our enterprise, it was strategically necessary to start with BIS usage.
BIS vendors' quality (ED2)	ED2_1	The reputation of the software manufacturer and/or provider is important when choosing a BIS.
	ED2_2	The technological competencies of software providers are essential when choosing a BIS.
	ED2_3	The ability of BIS producer and/or provider to successfully conduct the BIS adoption project is important to us while choosing BIS.
	ED2_4	It is important to us that the BIS manufacturer and/or provider support BIS use upon completion of the adoption project.
	ED2_5	Software manufacturers and/or providers promote BIS by offering free hours of education.

Source: Authors, work 2019. modified and adapted by (Boonsiritomachai 2014; Puklavec et al. 2018). BIS, business intelligence system.

### 3.3. Statistical Methods

Statistical analysis was conducted by using the following procedure. In the first step, factor analysis was performed. The influence of determinant statements within each observed variable analysis is presented through the obtained eigenvalue, the percentage of variance, and the cumulative percentage of variance. Then, a matrix of factor structure was made after Varimax rotation. This process confirmed the construct validity of the various factors. This result led to the identification of 9 variable groups (4 variable groups comprise the technology dimension, 3 variable groups comprise the organizational dimension, and 2 variable groups comprise the environmental dimension).

In the second step, Cronbach's alpha analysis was calculated for each of the 9 variable groups within the technology, organization, and environmental dimension. Since Cronbach's alpha values confirmed the reliability of the research instrument, average values were calculated for each of the 9 variable groups (4 summary variables comprise the technology dimension, 3 summary variables comprise the organizational dimension, and 2 summary variables comprise the environmental dimension).

Finally, the logistic regression model was developed, with the dependent variable measuring the BIS adoption, as the binary variable, and extracted factors reflecting TOE dimensions as the independent variables.

## 4. Results

### 4.1. Validity and Reliability Analysis

The authors performed factor analysis to identify selected determinants within each dimension and to check the selected framework applicability for the BIS adoption in Croatian SMEs. The results obtained by the Kaiser–Meyer–Olkin test (>0.5) and the Bartlett's sphericity test (statistically significant at 1%) indicated the adequacy of the data for factor analysis (Ferrando and Lorenzo-Seva 2018).

Table 2 shows the factor structure matrix after Varimax factor rotation for variables of all three dimensions. The results of the conducted factor analysis imply nine factors as proposed by the initial research instrument. However, only those variables with the factors higher than the cutoff value of 0.5 were retained in the further analysis. Some of the variables were omitted from the analysis, such as TD2\_2.

**Table 2.** Factor analysis and alpha coefficients.

Item	Factor										
	Mean	SD	TD1	TD2	TD3	TD4	OD1	OD2	OD3	ED1	ED2
TD1_1	4.21	0.913	0.629								
TD1_2	3.79	0.924	0.606								
TD1_3	4.42	0.741	0.858								
TD1_4	4.33	0.805	0.814								
TD1_5	4.08	0.961	0.560								
TD1_6	4.45	0.770	0.769								
TD2_1	3.29	0.967		0.707							
TD2_3	3.57	0.977		0.872							
TD2_4	3.02	1.063		0.877							
TD2_5	2.80	1.064		0.744							
TD3_1	2.90	1.267			0.727						
TD3_2	3.95	1.009			0.782						
TD3_3	3.82	1.009			0.786						
TD3_4	3.94	1.013			0.639						
TD4_2	4.08	0.929				0.668					
TD4_3	3.56	1.076				0.826					
TD4_4	3.10	1.150				0.827					
OD1_1	4.44	0.857					0.771				
OD1_2	4.12	0.967					0.731				
OD1_3	4.07	1.085					0.731				
OD1_4	4.21	0.891					0.821				
OD1_5	4.13	0.991					0.793				
OD1_6	4.10	1.000					0.681				
OD2_1	4.13	1.002						0.776			
OD2_2	3.94	0.941						0.721			
OD2_3	4.19	0.950						0.751			
OD2_4	4.19	0.873						0.742			
OD3_1	4.18	0.903							0.733		
OD3_2	3.76	1.006							0.651		
ED1_1	3.43	1.148								0.794	
ED1_2	3.52	1.159								0.835	
ED1_3	3.88	1.122								0.689	
ED1_4	3.76	1.065								0.769	
ED2_1	4.20	1.035									0.818
ED2_2	4.30	0.969									0.813
ED2_3	4.46	0.881									0.846
ED2_4	4.51	0.835									0.755
Cronbach's alpha			0.831	0.829	0.860	0.800	0.879	0.783	0.677	0.877	0.881

Notes: extraction method is Principal Component Analysis. Rotation method is Varimax with Kaiser Normalization. Source: Authors' work, 2019.

