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BUSINESS INTELLIGENCE SYSTEM ADOPTION THEORIES IN SMEs: A LITERATURE REVIEW

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ABSTRACT

Today, business intelligence system (BIS) is universally considered as an essential tool to aid business decision making process. There is consensus that BIS has significant effects on predicting current and prospective views of business operations. These effects will only be realized if, and when, BIS are widely spread and used. An imperative study of BIS adoption theories is crucial in order to understand the determinants of BIS adoption. Previous studies on the BIS adoption theories in the global Small Medium Enterprise (SME) are limited. To fill the gap, this study is aimed to study the BIS adoption theories as reported by prior researchers and propose the BIS adoption model for SME in Malaysia. Through systematic literature review (SLR), this paper discusses two prominent models being adopted in SMEs. These two prominent models; diffusion of innovation (DOI) theory, and the technology, organization, and environment (TOE) framework are discussed in details in this paper. This paper also makes recommendations for future research.

Keywords: Business Intelligence System (BIS), determinants, integrated adoption model, DOI theory, TOE framework.

INTRODUCTION

In recent years, the business insider in Malaysia recognizes Business Intelligence System (BIS) as an intuitive modelling of self-service analytics that able to give users ample information to understand the pitfalls of their business models. Advances in visualization, BIS offered a deeper analytics capability where the non-experts are able to use it without the need for extensive expert consultations or scripting [1]. It is not surprising that most of academic researchers conducted BIS research, focused on large organizations only. Whilst, literature relating BIS adoption within the small and medium-sized of enterprises still remain limited and scarce [2]. How and why these situations could happen? Does the gap exist is determined by the SME characteristics itself or there is other factors that refrain SMEs from adopting BI system into their business operations?

To date, BI systems have mainly been adopted in giant multinational enterprises, and hence, research work on the adoption model has largely been focused on them, as such reflecting their situations and needs [3]. To be precise, only the largest enterprises have reached a stage of maturity in BI utilization while SMEs still lag behind. Does this SMEs do not aware with these opportunities or they did actually aware of it, but due to the certain circumstances (i.e. Lack of financial resources, experts and etc.), they are not ready yet to adopt this BI system. However, according to Simon Ryan, the director of LogicXML explained that both small and medium-sized of enterprises now have as much need for BI utilization as the larger companies [4].

Most of the IS literature originates from the business world and Information Technology (IT) industry defined BI in various ways according to its context, judging by their capabilities in serving the needs of an organization. For this reason, there is currently no commonly agreed definition of BI by the prior researchers. Negash [5] defined BI as a system that combines "data gathering, data storage, and knowledge management with analytical tools to present complex internal and competitive information to planners and decision makers". While Elbashir et al. [6] defined BI as a specialized tool for data analysis, query and reporting that supports an organizational decision-making that potentially enhances the performance of a range of business processes. By reviewing both of this explanation, Boonsiritomachai et al. [2] came out with an explanation of BI as the capability of an enterprise to use its human resources together with a broad category of processes, applications and technologies for accessing, collecting, accumulating and analyzing data in order to generate actionable and competitive information that can support its users in making better decisions.

There is no justification on the BI definition made by the prior researchers. However, Boonsiritomachai *et al*. [2] said, although there is no commonly agreed upon definition of BI, he clearly sees that, the existing definitions share two common characteristics. The first is the fundamental aspect of BI which includes accumulating, analyzing, and conveying information that is available for collaboration in an enterprise, and the second is the use of BI to support the strategic decision-making process of the enterprise [2]. 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. With the advances of information technology (IT), increased competition, greater flexibility of products and more demands from customers, enterprises are now required to operate their businesses in highly complex and dynamic environments. Organizations that survive and succeed in these market conditions need to make decisions in a timely, effective and appropriate manner [7].

The established integrated model of BIS adoption in small businesses as presented in Thong *et al*. [8] and Thong *et al*. [9] specify contextual variables such as information system characteristics, environmental characteristics, and organizational characteristics as primary determinants of IS adoption in small businesses. In addition, two standard instruments have been used in his study focusing on the intensity of a business's service or product and its competition. Generally, there are many research standard instruments provided to study the adoption theory. However, due to the lack of a unifying theory of innovation adoption, it is essential to include the distinctive characteristics of context in the development of a strong theory to study innovation adoption.

