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Business Intelligence System Adoption Model for SMEs

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Abstract

Many prior studies on the business intelligence system (BIS) adoption stories are coming from the developed countries, while recent adoption stories on the developing countries are usually from Thailand, Singapore and Philippines. Rarely, research focusing on small and medium-sized enterprises (SMEs) being reported, especially from the developing countries such as Malaysia even after the introduction of BIS by Malaysia's SME in September 2013. Since, SMEs are the primary drivers for national development in Malaysia, the research on the BIS adoption in SMEs is important to promote the resilient growth of SMEs. This study aims to study the BIS adoption theories and determinants as reported by prior researchers and propose the BIS adoption model for SME in Malaysia. The developed research model contains ten, enabling determinants covering four characteristics: technological innovation, environment, organization, and CEO. The findings revealed that out of ten determinants, only six are relevant to the decision-making in BIS adoption.

Keywords: Business Intelligence System, small-and medium sized enterprises, determinants, adoption model

1. Introduction

Business Intelligence System (BIS) is an intuitive modeling of self-service analytics that able to capture and analyze an ample information of business data, which can be used to understand the pitfalls of organization' business models and as well enable the effective decision making and management support of an organization, with the overall purpose of increasing organizational performance (Fields 2014). Advances in visualization, BIS offered deeper analytics capability where the non-experts are able to use it without the need for extensive expert consultations or scripting (Fields 2014). Among the most important attributes of BIS are the ability to automatically trigger actions and alert the businesses with the market trends. According to Boonsiritomachai et al. (2014), the existing BI definitions allot two similar natures. The first allotment is on the important aspect of BI; this includes the process of accumulating, analyzing, and conveying information that needed for collaboration in an enterprise. The second allotment is focusing on the use of BI system in discovering actionable insights for better decision-making scenario (Boonsiritomachai et al. 2014). Ideally, BI can be defined as a one of a decisional-making system tools in which this application provides options for the organization to select the best approach from the listed options to be applied in an organization.

During the past decade, BIS has attracted attention from both academic researchers and industry practitioners. However, the author notice that, most of the previous studies conducted are based on the benefits of BIS implementation in the large enterprise. Seldom research focusing on small and medium-sized enterprises (SMEs) are being reported, especially from the developing countries such as Malaysia even though these SMEs are the primary drivers for national development (Boonsiritomachai et al. 2014). According to the authors Ong and Siew (2013), most of the adoption stories and cases of BI adoption are comes from developed countries such as Australia, Germany and America. While the recent adoption stories on the developing countries are usually from Thailand, Singapore and Philippines (Boonsiritomachai et al. 2014). Meanwhile, in Malaysia, most of the extensive papers are focusing on specific aspects of BIS, e.g. drivers and barriers for the BI adoption, critical success factors for the implementation of BI, and understanding the BI values (Loo 2013; Ong and Siew 2013), whilst many studies on the existed IT adoption model are concentrated on the collaborative e-commerce and e-business sectors (Oliveira and Martins 2011) cloud computing adoption (Amini 2014), accounting information systems adoption (Alla et al. 2012) and information and communications technology (ICT) adoption (Alam and Noor 2009; Hashim 2015; Hussin and Noor 2005; Selamat et al. 2011). There are none existing studies on BIS adoption for Malaysian SMEs. However, the Malaysian SMEs need BIS adoption to achieve the vision 2020 in order to promote developed economic since the current economy is shifting again from industry based-knowledge to a knowledge-based economy. Consequently, aiding the decision-making process of a business segment through the transformation of the existing data into knowledge is the major key success for Malaysian SMEs to achieve this target.

Since the knowledge on understanding and explaining the behavior of SMEs in technology adoption is poor. Well, this scarcity in understanding the determinant factors impacting the adoption of innovative technologies related to the usage of BIS by SMEs in Malaysia forms the basis of this present study. The authors feel that now is an opportune time to explore the current state of BIS and pinpoint those determinants affecting the technological adoption in SMEs area. Hence, the purpose of this paper is threefold. The first objective is to probe the current state of BIS adoption by Malaysia' SMEs. This objective provides an insight in determining the current state of BIS adoption in Malaysian SME through a comprehensive literature study and findings from this study. The second objective is to identify the determinant factors affecting the adoption of BIS in Malaysia' SMEs. For this objective, all the determinant factors that contribute to the successes of BIS adoption in SMEs will be identified. The third objective is to propose and validate the adoption model in identifying the determinants of BIS adoption in Malaysian SMEs.

The paper is organized as follows. The section 2 present the existing literature studies on what is a BIS and its relationship with SMEs, clarifying which questions the author would like to address. In section 3 the overall research method taken for this study is discussed. In the section 4 the findings of the review and the results of the experimental study are presented and discussed together with the conceptual adoption model; and finally, the section 5 summarizes the overall conclusion of the data analysis based on the purpose of the study and its implications.

2. Literature Review

In this section, the existing literature review studies until 2015 will be presented. The purpose of this section is to position our literature review with regard to existing knowledge about the BIS field, and to formulate specific research questions to be asked and issues to be discussed on the basis of our findings.