The statements within the questionnaire are translated from English into Croatian. Accordingly, our version of the questionnaire was previously tested within the sample, thus assuring the questions' clarity and comprehensibility. Cronbach alpha coefficients were calculated for providing a reliability analysis of the measurement scales. As Zeller (2005) propose, for this study, we used a Cronbach alpha coefficient limit value of 0.7 that indicates the adequacy of the measurement scale used.

#### 4.2. Regression Analysis

Since the aim of this study demands modeling the predictors of the binary dependent variable, the authors used logistic regression in this study. Many authors have used logistic regression in researching the adoption of different technologies (Awa et al. 2017; Suvedi et al. 2017), such as e-procurement system (Soares-Aguiar and Palma-dos-Reis 2008), ERP systems (Pan and Jang 2008), cloud computing (Senyo et al. 2016), and e-commerce (Walker et al. 2016).

The logistic regression model with the dependent binary variable ABIS was used for testing the impact of technological, organizational, and environmental dimension to the adoption of BIS, on the sample of Croatian SMEs. According to the obtained results shown in Table 3, it can be observed that there is no correlation between the variables, since no value of the variable surpasses the limit value of 0.9 (Hair et al. 2010). Therefore, it is concluded that there is no problem of multicollinearity in the model.

**Table 3.** Correlations between independent variables.

Variable	TD1	TD2	TD3	TD4	OD1	OD2	OD3	ED1	ED2
TD1	1								
TD2	−0.046	1							
TD3	−0.044	0.039	1						
TD4	−0.022	−0.014	0.042	1					
OD1	0.026	0.106	0.132	0.063	1				
OD2	0.024	0.081	0.17	0.074	0.231	1			
OD3	0.025	0.078	0.14	0.028	0.155	0.167	1		
ED1	0.038	−0.039	0.099	0.072	0.104	0.107	0.079	1	
ED2	0.002	0.098	0.196	0.085	0.154	0.177	0.158	0.127	1

Source: Authors’ work, 2019.

Table 4 represents the results of the goodness-of-fit of the research model. Presented value of 2 Log-likelihood is equal to 103,710 and thus statistically significant at 1%. The value of Cox and Snell R Square is 0.281, and the Nagelkerke R Square is 0.377. According to Hair et al. (2010), the model is considered more goodness-of-fit with the lower value of 2 Log-likelihood and the higher value of Cox and Snell R2 and Nagelkerke R2 value. Therefore, given the obtained results, it can be concluded that the model fit has significantly improved from the null model. Table 5 represents the prediction percentage of the research model that forecasted 62.8% BIS non-adopters and 78.9% BIS adopters with 72% overall prognostic correctness. Following all the obtained results of the conducted logistic regression, it is concluded that the research model fit the research data.

**Table 4.** Goodness-of-fit of the research model.

	Value
−2 Log likelihood	103,710 ***
Cox and Snell R Square	0.281
Nagelkerke R Square	0.377

Source: Authors’ work, 2019. Note: \*\*\* statistically significant at 1%.

**Table 5.** Classification table.

Actual	Predicted		% Correct
	BIS Non-Adopters	BIS Adopters	
BIS non-adopters	27	16	62.8%
BIS adopters	12	45	78.9%
Overall			72%

Source: Authors’ work, 2019.

Regression model, with dependent variable ABIS, is presented in Table 6. The following variables achieve a significant and positive influence on the dependent variable ABIS with 1% and 5% probability: OD2\_Organizational readiness, OD3\_Data management as a backbone for decision-making processes, ED1\_Competitive pressure, and ED2\_BIS vendors’ quality. The variable TD3\_BIS’s compatibility with enterprise information system is positively influencing dependent variable ABIS with 10% significance. Finally, four independent variables, namely TD1\_Perception of the comparative advantage of BIS, TD2\_Perception of BIS’s complexity, TD4\_Key personnel ability to assess the BIS benefits,

and OD1\_Top management organizational support, do not attain a significant impact on the observed dependent variable ABIS.