Generally, to begin with the understanding of the factors that could influence user acceptance on BIS, both researchers and practitioners either in the large enterprises or in the small and medium-sized of enterprises employ these two prominent IS theoretical foundations, namely Diffusion of Innovation (DOI) theory and Technology, Organization and Environment (TOE) framework [10]. DOI [11] introduces three sets of factors that influence an enterprise's IT adoption intent, namely CEO characteristics (innovation and knowledge of the leader toward changes), internal characteristics of organizational structure (centralization, organizational slack, complexity and size), and external characteristics of the organization (system openness).

On the other hand, TOE framework [12] encompasses external task environment, organization, and technology. The environmental context includes the technology support infrastructure, industry characteristics and market structure, and government regulation. The organizational context includes formal and informal linking structures, collaboration, resource availability and the organization's management. The technological context consists of the innovations and readiness of technology. Different authors, use different taxonomy to describe their contextual variables in the adoption model. From the multiple of these established adoption models, we will extract the main and important points, eliminate the redundant variable to improve and enhance the integrated BIS adoption model for SMEs.

According to National SME Development Council (NSDC), a business will be deemed as an SME if it meets either one of the two specified qualifying criteria, namely sales turnover or full-time employees, whichever is lower. In terms of manufacturing, the sales turnover must not exceed RM50 million or full-time employee not exceeding 75 workers. Next, in term of services and other sectors, the sales turnover must not exceed RM20 million or full-time employees not exceeding 75 workers. As such, only those SME Corporation that fulfills one of this requirement are selected in this research study [13].

This paper begins with the introduction of BIS in SMEs, followed by the description of the SLR procedures used in conducting this research study. The following section, provide an overview of adoption theories used by previous researchers in studying BIS adoption. The next section discusses the relevant unifying IS adoption theories used in literature, the top established prominent unified models are, diffusion of innovation (DOI) [11]; and the technology, organization, and environment (TOE) framework; [12] followed by the identification of BIS determinants based on the articles that are found from SLR procedures. Lastly, the paper concludes with a discussion and conclusion.

RESEARCH METHOD

This paper 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*. [14] we 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 this 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 to respond to the research objectives of this study. The following sections describe each phase in detail.

Identification and extraction of articles

In this phase, two main criteria are identified and clarified in order to smooth the researchers in defining the research method for a comprehensive review of the IS literature on business intelligence. These two main criteria are the sources and the search strategy.

Selecting the sources

To frame the breadth and depth of the proposed theoretical foundations, online databases and 11 instrumental journals from the researched field have been used in searching for the conference, proceeding and journal articles. The first 9 journals (i.e. Economic and Business Review, Electronic Journal of Knowledge Management, International Journal of Information Management, Small Enterprise Association of Australia and New Zealand, The Electronic Journal Information System Evaluation, Emerald Insight, Aberdeen Group, International Journal of Emerging Science and Engineering and Interdisciplinary Journal of Information, Knowledge, and Management) appeared in the online databases provided by the university. To this list, 2 more journals were added that are deemed important to a broader range of the research context (i.e. European Research Center for Information System and Loyola eCommons Library Database). As the researched topic is a part of rapidly changing IT/IS field, this study focused on the volumes for the past 6 years. The searching process is limited to paper published in 2009 until 2015. The paper range from the year of 2009 is to get the latest information and updated information regarding this area. Any paper published before 2009 is not included, however, there are some exceptions that apply, only for those related IS

journals describing on the root/core theory of definition and the main architecture framework method.

Search Strategy

In a systematic literature review, the search strategy is important to keep the search area on track by eliminating the irrelevant studies. Additionally, the search scope, search strings and electronic data sources used is determined to keep this method successfully. Also, the data must be extracted in order to get the information from the primary studies. In terms of the search strategy, first, the key word 'business intelligence system adoption factors + SMEs ' was searched for, in the title, abstract, and key words of all papers in the target source list, through a database search. This yielded 102 from the IS journals and 36 from conferences, however, almost 60% of the yielded results is not related to the main topics. As this search only yielded very few articles, the search for the key word is extended to 'IS adoption theories + decision support' in the body-text field as the next step. 8 selected IS journals is yielded from the Google Scholar databases. All papers in these sources were downloaded as full text pdf files. They were systematically indexed (by year and source) using the Adobe Acrobat professional tool. Adobe Acrobat professional's 'advance-search' facility was used to search the indexed papers. 53 papers were selected through this effort, where they had mentioned business intelligence determinants and IS theories meaningfully, somewhere in the text of the paper. Thus, the sample paper pool having a total of 53 papers (42 secondary and 11 principals) as we entered the pre-analysis planning phase.