2.1 What is Business Intelligence System?

Historically, it was Sir Richard Millar Devens that starts introducing the term business intelligence to public in 1865. Previously, the term BI symbolizes on how Sir Henry Furnese (the banker) use and act upon the information, studying his external environment and earned profits, a step ahead of other competitors (Devens 1868). An ability of Furnese in accumulating and responding to the information retrieved in a real-time manner, is the concept of BI today. Started as assistance decision-making and planning tools in the late 1950s. The understanding of BI systems today, has evolved from the traditional decision support systems to a contemporary management information system (MIS) where a decision - support system (DSS), enterprise system (ES), executive information systems (EIS), online analytical processing (OLAP) and BI have gained popularity among enterprises that look for

improvement in the decision-making process (Luhn 1958). In regard to the growing popularity of BI systems in managing organization valuable resource, today BIS has greatly changed the daily lives of today's businesses. The strategic use of BIS can help the organizations compete with their business' competitors and gains competitive advantage through a considerable movement in operating business activities. Developing a business strategy with the BIS component that in line with business objectives, and is supported by a sound business need, will enable an enterprise to upgrade work performance, deliver excellent customer service, escalate the productivity and help mitigate the risks involved with organizational decisions.

2.2 The Current State of Innovation and Technology Adoption in Malaysian SMEs

In general, there are various SME definitions given in accordance with certain aspects of a business such as the output type, number of employees hired, fixed asset size, capital, sales and so on. Each country will use different standard sizes and different criteria as the measurement and assessment of SMEs. In Malaysia, the definitions are solely based on the size of operation, the total number of capital, the total number of workers, total assets and sales turnover or also known as total revenue (Hashim and Abdullah 2000). According to the National SME Development Council (2013), SMEs in the manufacturing sector are defined as enterprises with full-time employees not surpassing 200 workers or annual sales turnover not surpassing RM50 million, whereas SMEs in the services and other sectors are defined as enterprises with full-time employees of not surpassing 75 workers or annual sales turnover not surpassing RM20 million.

Undisputedly, over a few decades ago, the Malaysian economy has passed through a considerable transformation from agricultural-based to industry-based. However, Khan and Khaliq (2014) claimed that now the economy is shifting again from industry-based to a knowledge-based economy in order to achieve the vision 2020 and to become a developed economy. Therefore, the major key success for Malaysian SMEs to achieve this target is depending on how SMEs can utilize the use of technology to acquire the information and transformed it into knowledge. Basically, this information can be accessed through performance monitoring and activities running inside the firm. Innovation and technology often fall to the wayside as SMEs are very pre-occupied with sustaining the day-to-day running of their business operations. In the past, a lot of resources have been devoted to research and development (R&D) and basic research but the results have not been forthcoming. Hence, increasingly the focus of the Government has now shifted to licensing Intellectual Property (IP), bringing products to the market through commercialization as well as encouraging industry-driven research through closer collaboration between the industry, academia and public sector (NSDC 2013). The Government has also stepped up the program to encourage ICT adoption in business operations, online commerce and e-payment applications.

In 2013, BIS has been introduced to the Malaysia's SME community to improve the publication of the Malaysia SME® Community Directory by offering detailed and relevant data about the company which includes facts, consumer preferences, and statistics on nineteen (19) business communities driven by the SME (Corporation 2013). However, even after the introduction of BIS, today SMEs still use the Excel spreadsheets for the administrative task. The SMEs concerned about the money that they need to spend to implement this technology as the overall cost related to purchasing hardware and software, maintenance, training and additional equipment are very pricey where they cannot afford it (Boonsiritomachai et al. 2014). However, there is some cases where some advanced SMEs subscribes or pay-as-you-go basis on the Software as a Service BI (SaaSBI) offered by BI vendors to access the BI functions instantly (Sheikh 2011).

2.3 Related Theories

For Information System (IS) adoption theories, the relevant theories that frequently used to study innovation adoption, according to the increasing level of impact are;

Theories that impact on individuals:

- The theory of planned behaviour (TPB) (Ajzen 1985);
- The theory of reasoned action (TRA) (Ajzen and Fishbein 1980); and
- The technology acceptance model (TAM) (Davis Jr 1986)

Theories that impact on societies:

- The diffusion of innovation theory (DOI) (Rogers Everett 1983); and

- The unified theory of acceptance and use of Technology (UTAUT) (Venkatesh et al. 2003).

Where, these relevant theories can be viewed based on two broad perspectives based on their center attention which as follows;

- Macro point of view: Theory is developed by focusing on organizational change. The study purpose is to investigate change as an overall operation that involves restructuring and reorganizing the enterprise.
- Micro point of view: Theory is developed by focusing on the spread of technology adoption. Here, the study purpose is to investigate changes in the current operations that can be applied to other parts of the enterprise.

From the systematic literature reviews, the authors found that major studies on the IS adoption use the theoretical background of technology-organization-environment (TOE) framework to describe the multiple perspectives of an innovation characteristic or combine the TOE with the other IS innovation theories to investigate the adoption process (Boonsiritomachai et al. 2014). Those famous IS innovation theories are TPB, TAM, UTAUT, the DOI theories. However, the authors found that DOI and TOE theory are the most relevant to be applied in studying BIS adoption because these theories can be applied at the firm (organizational) level within the SME context. While the rest, TPB, TAM and UTAUT are solely at the individual level, which only focused on the individual perceived benefits instead of an organizational perceived benefit (Oliveira & Martins, 2011). It has been proven by the prior researches who already applied DOI and TOE theories in their studies that both of these theories suit for studying both individual characteristics and organizational characteristics (Oliveira & Martins, 2011). In particular, there is an evidence that Roger's DOI theory has extensively been used by scholars from different fields, either to confirm the validity of the model; or used as the constructs to interrogate the diffusion of an innovation by modifying the model and propose a new model. Many studies combined the DOI model and the TOE framework to study the IT/ICT adoption in SMEs (Boonsiritomachai et al. 2014; Chen 2003; Daryaei et al. 2013; Olexova 2014; Oliveira and Martins 2011; Puklavec et al. 2014).