**Table 6.** Logistic coefficients.

Variable	B	Wald	Sig.
TD1	0.274	1.113	0.291
TD2	−0.050	0.038	0.846
TD3	0.462	3.223	0.073 *
TD4	0.320	1.701	0.192
OD1	0.406	2.418	0.120
OD2	0.798	7.512	0.006 ***
OD3	0.629	6.234	0.013 **
ED1	0.615	5.747	0.017 **
ED2	0.733	6.347	0.012 **
Constant	0.285	1.374	0.241

Source: Authors' work, 2019. Note: \*\*\* statistically significant at 1%, \*\* 5%, and \* 10%.

## 5. Discussion

As has been assumed, the risks of enterprises, and especially SMEs, are their limited resources, human, material, and financial. The analysis of the obtained results concludes that Croatian SMEs are dependent on their resources and that their rational use is crucial to them. As [Bijker and Hart \(2013\)](#) stated, a common challenge in using BIS within the enterprise is using it correctly in a purpose to achieve its business value, which demands proper training and educational programs for employees, which consequently can also lead to financial costs. Hence, the risks of insufficient financial resources, lack of professional staff, infrastructure, and other technological resources are just some of the risks that Croatian SMEs want to minimize when adopting new technology such as BIS. Given the nature of systems such as the BIS, which is to perform actions and analytical processes through the processing of internal and external data, Croatian SMEs have recognized the characteristics of the existing data as one of the potential risks that could slow down the BIS adopting process. According to [Bijker and Hart \(2013\)](#), a common challenge in BIS usage is inadequate data quality, improper data level and format, and unavailability of timely and accurate data. Therefore, this result shows that Croatian SMEs believe that, with better quality data and quantitative data processing processes, they can provide a safer path to the BIS's successful adoption in the enterprise's operations.

Contrarily, Croatian SMEs do not perceive organizational support as a potential threat for successful BIS adoption project conduction within their enterprises. The explanation for such results can rely on the fact that the top management of SMEs, in most cases, consists of owners of the enterprises at the same time ([Tan 2010](#)). Given the general knowledge by which information is currently the main resource for achieving a competitive advantage on the market, every owner strives to provide their enterprise with quality information and appropriate innovative IT, such as BIS, that will create new business knowledge. Accordingly, this result could potentially imply a high level of top-management innovativeness and IT knowledge within Croatian SMEs.

Within the environmental dimension, the obtained results show how SMEs see the competition and vendors' quality as potential risks that must be dealt with to succeed in the BIS adoption process. This result does not surprise us, since SMEs strive to achieve sustainability in a turbulent market and enhance their competitive advantage in their industry, so they want to minimize the potential risk of having stronger competition than themselves. Similarly, [Ahmad et al. \(2020\)](#), in their research, emphasize the importance of observing competitive pressure, as well as market trends as determinants that significantly impact the successful BIS adoption project completion. Moreover, a competitive advantage can be easily achieved by effectively using BIS. Since SMEs are often challenged with a lack of technical personnel, as well as financial, technical, and time resources, it is logical that they aspire to achieve a good deal with BIS suppliers. That includes timely and

cost-effective project achievement, as well as the vendor support after the adoption project is finished (Stjepić 2020). The risks come from the fact that BIS project adoption can be protracted if the requirements for project implementation are not clearly defined between the enterprise and the software provider (Olexova 2014). That can be explained by the strong enterprises' reliance on IT vendors as their strategic partners in the whole project of BIS, as Bijker and Hart (2013) argued in their work. Consequently, the mentioned reliance increase risks for enterprises of experiencing the adoption project failure, caused by insufficient vendors' skills or knowledge to complete the project on time and within budget. In that case, enterprises could suffer because of additional time or financial costs that they could avoid by developing their own in-house IT experts, as Bijker and Hart (2013) suggest.

Finally, within the technology dimension, Croatian SMEs recognize only BIS's compatibility with enterprise information system as a potential risk that could interfere with the safe path to a successful BIS adoption project. This result implies a lack of technology infrastructure, as well as a possible lack of BIS integration with existing systems, tools, software, business processes, and values within the Croatian SMEs. In the same way, Ahmad et al. (2020) recognize BIS's compatibility with enterprise information system as a significant determinant that impacts BIS adoption project success. Moreover, they stress the fact that BIS incompatibility with legacy systems, as well as with existent business procedures, could lead to BIS adoption project failure.