Preparing for the analysis

For preparing an analysis on this IS theories, a review of prior studies and the relevant IS literatures on the adoption theories of any IT/ICT articles (whether directly and indirectly mentioning on BIS) is considered as an essential reference that could facilitate to the theory development will be taken into account. This article addresses on the particular state of IS theories within the IS field that promote BIS research that mainly conceptualize on the BIS adoption model implemented by global small and medium-sized of enterprises.

The accumulated journals, articles and papers yielded from the online database were categorized into several concepts which based on the IS theories that have been applied by the researchers. For structuring reviews, we use the concept-centric to determine the organizing framework of a review and the researchers' intent and direction of its research study. This approach is illustrated in Table-1.

Table-1. Concept-centric Approach.

Approaches to Literature Reviews	
Concept-centric	
Concept X…..	[Authors 1, authors 2…]
Concept Y…..	[Authors 1, authors 2…]

Basically, when preparing an analysis of IS theories, there is two types of reviews could exist. First, the authors could deal with a mature topic where an accumulated body of research exists that needs analysis and synthesis. For this case, a thorough literature review and then proposes a conceptual model that synthesizes and extends existing research could be conducted. Second, the authors could tackle an emerging issue that would benefit from exposure to potential theoretical foundations. Here, the review of current literature on the topic would, of necessity, be shorter. The authors' contribution would arise from the fresh theoretical foundations proposed in developing a conceptual model. As for this study, we would choose the second reviews type. We scrutiny on all IS theories that have been applied by the prior researchers, and suggest the best unifying theories to study BIS adoption model.

The following sections present the findings of the literature-based analysis on business Intelligence adoption theories in the literatures. In recent years, although Malaysia's SMEs has begun familiar with the use of BI, the number of business intelligence literature focusing on the BIS adoption is still scarce. By evaluating this situation, this article is aimed to explore the adoption theories of BIS in SMEs that reported by the prior researchers in IS literatures. Next, we will present an overview of theories applied, followed by a justification of IS theories that most prominently used to conduct business intelligence adoption and end with discussion and conclusion of the study.

AN OVERVIEW OF THEORY

IS theories demonstrates the nature and reasons of technological innovations is being accepted and adopted by the several distinct factor groups that related to 1) the psychology of the users, 2) the design process of information technology, and 3) the quality of the technology in user terms [15]. According to prior researchers, IS theories can be divided into several threshold according to the purpose of the designated research either it being used to explore the concept of acceptance in innovation diffusion (i.e. DOI theory and TOE theory), or to understand the psychology of user acceptance (i.e. The theory of Reasoned Action, The Technology of Acceptance Model, and Theory of Planned Behavior), or to study the design acceptance in technology (i.e. Human – Computer Interaction and the Usability Engineering Approach to Acceptance and other related work).

In this paper, a search of theories focuses on the BISs (the primary set of fifty-nine papers) resulted in identification of twelve papers have applied on the IS theories in their research study with twelve theories being applied. The rest is related to the ICT/IT/IS system adoption in small and medium sized businesses and papers discuss BIS as one of the examples of ICT/IT/IS systems. In the meantime, there are no additional secondary papers or theories were identified regarding with these topics.

As discussed earlier, the IS theories that streamline focusing on the BIS in SME, especially in Malaysia are scarce and scattered. Particularly, Malaysia was still being considered as a new infant in this intelligence - technology area. The awareness is there, but the readiness is lagging behind due to uncertainty reasons of an organizational to adopt it. Lack of user acceptance might be one of the significant impediments to the success of new information systems, plus with the lack of knowledge and high budgeting cost to implement BIS might restrain the SMEs to adopt it. In fact, users are often unwilling to use information systems which, if used, would result in impressive performance gains [15]. However, it is too early to make those assumptions; therefore we will provide a descriptive overview of the different theories applied in the global SME to date and how they were applied. This descriptive overview should provide an early impression on how this theoretical work for BIS. In this section, we will discuss on the theoretical background of the innovation theory that will be used as a foundation in developing the research framework for this study. Below is the summary of the findings.