In addition, the TOE framework describes the process by which an enterprise adopts and implements technological innovations are influenced by these three attributes; technological, organizational, and environmental contexts. Basically, the concerning characteristics of technological innovations that are salient to the attitude formation are relative advantage, observability, and complexity (Tornatzky and Fleisher 1990). Basically, the TOE framework used to;

1. Identify and describe the application's perceived relative advantage (the extent to which the technology offers improvement over currently available tools), compatibility (ease of interaction), and complexity (ease of learning), and as innovation characteristics that are salient to the attitude formation of the individual to make decision in determining the capabilities of BIS in supporting their main business operation. Some of the researchers refer this capability as a determinant, a determinant that brought the individual to accept the BIS technology so that better methods for designing, evaluating, and predicting how users will respond to new technology can be developed.
2. Study the possible, enabling factors impacting innovation adoption characteristic of technological innovation. TOE framework provides a useful analytical framework that can be used for studying the adoption and assimilation of different types of IT innovation.
3. Study the key determinants of innovation adoption in organizations.
4. Identify instrumental determinant candidates for delving deeper into BIS adoption in SMEs by leveraging semi-structured interviews with BIS experts.
5. To study the adoption and assimilation of different types of IT innovation specified within the three TOE contexts. The TOE framework has a solid theoretical basis, consistent empirical support, and the potential for application to IS innovation domains, though specific factors identified within the three contexts may vary across different studies.

Meanwhile, the DOI theory intensive on how, why, and at what rate new ideas and technology spread through cultures, operating at the individual and firm level. The DOI theory sees innovations as being communicated through certain channels over time and within a particular social system (Rogers 1995). This DOI theory offers a conceptual framework/model for discussing acceptance at a global level. There is a research attempted to extend diffusion theory to more complex adoption scenarios (Dillon and Morris 1996). For example, organizational innovativeness or organizational change can

encourage (or discourage) the user acceptance explicitly through a new organizational method implementation in the firm's business practices, workplace or external relations. Thus, studies that examine the acceptance level in the firms need to account for the potential importance of organizational innovativeness (Oliveira and Martins 2011). According to Olexova (2014), DOI theory focused on the factors that impact the speed of adoption of innovations as innovation diffusion theory provides a general framework/model within where the social impact of a technology can be modeled. This could provide an insight into the characteristics of the particular groups to adopt BIS in a different phase. To be clear, DOI reviewed perspectives in which one may examine the uptake and impact of information technology over time pertaining to innovation characteristic. Essentially, in this recent area of innovative technology, many researchers had seen this innovation characteristic could provide a little explicit treatment of user acceptance and drive individual adoption decisions (i.e. observability, perceived relative advantage and perceived complexity) of up taking BI system to a specific group or organization to adopt it (Rogers 1995). Further discussion on this are discussed in Section 4.

3. Methodology

To be able to gain an overview of a research field and answer the research questions mentioned above, this study adopted a quantitative approach and a positivist paradigm to construct the adoption model. The methodology is divided into two stages. The first stage is the quantitative meta-analysis of systematic literature reviews (SLR) on the theoretical foundations of IS adoption, and the second stage is the quantitative case study (survey) of BIS adoption in Malaysian SMEs.

Stage 1: Systematic Literature Review

This SLR approach proposes on the searching and reviewing the literature on the theoretical foundation of BIS adoption in Malaysia's SMEs; predominantly the focus here is on how, the nature of business intelligence is perceived and reported by previous researchers. By following Bandara et al. (2011), this study applied three staged method to extract, analyze and report the literature based findings. The first stage involved identifying the related articles to be included in the review. The second stage is made up of designing and implementing an appropriate classification scheme to match with the study objectives. Finally, the third stage consists of synthesizing the finding data and analyzing the literature (the initial findings in Section 4) to respond to the research objectives of this study. The Figure 1 illustrates each phase in detail.

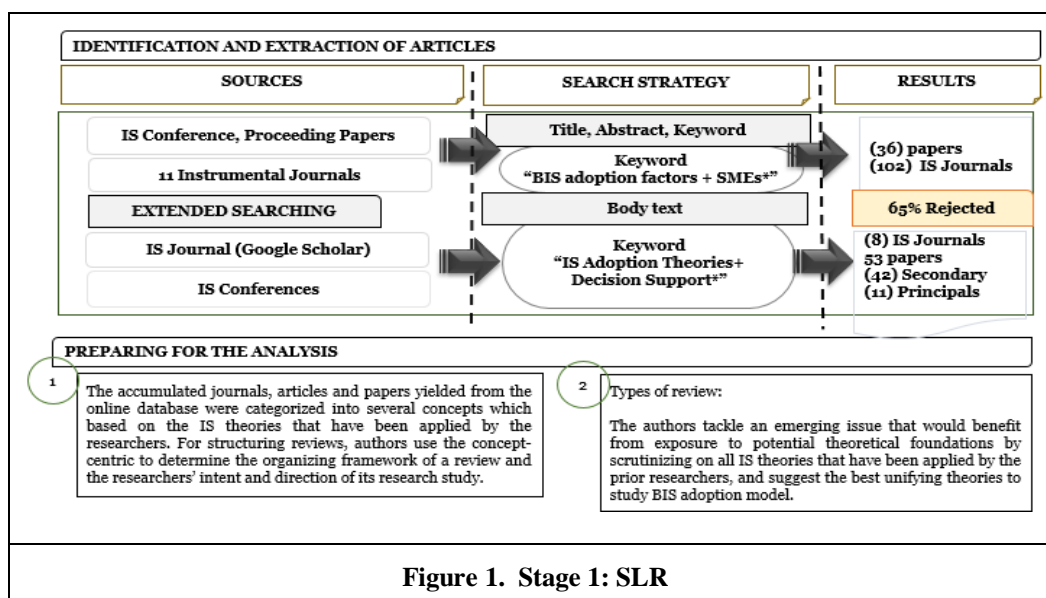


Figure 1. Stage 1: SLR

Stage 2: Quantitative Case Study (Survey)