On the other hand, SMEs within the sector in the Republic of Croatia do not perceive BIS complexity, perception of the comparative advantage of BIS, and key personnel ability to assess the BIS benefits as potential risks of the BIS adoption success. This result can be supported by fact that the sector is based on working with a large amount of data and information and therefore the necessity of applying BIS in enterprises in this sector develops the motivation and desire of employees to master the application of its functionalities in work as soon as possible. Moreover, various cloud and mobile solutions for BIS, are contributing to BIS's ease of use (Stjepić 2020). A low level of perceived complexity by enterprises can be an indicator of highly educated and skilled employees (Ismail and Mokhtar 2016). Therefore, these results can point to the IT skilled and educated employees within Croatian SMEs for adopting BIS. Moreover, this result can be related to the descriptive analysis, which indicates that most participants of this research finished graduate studies (74%) and work as IT experts (28%) or top managers (24%). The reason why SMEs do not perceive determinant of BIS's comparative advantage as a risk, can rely on the fact that they do not see it as the financial load as they generate a smaller amount of data so they do not use BIS as a stand-alone solution. This result can be confirmed by similar researches on technological innovation adoption that also did not recognize Perception of the comparative advantage of BIS as a potential threat for technological adoption project success (e.g., Wang et al. 2010) SMEs often do not use BIS as a stand-alone solution but as a part of some larger enterprises' system (Puklavec et al. 2018). That could be the reason why they do not perceive BIS's benefits clarity presentation as a crucial determinant for its adoption project success as they do not perceive BIS as a separate tool. This result can be confirmed by the results Olexova (2014), who claims that the possibility of trying out the use of BIS and gaining insight into its benefits before its adoption does not necessarily need to have a significant impact on its use.

## 6. Conclusions

The conducted study contributes to the BIS literature, as well as the technological innovation adoption literature in the context of SMEs. The main goal of this paper was to identify the potential risks of the BIS adoption project in Croatian SMEs by investigating success factors within three TOE dimensions.

The results of the research revealed that Croatian SMEs consider organizational risks as most important when it comes to BIS adoption, like insufficient human, technical, and financial resources, as well as quality data managing level. Given the obtained results, Croa-

tian SMEs recognized potential risks for conducting BIS adoption within their competition and BIS vendor's support as well. Within the technology dimension, SMEs recognized BIS's compatibility with enterprise information system as a potential problem for enterprises that want to engage in the BIS adoption process.

On the other hand, Croatian SMEs do not experience a lack of organizational support, since this determinant is not identified as a potential threat for BIS adoption. The perception of BIS's complexity determinant is another determinant that is not recognized as a potential threat for the adoption process since today's BIS solutions are available in the form of a cloud or mobile solution and therefore becoming more accessible and easier to use for SMEs. Moreover, BIS software solutions are mostly used as an integrated model within some larger enterprise systems, so SMEs do not perceive their competitive advantage compared to other technological solutions. Hence, perception of the comparative advantage of BIS is the determinant that has also not been revealed as a potential risk for the BIS adoption project's success. Furthermore, the risk of BIS adoption does not arise from the lack of clear and understandable presentation of benefits to company employees, whose need for the presentment of its advantages was considered one of the factors of successful BIS adoption (Rostek 2013). The explanation for such a result may be in today's wide BIS availability and its use as an integrated module within another system.

Even though this paper expands the existing literature in the scientific field of BIS adoption in small and medium enterprises, this research has certain limitations that should be noted. First, this study is conducted on a small sample size that only encompasses the sector. Second, this research is only examined by using quantitative methods. Therefore, it is advisable for further research to conduct this study on a larger sample or within SMEs that operates under the primary or secondary sector. Likewise, the recommendation for future research is to conduct a qualitative analysis of this research to achieve the depth of understanding obtained results and more detailed proof of the relationship between the established variables.

**Author Contributions:** Conceptualization, A.-M.S., M.P.B., and V.B.V.; methodology, M.P.B. and A.-M.S.; validation, A.-M.S., M.P.B., and V.B.V.; formal analysis, A.-M.S.; data curation, A.-M.S.; writing—original draft preparation, A.-M.S., M.P.B., and V.B.V.; writing—review and editing, M.P.B.; visualization, M.P.B.; supervision, M.P.B. and V.B.V. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the Croatian Science Foundation, grant number IP-2014-09-3729.

**Acknowledgments:** This research has been fully supported by the Croatian Science Foundation under the PROSPER (Process and Business Intelligence for Business Performance) project (IP-2014-09-3729).

**Conflicts of Interest:** The authors declare no conflict of interest.

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