Initially, Diffusion of Innovation (DOI) theory has been applied to business intelligence by Boonsiritomachai *et al*. [2], Chen [16], Cecília Olexova [17], Mehdi Daryaei, Majid Shirzad, Vinod Kumar [18], T. Oliveira and M. Fraga Martins [19], and Borut Puklavec, Tiago Oliveira, & Aleš Popoviè [10] to study the technological innovation adoption factors in SMEs. For example, Boonsiritomachai *et al*. [2] applied this theory to study the attributes affecting technological innovation adoption of relative advantage, complexity, compatibility, trialability & observability. Basically, this DOI theory is considered as the most significant theories used by the researchers when study an adoption model at the enterprise level used in information systems (IS) literature. According to this theory, the attributes affecting technological innovation adoption are a relative advantage (RA), complexity, compatibility, trialability and observability. Chen [20] also employed these attributes to examine electronic businesses and has found the key influence technological innovation adoption. In despite, three of these attributes had the greatest influence on adoption; those attributes are compatibility, relative advantage and complexity and omit two attributes (trialability and observability). However, Dillon and Morris [15] criticized on these conceptualizations. They argued that the meaning of the "greatest influence" refer to the "advantageous" criteria that beneficial for an organization (where compatibility and relative advantage were positively related to innovation adoption and complexity was negatively related to innovation adoption) and this advantageous criteria is an ambiguous thing that could not be judged and define. For an example, in particular of relative advantage, an innovation could be advantageous because it costs less or is less complex? Clearly, there is no definite answer for this. Therefore, in order to enhance user acceptance on BIS, Dillon and Morris [15] reported an extensive effort suggested by Moore and Benbasat (1991) to develop an instrument which can be used to evaluate user perception in IT innovations in terms of the decision involuntariness of use, image, relative advantage, compatibility, ease of use, trialability, result demonstrability and visibility to support this reasoning theory [15]. Olexová *et al*. [17] applied the DOI theory to focus on the factors that might impact the speed of adoption of innovations. While Daryaei et al. [18] used the DOI theory to find the important factors which influence the intention to use BIS ending up with what the barriers of adoption are and what are the critical success factors (CSFs) for implementing BIS. Whereas, Puklavec *et al*. [10] applied the DOI theory to identify the correlation of SME-specific determinants with BIS functions at the firm level, and guide the development of the BIS adoption model to be tested in SMEs.

Recent research has attempted to extend diffusion of innovation theory with the Lacovou model for more complex adoption scenarios [15]. Lacovou model was introduced in 1995 to study the significant correlation in the areas of expected benefits (Lacovou's perceived benefits of IT innovations) and in an organizational context, mostly in organizational readiness (i.e. financial resources, IT resources). Low correlation appears in the area of external influences (i.e. external pressures), which could be attributed to the differences between BIS and Electronic Data Interchange as Lacovou's research environment. This Lacovou model has been applied by Puklavec et al. [10] in their studies to determine the BIS determinants in SMEs by comparing the results gathered from the survey with the determinants listed in the TOE framework by prior researches and study the organizational perceivedness use.

Meanwhile, the Technology-Organizational-Environmental (TOE) framework has been applied by Boonsiritomachai et al. [2], Damanpour and Schneider [21], Puklavec et al. [10], Thong *et al*. [22] and Oliveira and Martins [19] in exploring a generic set of factors in TOE and its characteristics, where later, it leads to the prediction of the likelihood of BIS adoption either in an organization, firm or small enterprises. 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 [22]. 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. [2]

3) Study the key determinants of innovation adoption in organizations. [21]
4) Identify instrumental determinant candidates for delving deeper into BIS adoption in SMEs by leveraging semi-structured interviews with BIS experts. [10]
5) To study the adoption and assimilation of different types of IT innovation specified within the three TOE contexts. [19]

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. [2, 10, 19, 21, 22]