The second stage employed a quantitative methodology through a survey technique based on the concept of self-administered questionnaire. It was developed based on the previous similar studies

and relevant literature, and was reviewed by three BI experts. The designated questionnaire applied the close-ended questionnaire of 5- point Likert scales with the aim to identify the determinants affecting the adoption of BIS in SMEs in Malaysia. This questionnaire consists four parts, the first part is the basic information on the respondents' profile; the second part is the questions related to the use of information in enterprises and company background; the third part is the questions related to the enabling factors for BI adoption (the determinants) and finally, the fourth part is the questions regarding technology adoption level within the enterprise. The sample was randomly selected from a publicly accessible list obtained from the SME Corp and Human Resource Development Fund (HRDF) databases by using a stratified sampling technique, followed by systematic sampling and distributed to 320 participants of Malaysia's SME with the expectation of getting at least 96 responses. Empirical data were collected by using online questionnaires (SurveyMonkey). A partial least squares structural equation modelling (PLS-SEM) technique is used to analyze the data, measure the constructs and validate the model (following Hair et al 2010' rule). Table 1 below shows the steps undertaken to evaluate the measurement model. While, the data collection and the response rate are discussed in the next section in detail.

Table 1. Steps to Construct Validity			
Steps	Validity test for	Description	Measured value
1. Run PLS algorithms	Indicator/Factor Loading Reliability	Test the convergent and discriminant validity of the 1 to 5 Likert-scale questionnaire formats.	Recommended factor loading ≥ 0.6 , items under 0.4 should be removed from the constructed model.
2. Construct Reliability	Items reliability	Cronbach's Alpha used to estimate the reliability based on the indicator intercorrelations for internal consistency.	$\alpha \geq 0.7$ is regarded as satisfactory and /or $\alpha \geq 0.6$ is also acceptable for an exploratory study.
3. Test Composite Reliability	Composite reliability	Composite reliability takes into account that indicators have different loadings, and can be interpreted in the same way as Cronbach's Alpha.	≥ 0.7 has high reliability, if below should reconsider the measured model.
3. Construct Validity	Convergent Validity	Average Variance Extracted (AVE) is used to measure the amount of variation captured by a construct in relation to the variance explained by the common factor.	≥ 0.5 is satisfied, meaning that a latent variable is able to explain more than half of the variance of its indicators on average.
	Discriminant Validity	Applying Confirmatory Factor Analyses (CFA) model of cross loadings by considering AVE value to evaluate it.	Each reflective indicator load highest at least 0.5 on the construct it is linked to. If an indicator has a higher correlation with another latent variable than with its respective latent variable, the appropriateness of the model should be reconsidered.

Table 1. Steps to Construct Validity

4. Analysis & Results

4.1 Descriptive statistics of 100 respondents

There were 100 participants in the final sample for this study from overall 320 participants. Although 121 questionnaires were returned, 21 of it were excluded for two reasons. First due to answered questionnaires does not satisfy and fulfill the SME's criteria and the second is due to incomplete survey. Summaries of the data collection and usable response rate are shown in Table 2.

Table 2. Data Collection and Response Rate				
	Sent out	Completed	Non-delivered	Response rate

		Survey	Survey	(from 320)
First round	320	86	36	26.8750%
Second round	198	35	0	10.9375%
Total completed survey		121		37.8125%
Not meeting SME's criteria		7		
Incomplete survey		14		
Usable response for analysis		100		31.25%

Table 2. Data Collection and Response Rate

The majority of respondents were female at 64.0%, with male comprising 36.0%. Respondents' ages ranged from 18 to over 50 years, with the highest percentage being 21 to 30 years, which 67.0%, and the smallest 18 to 20 years with 1.0%. In terms of education level, SME respondents who had completed a bachelor degree contributed to 64.0% of the total, while only 5.0% had graduated from high school or equivalent followed by master degree or higher education with only 7.0%. In regard to respondents' role in the enterprise, about 3.0% of respondents held owner-manager positions, while 8.0% were managers, 85.0% as employees and 4.0% of other positions, which was an intern to the enterprise. In terms of respondents' position in the enterprise, the majority who answered the survey held junior executive/IT officer position (53%), followed by another (IT or business consultant) which is 23.0%. Only 2% are answered by the director board and 1% by the CIO. In terms of user type for BI or any analytical tool software such Microsoft Excel, SAP and etc., Most of the user type used these tools were from the executive user division (37.0%) or by the IT staff division (22.0), and only 12.0% of the partner consumers. The least was used by the functional manager and other with both of these users score 4.0%. Next, in terms of respondents that have formal qualification on operating BI systems, either the respondents were certified as business intelligence professional or have SAS accreditation. 78.0% answered no as their answers, 16.0% in the process of getting the formal qualification and 6.0% already been certified as a professional. Moving on to the respondents' BI training experience, majority 70.0% answered no, 22.0% answered in process and 8.0% already experiencing BI training. When compared this BI training experience item with the BI qualification item, there is an assumption that can be made which is, 8.0% of respondents that answered "no" on having BI formal qualification is currently doing the BI training, or 2.0% of respondents that have BI training experienced is now in the process of getting a BI formal qualification.