Is Adoption Model introduced by Boonsiritomachai et al. [2] is to explore that an owner-managers' innovativeness is a significant determinant in BIS adoption for SMEs. This model was devoted to small business studies in IS adoption only. According to Thong et al. [22], this model provides a basic foundation for development of the conceptual model in some BIS determinants. For example, Thong et al. [8] clarified that, "IS adoption model specifies contextual variables such as owner's decision-maker characteristics, IS characteristics, organizational characteristics, and environmental characteristics as primary determinants of IS adoption in small businesses". By mediating with the other two theories; DOI theory and TOE framework, the possible, enabling factors impacting innovation adoption are categorized into four characteristics, including technological, organizational, environmental, and owner-managers and the established framework of this paper is referring and posits these four attributes and were discussed in detail in their paper [2]. As one of the BIS determinants is CEO innovativeness, this theory was supported by Hameed *et al*. [23] and Ifinedo [24] in which they have stated that, leader attitudes are important towards changes and support of the management and organizational commitment as well is seen as one of the factors that lead to successful adoption of new innovation technology. Thong *et al*. [22] applied Kirton's Adaption-Innovation Inventory (KAI) instrument to measure CEO innovativeness. This instrument has been widely used in organization studies and found to be reliable and valid for measuring cognitive styles.

Another promising user acceptance theory of BIS adoption are Technology Acceptance Model (TAM), Theory of Planed Behavior (TPB) and the Theory of Reasoned Action (TRA) that have been applied by Shirzad and Kumar [18] which is significantly focused on the theoretical approaches in understanding the psychology of user acceptance. In their studies TAM was used to clarify the relationship between Adoption of BI & Perceived Usefulness, Perceived Ease of Use, Educational Level & Computer Literacy, Social Influences & Motivation, Venturesomeness, Task Fit and Perceived Risk. While TPB and TRA were used to examine regarding to personal characteristics on skills, resources and opportunities to achieve outcomes and to study the social / individual intentions and behaviors in using BIS. According to Dillon and Morris [15] by drawing on the work of social psychologists concerned with human actions, these theories could provide an explicit information on some acceptance issues utilizing constructs and theoretical approaches that are not typically cited in the innovation diffusion literature [15].

The next theory applied in the adoption of IS literatures is the Resource Based theory, this theory was used to study the success factor in BIS adoption by identifying the firm's potential key resources in manufacturing Small and Medium-sized Enterprises (SMEs). Caldeira and Ward [25] used this resource based theory to define a legitimate measure of 'success' that could, clearly, unambiguously differentiate a number of levels of success in the case studies. Based on their research findings, they found that resource based theory has been developed to understand how organizations achieve sustainable competitive advantages in which this theory focuses on the idea of costly-to-copy attributes of the enterprise as sources of business returns and the means to achieve superior performance and competitive advantage [25]. Meanwhile, according to Barney et al. [26], those enterprise's competitive advantage is considered achieved, if they fulfill and met these four criteria which are the rare, valuable, imperfect imitability and non-substitutability that occurs only when there is a situation of resource heterogeneity (different resources across enterprises) and resource immobility (the inability of competing enterprises to obtain resources from other enterprises) [26].

In another study, Hartley and Seymour [27] have applied both Retro Advanced Leadership model and Heeks Design-Reality gap model in order to investigate ICT solutions to support service delivery in developing countries. RAL theory provides a study of a particular sector of government that could help researchers to investigate IT innovation adoption at each level of governance, e.g. focusing on economic growth, by studying on the key components for enhancing service delivery, of 1) leadership performance, 2) achieving realistic goals, 3) continuous maintenance and 4) monitoring of the ongoing achievements for the local, provincial and national organization and how information is collated and integrated at each level. This RAL model can be supported by other IS theories/ model to improve the result of the influencing factors that could be extracted from the study. For example, the researchers applied Heeks Design-Reality gap as an IS development assessment model that introduces seven elements of (IS) development, that could be used to analyze information system, in this case, BIS adoption by the enterprise. The seven elements identified were Information, Technology, Processes, Objectives and values, Staffing and skills, Management systems and structures, and other resources.

This model was developed specifically for the case of developing countries adopting an information system.

Next, we drill on the related work theories (i.e. inductive reasoning skills,) that could be applied to study the business intelligence system adoption, by referring to Torkzadeh and Dwyer theory (imply a reciprocal relationship) where the basis of user training can influence the acceptance and impact on user satisfaction and confidence level [15]. This theory was tested by Estrin *et al*. [28] to study SMEs' software technology to overcome technology adoption barriers and acquire the capabilities that the defense industry requires. By implementing of The Technology Insertion Development and Evaluation (TIDE) Program to address the software technology, these researchers were able to identify the needs of SMEs and defense industry requires [28]. While, Olszak and Ziemba [3] used critical thinking and inductive reasoning to identify the critical success factors (CSFs) for BIS implementation in SME and aim to access the role of SMEs in the economy and the barriers to their development.

RESULTS

In this section, we present the theories and their determinants from previous studies in BIS adoption for SME.

Table-2. Theories used in previous studies.

Author (s)	Theory (ies)	Determinant(s)
Boonsiritoma -chai et al. (2014)	DOI theory, TOE model, IS Adoption Model for Small Business	Relative Advantage, Complexity, Compatibility, Trialability, Observability, Organizational size, Organizational age, Absorptive capacity, Organizational resource availability, Competitive pressure, Vendor selection, Owner-manager's innovativeness, and Owner- managers' IT knowledge.
Chen. (2003)	DOI theory	Enabler approach, Managerial approach, and Technical approach
Cecília Olexová et al. (2014)	DOI theory	Relative advantage, Compatibility, Triability, Observability (on visibility & result demonstrability) and complexity.
Mehdi Daryaei, Majid Shirzad, Vinod Kumar. (2013)	DOI theory, TAM theory, TPB theory, TRA theory	Perceived ease of use, Perceived usefulness, Perceived risk, Task fit, Venturesomeness, Social influences and Motivation, educational level and computer literacy.
T. Oliveira & M. Fraga Martins. (2011)	DOI theory, TOE model, Lacovou model	**Organizational innovativeness**: Attitude toward change, Centralization, Complexity, Formalization, Interconnectedness, Organizational slack, Size, and System openness, **Technological innovation decision making**: Industry characteristics and market structure, Technology support infrastructure, Government regulation, Technology availability characteristics, Organization formal and informal linking structures, Communication processes, Size, and Slack. **Adoption of innovation**: Perceived benefits, Organizational readiness and External pressure
Puklavec et al. (2014)	DOI theory, TOE model, Lacovou Model	Technological expected benefits, Perception of strategic value, Cost (financial resource), BIS as a part of ERP, Management support, Organizational culture, Project champion, Organizational data environment, Organizational readiness, Organizational size, and External support.
Damanpour & Schneider. (2006)	TOE model,	Environmental pressure, Organizational innovativeness, Top managers' characteristics on the initiation, and Top managers' adoption decision.
James Y.L. Thong. (1999)	TOE model, KAI Inventory	CEO's Innovativeness, CEO's IS Knowledge, Relative Advantage of IS, Compatibility of IS, Complexity of IS, Business Size, Employees' IS Knowledge Information Intensity, and Competition.
Mário M. Caldeira, John M. Ward. (2001)	Resource Based Theory	Relative Advantage, Collaborative tools, Educational sense making, and BIS is a part of ERP.
Kaashief Hartley, Lisa F Seymour. (2010)	RAL model, Heeks Design-Reality gap model	Data quality, Interoperable systems, Structured processes, Leadership skills, High IS staff turnover, Improve management systems performance, and other resources.
Celina M. Olszak & Ewa Ziemba. (2012)	Other Related Works – Inductive Reasoning Skills.	Installation cost, BI sustainability for users' business needs, Well defined business problem and processes, Changeability, Developing "User friendly" BI system, The reference list of BI Supplier, Past cooperation with a BI supplier, and The kind of BI technology tools.
Len Estrin, John T. Foreman & Suzanne Garcia. (2003)	Other Related Works – TIDE programs	Information expertise, Technological cost, Pressure to be Productive, and Organizational Fit for BIS adoption.

Table-3 summarized the proposed determinants for BIS adoption in SME. These determinants were identified through the reviewed literature for further understanding of the determinants in order to derive a more parsimonious list of proposed determinants. Four main factors identified as the main context are the Technological, the Organizational and the Environmental from the TOE theory and the CEO' innovativeness based on DOI theory. Later, the proposed determinants will act as an indicator for the implementation of BIS in the Malaysia SME.