In terms of enterprise backgrounds, the overall industry type was well suited and comparable with the sampling frame retrieved from the SME Corporation and HRDF database. The majority of enterprises were from the wholesale/retail sector at 38.0%, followed by services, manufacturing, construction and primary agriculture at 33.0%, 24.0%, 4.0% and 1.0 % respectively. As this study focuses on SMEs, enterprises that did not meet the SME criteria given earlier were excluded. With this study limiting the number of employees working in enterprises to 200, around one-thirds (37.0%) of the sample were categorized as small businesses with 50 employees or less, and the remainder was categorized as medium businesses with between 51 to 200 employees. In regard to annual budget located for IT tools or purposes, basically, most SMEs allocate RM550, 000 and less in the IT budget with 47% of SMEs spend RM251, 000 to RM550, 000 and 36% less than RM250, 00. In relation to the length of time in business, around 63% of responding enterprises indicated that they had been operating more than 10 years, 22% between six to ten years and 14% between one to five years. Only a small proportion of responding enterprises (1%) were start-up enterprise which had been operational for less than one year. In terms of location, despite the random selection of the sample, results show that participating enterprises from Johor came first with 26.0%, followed closely by Selangor (23.0%) and W.P Kuala Lumpur (17%). The fourth places were held by the Pulau Pinang (7.0%) and the rest contributed only 1% to 5% of responding enterprises. Next, in terms of areas in which the enterprise uses the BI system or any analysis software to support business activities, customer management (15%) activity dominated the first place. Followed by the market research, strategic analysis and stock control activities with 13.82%, 11.76% and 10.0% respectively. While, the lowest percentage scored by the staff planning activity (5.59%). Surprisingly, these results were supported by the respondents' answers in the next item where most of these IT business initiatives targeted at business process improvement (15.55), targeting customer and market more effectively (14.62%), expanding current customer relationships (12.53%) and expanding into new markets (11.83) and these answers correlate with the customer management, market research and strategic analysis attributes. Lastly, only 0.23% of the respondent answered "other" and specifying establishes relationships with key accounts and creates networks of business contacts as an answer.

4.2 RO1: The Current State of BIS Adoption in Malaysian SMEs

When related to SMEs, there is no doubt that SMEs play a pivotal role in enhancing the economic development of Malaysia. In this process, a wealth information is needed in order to attain its sustainability. The recent data gathered from Ong and Siew (2013) regarding with the BIS adoption in Malaysia show that the current market is deem towards the BIS implementation due to its ability to bring values towards the enterprises. Basically, in terms of providing a systematic process for an organization to collect, analyze, and disseminate information from the information sources and later to be consumed in the decision-making process of their business activities. However, when discussed on the BIS adoption in Malaysia, the author sees that the pattern of adoption can actually be categorized into two;

1. Seriously or actively adopting BIS: refer to the large enterprises. In due to the market demand and fully financial supports, these large enterprises are seriously considerate in adopting BIS (Ong and Siew 2013).
2. Thoughtfully or considerately adopting BIS: refer to the mid and small sized enterprises. Although SMEs requires BIS as a business competitiveness tool, but due to limited financial resources, lack of skills and human resources, it restricts their intention to adopt BIS (Boonsiritomachai et al. 2014). Even many designated study marks that the IT implementation in the SMEs as an unsuccessful and because that the adoption rate is slow (Nguyen 2009).

From the literature review, it was found that the SMEs still in the laggard state. However, in order to confirm this statement, a survey was conducted by asking about the respondent experience with BIS and/or do they have any qualification in operating BIS. The findings reveal that, the state of BIS in Malaysian SMEs is straggler and unstable even there are various types of industries have begun to implement BIS, the results show that only 6-8% SMEs in Malaysia was fully implemented BIS and 16-22% are still in the process of adopting BIS, these results were based on only 100 participants of SMEs, but if compared to the total establishment of SMEs which is 645,136, the amount of BIS adoption is still comparatively low. In the context of the BIS adoption of all developing countries' SMEs, many researchers claimed that the level of use of the BIS in Malaysia is lagging behind when compared to the other, such as Thailand, Singapore and Philippines (Ong and Siew 2013). Most of the BIS usage among the Malaysian SMEs is fixated on the reporting, statistical analysis, forecasting, decision-making, budgeting, and KPI monitoring. In conclusion, the pattern of BIS adoption in Malaysian SMEs is still in the consideration stage, even among those who are aware of the BIS capabilities. The SMEs may still be doubtful of the return on investment and therefore are delaying BI deployment that could bring a competitive edge to their business.

4.3 RO2: Determinants Affecting the Adoption of BIS in Malaysian SMEs

The initial research model of BIS adoption is constructed based on all the identified determinants that were found has a positive impact on IT/BIS adoption in SME based on the findings of the priori studies. Table 3 elicits the potential determinants that may affect BIS adoption based on broad categories and Table 4 exhibits the determinants for each category in detail.