Table-3. Proposed determinants that related to the SME in adopting BIS.

	Description	Determinants	Approach
Techno-logical Context	Includes the internal and external technologies that are relevant to the enterprise. Technologies may include both equipment as well as processes.	• Relative Advantage • Compatibility • Complexity • Trialability • Observability • Innovativeness • Knowledge in IT • Cost/Financial Resources	TOE Framework
Organizational Context	Refers to the characteristics and resources of the enterprise, including the enterprise's size, degree of centralization, degree of formalization, managerial structure, human resources, the amount of slack resources, and linkages among employees.	• SME Characteristic; Organizational Age; Organizational size • Collaboration • Organization Resource/ Availability • Managerial Influence • Organization Readiness • Customer Demand • Industry/ Market' Needs	
Environmental Context	Includes the size and structure of the industry, the enterprise's competitors, the macroeconomic context, and the regulatory environment.	• Business Partners • Competitive Pressure • Vendor Selection • Technology Support Infrastructure • Government Regulation • Market Trends • Linked Firm/ Alliance Trust	
CEO's Innovativeness Context	Includes the owner-managers' characteristics when making decision, either the CEO has the sense of innovation in IT/IS adoption to improve business performance.	• Owner-managers' innovativeness • Owner-managers' IT knowledge, • Owner managers' decision on IS adoption	DOI Theory

In summary, this study suggested an integrated model of BIS adoption models to be tested in Malaysia SME. Table-2 and Table-3 present the supporting evidence for these factors, which gathered from the literature data and a list of proposed determinants that form the main factors. Figure-1 provides the summary results for this analysis.

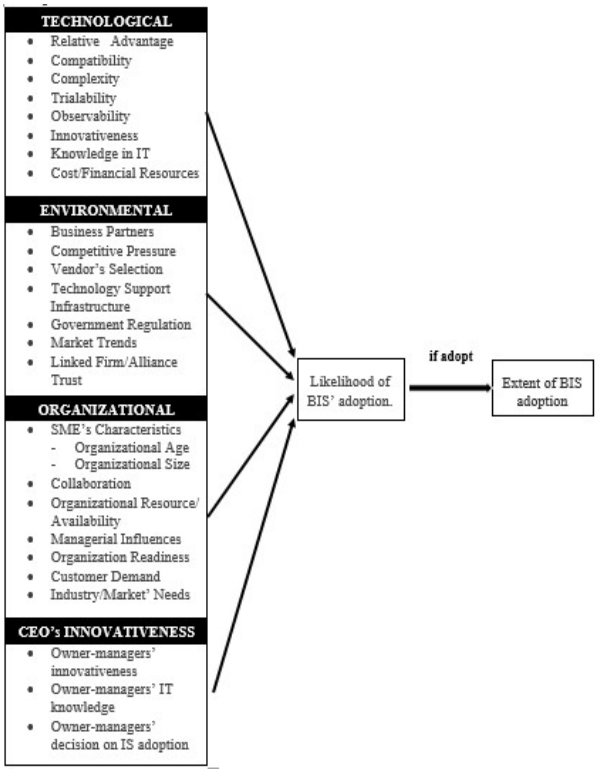

Figure-1. BIS adoption models for SMEs.

DISCUSSIONS

Even though, there are many adoption theories used in IS research, only a few of them have been applied in business intelligence systems in the perspective of IT adoption. According to Boonsiritomachai *et al*. [2], the most used theories in BIS study are the theory of planned behavior (TPB), the technology acceptance model (TAM), the unified theory of acceptance and use of technology (UTAUT), the DOI theory, and the TOE framework and

the related theories of acceptance. However, in this study, we found that DOI and TOE theory are the most relevant to be applied because these theories can be applied at the firm level for the SME context. While the rest such as TPB, TAM and UTAUT are at the individual level [19] which only focused on the individual perceived benefits instead of an organizational perceived benefit. The firm level means here is referring to the initial purpose of the theoretical theories are, and it has been proven by the prior researches (already been applied in their studies) that suit for studying both individual characteristics and an organizational characteristics.