	Characteristics			
	Technological	Organizational	Environmental	CEO
Boonsiritomachai et al. (2014)	Yes	Yes	Yes	Yes
Olexova (2014)	Yes	No	No	Yes
Puklavec et al. (2014)	Yes	Yes	Yes	No
Daryaei et al. (2013)	Yes	Yes	Yes	Yes
Olszak and Ziemba (2012)	Yes	Yes	Yes	Yes
Oliveira and Martins (2011)	Yes	Yes	Yes	Yes
Hartley and Seymour (2011)	Yes	Yes	Yes	Yes
Damanpour and Schneider (2006)	Yes	Yes	Yes	Yes
Chen (2003)	Yes	No	Yes	Yes
Estrin et al. (2003)	Yes	Yes	Yes	Yes
Caldeira and Ward (2003)	Yes	No	Yes	Yes
Thong et al. (1994)	Yes	Yes	Yes	Yes

Table 3. Findings on potential broad categories of factors of IT/BIS adoption by organizations based on selected papers

Table 4. Findings on determinants of IT/BIS adoption based on selected papers					
	Theory (ies)	Characteristics			
		Technological	Organizational	Environmental	CEO
Boonsiritomachai et al. (2014)	DOI theory, TOE model, IS Adoption Model	Complexity, Compatibility, Trialability, Observability and RA	Organizational size and age, organizational resource availability	Competitive pressure, vendor selection,	Owner-manager's innovativeness & IT knowledge.
Olexova (2014)	DOI theory	RA, Compatibility, Triability, Observability, Complexity.			CEO' innovativeness
Puklavec et al. (2014)	DOI theory, TOE model, Lacovou Model	Technological expected benefits, Perception of strategic value	Cost, Organizational culture & size, Organizational readiness	External support.	
Daryaei et al. (2013)	DOI theory, TAM theory, TPB theory, TRA theory	Perceived ease of use, Perceived usefulness	Venturesome, Social influences	Perceived risk, Task fit	Motivation, CEO's, computer literacy
Olszak and Ziembra (2012)	Inductive Reasoning Skills.	The kind of BI technology tools/ Perceived ease of use	Organizational structure & changeability, Organizational innovativeness	BI sustainability, business needs, vendor selection,	CEO's innovativeness and IT knowledge
Oliveira and Martins (2011)	DOI theory, TOE model, Lacovou model	Technology availability, perceived benefits	Organizational innovativeness Organizational readiness	External pressure, Technology support infrastructure, Government regulation	Owner managers' innovativeness
Hartley and Seymour (2011)	RAL, Heeks Design-Reality gap model	Data quality, Relative Advantage, Complexity	Organizational resource availability,	Market structured processes	Leadership skills
Damanpour and Schneider (2006)	TOE model	Relative advantage and complexity	Organizational innovativeness	Environmental pressure	Top managers' innovativeness & IS adoption decision.
Chen (2003)	DOI theory	Technical approach		Enabler approach	Managerial approach
Estrin et al. (2003)	TIDE programs	Technological cost	Organizational Fit	Pressure to be productive	Information expertise
Caldeira and Ward (2003)	Resource Based Theory	Relative Advantage		Collaboration	Educational sense making
Thong et al. (1994)	TOE model, KAI Inventory	RA, Compatibility, Complexity	Business Size, Employees' IS Knowledge	Business Competition	CEO's innovativeness

Table 4. Findings on determinants of IT/BIS adoption based on selected papers

The findings demonstrate that the technological, organizational and environmental characteristics of the TOE theory and the CEO' characteristics from the DOI theory suggested four main factors that

needed to construct the main context for the theory model building and as well its identified determinants for each category. However, in order to narrow down all of those identified determinants, again, the author tries to seek for the supporting evidence for each identified determinant based on IT adoption in Malaysian SMEs and those unsupported determinants are excluded from this study as we want a very solid determinant that have significant influence to BIS adoption in the Malaysian SMEs. Table 5 presents the supporting evidence for these potential, enabling factors affecting BIS adoption and Figure 2 show the initial model of a proposed BIS adoption model. The operational hypotheses are then formulated based on these supported determinants in which; either:

- H0: There is no correlation between H1, H2, H3, H4, H5, H6, H7, H8, H9, H10 and BIS' adoption.
- H1: There is a correlation between H1, H2, H3, H4, H5, H6, H7, H8, H9, H10 and BIS' adoption.

No	Determinants	Results of prior studies	IT Fields
H1	Relative Advantage	Relative advantage positively affects IT adoption in Malaysian SMEs (Ahmad et al. 2011; Alam and Noor 2009; Hashim 2015; Loo 2013; Ong and Siew 2013)	ICT BIS E-Commerce
H2	Complexity	Complexity positively affects IT adoption in Malaysian SMEs (Hussin and Noor 2005; Selamat et al. 2011)	E-Commerce, ICT
H3	Observability	Observability positively affects IT adoption in Malaysian SMEs (Hashim 2015; Hussin and Noor 2005)	E-Commerce, ICT
H4	Internal Pressure	Internal pressure positively affects IT adoption in Malaysian SMEs (Ahmad et al. 2011; Loo 2013; Nguyen 2009; Ong and Siew 2013; Sin 2010)	BIS IT/ICT
H5	External Pressure	External pressure positively affects IT adoption in Malaysian SMEs (Ghobakhloo et al. 2011a; Loo 2013)	BIS IT/ICT
H6	External Task	External task positively affects IT adoption in Malaysian SMEs (Ahmad et al. 2011; Alla et al. 2012; Loo 2013)	AIS IT
H7	Market Trends	Market trends positively affects IT adoption in Malaysian SMEs (Loo 2013; Sin 2010)	BIS IT/ICT
H8	Organizational Innovativeness	Organizational innovativeness positively affects IT adoption in Malaysian SMEs (Ghobakhloo et al. 2011a; Ghobakhloo et al. 2011b; Selamat et al. 2011)	ICT
H9	Organizational Readiness	Organizational readiness positively affects IT adoption in Malaysian SMEs (Ai Ping Teoh 2014 ; Ghobakhloo et al. 2011a; Shah Alam et al. 2008)	BIS E-Commerce, ICT/IT
H10	Owner-managers' Innovativeness	Owner-managers' innovativeness positively affects IT adoption in Malaysian SMEs (Alam and Noor 2009; Ghobakhloo et al. 2011a; Hashim 2015; Nguyen 2009)	ICT E-Commerce