Based on the findings, most of the adoption theories share common research objective, such as to find the correlation of SME' criteria with the BIS determinants trigger the SME to uptake/ diffuse BIS into their business operation. Most of the researchers, try to unfold this problem by using the TOE framework because it describes the factors that influence technology adoption and its likelihood. TOE framework describes the process by which an enterprise adopts and implements technological innovations is influenced by the technological context, the organizational context, and the environmental context concerning characteristics of innovations, identified relative advantage, compatibility, and complexity as innovation characteristics that are salient to the attitude formation [12]. For example, Puklavec *et al*. [10] implement a TOE framework to test BIS adoption framework in the milieu of SMEs. They conducted their research by disseminating the semi-structured interviews involving BIS experts and adopters. Eventually they have successfully identified instrumental determinant candidates for investigating deeper into BIS adoption in SMEs.

Meanwhile, as for the DOI, DOI is a theory of 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 [11].The DOI theory was developed in 1995. This DOI theory offers a conceptual framework for discussing acceptance at a global level. Later, there is a research attempted to extend diffusion theory to more complex adoption scenarios. For example, managerial influence in the organization can encourage (or discourage) the user acceptance explicitly through expressed preferences and/or mandates and as well through the reward systems and incentive. Thus, studies that examine the acceptance level in the firms need to account for the potential importance of managerial influence [15].

According to Olexova [17], DOI theory focused on the factors that impact the speed of adoption of innovations as innovation diffusion theory provides a general framework 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. compatibility, perceived relative advantage and perceived complexity) of up taking BI system to a specific group or organization to adopt it [11].

For a clear cut, most of the empirical studies conducted by prior researches are derived from the DOI theory and the TOE framework [19]. According to them, "as the TOE framework includes the environment context (not included in the DOI theory), it becomes better able to explain intra-firm innovation adoption; therefore, they are considering this model to be more complete." [19]. As SME is a bunch of an enterprise (relatively < 75 full-time workers) registered under the same firm (SME Corporation Malaysia) with the objective of co-promote the development of competitive, innovative and resilient of SMEs through effective coordination and provision of business support. This integrated model could be tested to study their BIS innovation adoption criteria.

CONCLUSIONS

In conclusion, the theoretical background of the DOI theory, the TOE framework and literature relating to the adoption of technological innovation was presented in this paper. From the multiple perspective of technological innovation adoption theories, two prominent adoption models, namely DOI theory and TOE model were selected as the foundation for the development of the conceptual model (BIS adoption model) used in this study. Studies related to the adoption of technological innovation in an organization were reviewed.

Based on reviewing previous studies in this research domain, twenty-five (25) enabling factors were extracted. These factors were then categorized into one of four meta-characteristics: specifically technological, environmental, organizational, and CEO's innovativeness. Eight factors under technological characteristics include relative advantage, compatibility, complexity, trialability, observability, and innovativeness, knowledge in IT and cost or 'financial resources'. Seven factors under environmental characteristics include business partner, competitive pressure, vendors' selection, technology support infrastructure, government regulation, market trends, linked firm and alliance trust. Seven factors under organizational environment include; SME's characteristics, collaboration, organizational resource availability, managerial influence, organizational readiness, customer demand and industry/market' needs. Three factors under CEO's innovativeness include; owner-managers' innovativeness, owner-managers' IT knowledge, and owner managers' decision on IS adoption.

The research indirect extends knowledge on the SME's readiness in adopting BISs and how it could benefit them. Such knowledge will be useful for the top management in being encouraged to become more proactive in promoting the BIS to increase the chances of

success in business development, in order to improve productivity and increase competitiveness. This study provides a justification on the theoretical perspective that integrates both theories of DOI theory and TOE framework in a complimentary manner reinforced by findings from the case study analysis of BIS acceptance.

In summary, this study could provide ample information and understanding on the IS theories used to explore BIS adoption in global SMEs as reported in the IS literature. This paper can be used to be compared or to be referred by the other researchers when studying on the BIS adoption model. In addition, by reviewing the listed IS theories in this paper, researchers might find the suitable IS adoption theories to study the influencing factors, which could lead to the successes adoption of BIS. For future directions, as this integrated model will be tested in SME Corporation Malaysia, hopefully it can be able to examine the current state of BI in Malaysia. This suggested model would be beneficial for the academic researcher, BIS vendors and SMEs organization itself in study the factors, opportunities and concerns for Malaysia SMEs regarding with BIS adoption.

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