Table 5. Supporting evidence for each proposed determinant based on IT adoption in Malaysian SMEs

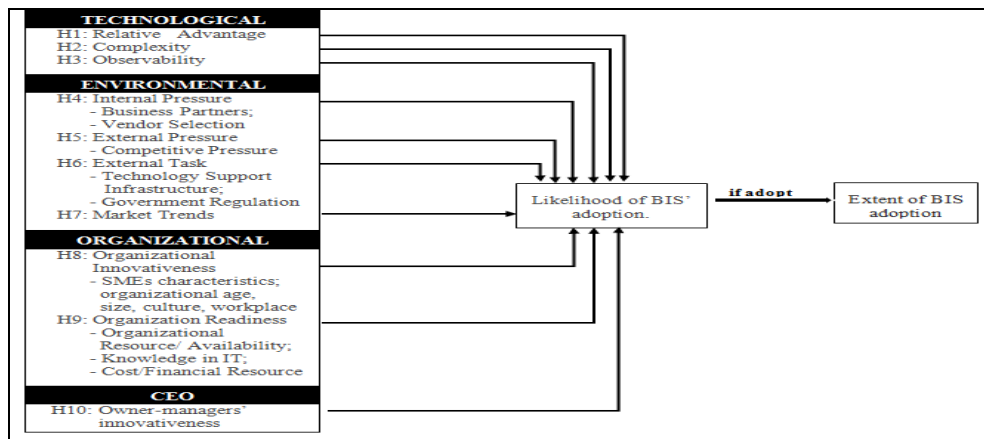


Figure 2. Initial BIS Adoption Model for SMEs

4.4 RO3: Revised BIS Adoption Model for Malaysian SMEs

After making an identification of the most important determinants in BIS adoption, the initial research model was evaluated by using an SEM PLS technique to indicate the relative T value and the P value of each item to specify the relationship of each ten proposed determinants with the BIS adoption. Based on the results of hypothesis tests, six out of ten hypotheses are confirmed to have correlations with the BIS adoption. These six hypotheses are as follows; Hypotheses H1 and H3 under technological contexts of relative advantage and observability. Hypotheses H4 and H6 under environmental contexts of internal pressure and external task. Hypotheses H8 and H9 under organizational contexts of organizational innovativeness and organizational readiness. Hypotheses H2 (complexity), H5 (external pressure), H7 (market trends) and H10 (CEO’ innovativeness) shows an absolute T and P values which are below the satisfactory conditions (T-statistical <1.96 and P-value > 0.05), therefore these four hypotheses are rejected as it is unsupported by the T and P values. The Table 6 shows the overall results for each hypothesis in this study. Figure 3 below is the revised model of BIS adoption for this study.

Hypotheses	Composite Reliability	AVE	Path Coefficients	T-test	P-value	Results
H1	0.803	0.509	0.307	2.963	0.003	Supported
H2	0.812	0.596	0.047	0.868	0.386	Not Supported
H3	0.775	0.553	-0.258	2.825	0.005	Supported
H4	0.782	0.554	-0.317	2.864	0.004	Supported
H5	0.821	0.539	-0.043	0.566	0.571	Not Supported
H6	0.853	0.744	0.211	2.199	0.028	Supported
H7	0.822	0.543	0.016	0.240	0.810	Not Supported
H8	0.795	0.668	-0.294	2.576	0.010	Supported
H9	0.822	0.608	0.285	2.981	0.003	Supported
H10	0.829	0.626	0.075	1.009	0.313	Not-supported

Table 6. Hypotheses Results

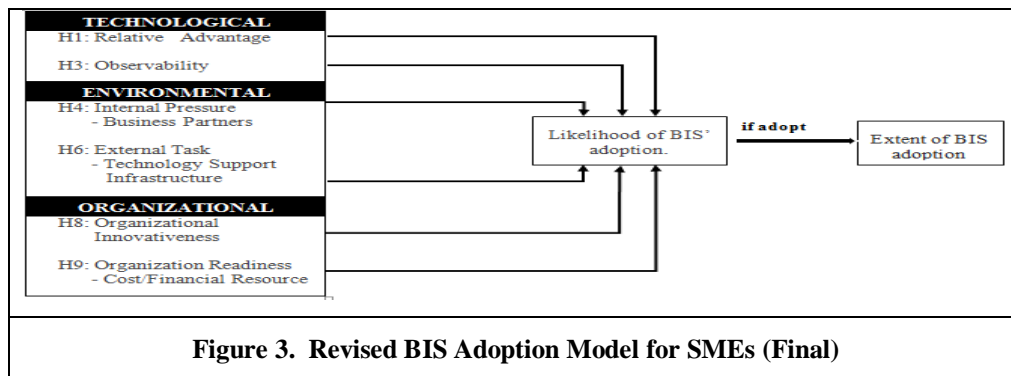


Figure 3. Revised BIS Adoption Model for SMEs (Final)

Since this study implies all the positive determinants at the first process of initial BIS model development, where all of these ten (10) suggested determinants were supported by prior researchers on the IT/ICT adoption studies in Malaysia’s SMEs. So, it is quite surprising when some of these suggested determinants are rejected. One of the possible reasons found to explain such phenomenon is that these rejected determinants are more significant during the implementation stages of adoption, but less important for the initiation stages of adoption or vice versa (Ai Ping Teoh 2014; Nguyen 2009). According to Ai Ping Teoh (2014), despite all the previous study that shows the positive relationship on those suggested determinants, but sometimes when test on the different contexts, these results might be changed and varied. The four rejected determinants might be fully evaluated if the SMEs are in the state of implementing the BIS where this SMEs can fully see and truly understand of what BIS really capable with. This explains why most of the respondents answered neutral for these four items including the external task items on the government regulation and internal pressure items of vendor selection. This neutral answers affects the reading of T-values and P-values and somehow might affect the adoption of BIS a little bit, because the result is in between correlated and not

correlated. As we know, one of the key characteristics of SMEs is the lack of resources. This includes financial strength, knowledge acquisition, skilled workforce, and high-tech technology. Most of the SMEs production does not apply a high level of technology, sophisticated machinery and highly skilled workers unless there is needs, requirements, challenges by the enterprise. We assume for now, these four rejected determinants are not really related to them during the initiation (adoption) stage, but in the implementation stage, the answer might be yes. Maybe the six supported determinants are evaluated by of what benefits BIS could bring to them, how BIS can fulfill their internal enterprise needs and improve their collaboration with the partners, how important the technology support infrastructure, organization readiness and innovativeness of their enterprises will lead to technology adoption. Overall, all of these answers were basically based on the initial adoption perspectives of what an enterprise really need and care.

5. Conclusion & Implication

This research was conducted by studying the BI determinants based on two selected theories which are DOI theory and TOE to come out with the BIS adoption model relatively for Malaysia's SMEs. In brief, the BI systems have been introduced to the Malaysia's SME community by SME Corporation in September, 2013. In particular, there is evidence that the BIS adoption level within the SME communities are still low- only the large enterprises are synonymous with the BI tool applications as most of BIS implementer were from the large enterprises. Most of the BIS adoption studies in Malaysia were focused on the well-established enterprises and barely on the SMEs, where most of these studies in SMES are majorly featured on the critical success factors and the barriers of BIS. Hence, this study points to a lack of inclusive research model for examining the determinants that influence the adoption of BIS in SMEs. This leads to the research aims of this study, which is to identify the determinants affecting the adoption of BIS and explore the current state of BI adoption in Malaysia's SMEs. Based on the review of previous studies, ten possible determinant factors were suggested as the constructed items in the initial BIS adoption model development. All ten determinants are categorized into four different contexts; three determinants under the technological context, two under the organizational context, four under the environmental context, and one under the CEO context. A survey technique was used to collect the empirical data. The sample was drawn from the SME Corp and HRDF databases by means of a stratified random sampling technique. The data analysis was based on 100 participants of SMEs in Malaysia. The results reveal that in terms of BI user's experience; only 30% have experience in BI training where 16% of them is currently getting the formal qualification on operating BIS, 6% of them already been certified as a professional and 8% is not decided yet to apply it. Additionally, the results also show that when do the cross-tabulation analysis between the type of industries and BI roles/application, most of the BI role centered on the manufacturing, wholesale/retail and services industries. Ranking from the important role of BI which is reporting, decision-making, forecasting, statistical analysis of the less important role which is the KPI. Whereas, the results of evaluating the determinant factors using PLS SEM of T-tests indicate six out of the ten factors have the correlations with the BIS adoption. The results from the P-value test confirm that these six factors did influence (p values < 0.05) the BIS adoption in Malaysia's SMEs with 95% confidence level. Based on these results, the proposed model in Figure 2 is revised and presented in Figure 3, representing the overall conclusion of this study. Overall, the key finding of this study is expected to contribute to better understanding of the SME characteristics that determine the adoption of BI in Malaysia. The results of this study provide insights to the current state of BIS adoption in Malaysia's SMEs and report the critical factors that have high correlation to the adoption of BIS technologies in SMEs. It is believed that the research model developed in this study can serve as a base for future studies on SMEs adoption of technological innovation, especially the technologies relating to decision support systems. As most of the publications and previous research study focused on the innovation adoption in large organizations, this study will extend the existing knowledge by studying the trends and developments of Malaysia SMEs in implementing innovation technology. This will contribute to the awareness of Malaysia's SMEs to adopt BIS as a catalyst to support their businesses as well boost global understanding of innovation adoption among SMEs, not only in the Malaysia context, but also to the knowledge base for application in other developing countries. The application of theoretical model of this research study is aimed to advance knowledge and provide a clearer understanding of the factors contributing to the process of BIS adoption in Malaysia's SMEs and its current state. In utilizing this adoption model, prospective outcomes are expected to form a basis for the researchers to determine the current stage of BIS adoption in SMEs. Before investigating

the factors that can affect the decision on adopting BIS, SMEs will be classified into different stages of BIS adoption, according to the DOI theory justification on the adopters' stage

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