A research framework for the adoption of Business Intelligence by Small and Medium-sized enterprises

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Abstract:

Due to the complexities of making effective and timely business decisions in highly competitive markets, Data-driven decision-making using Business Intelligence (BI) applications has attracted many organisations worldwide. However, despite these applications being suited for use in most organisations regardless of size, only the larger enterprises have reached a stage of maturity in BI use while small and medium-size enterprises (SMEs) still lag behind. Whilst many academic researchers have conducted BI research focused on large organisations, literature relating to BI adoption within SMEs has remained limited. To fill this research gap and support the adoption rate of BI in SMEs, this paper proposes a research framework for identifying the current state of BI adoption by SMEs and the enabling factors that impact BI adoption in SMEs. Future research directions for using this framework are also discussed.

Keywords: Business Intelligence, small and medium-sized enterprises, Information Evolution Model.

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INTRODUCTION

With the advances of information technology (IT), increased competition, greater flexibility of products and more demands from customers, firms are now required to operate their businesses in highly complex and dynamic environments. Organisations that survive and succeed in these market conditions need to make decisions in a timely, effective and appropriate manner (Habjan and Popovic, 2007). However, many organisations are faced with the challenges of data overload where small subsets of large amounts of data are key to the overall evaluation of information (Arnott and Pervan, 2005). For example, the International Data Corporation (IDC) reported that digital data growth was up by 48 percent in 2012, with 90 percent of information being unstructured. As a result of this type of data complexity, many businesses are now challenged to understand and analyse the wide range of information involved (Gens, 2011). However, as many business users lack access to the information they need, many tend to make decisions based on instinctive knowledge that can result in loss of productivity, reduced agility in the marketplace, and flawed decision-making (Hilgefort, 2010). In this situation, it is important to seek ways to provide useful information that supports decision makers and adds value to business organisations.

In order to increase efficiency, many organisations have implemented IT systems in their business operations to collect, combine, access, and analyse massive amounts of data. One such analytical tool is BI technology that turns data into information and then into knowledge (Golfarelli et al., 2004). BI technology supports firms not only in driving performance improvement throughout their enterprises (Hill and Scott, 2004), but also assists in forecasting by analysing historical data (Marjanovic, 2007). For example, in conducting a survey among 2,053 Chief Information Officers (CIO) covering 36 industries in 41 countries, Gartner Research (2013) found that BI technology is often a first priority in technology investments. This finding agrees with O’Brien and Kok (2006) and Kimball et al. (2008) who found that BI technology had reached a stage of maturity that is widely used at all levels of the business world.

Demand for BI technology has continually grown even at a time when the demand for many IT products has decelerated (Soejarto, 2003). Recently, the International Data Corporation (IDC, 2013) reported that the Business Intelligence market had grown by 8.7% in 2012, while the total software market and total Information Communication Technology (ICT) market had grown by only 2.9% and 3.6%, respectively. BI technology is therefore expected to continue to grow, albeit at single digit rates, over the next few years (IDC, 2013). However, despite BI technology being normally considered as reserved for larger firms, the current demand for BI is not restricted to firm size (Pegasus Software, 2008). Indeed, both small and medium-sized enterprises now have as much need for BI utilisation as the larger companies (LogicXML, 2009).

The accepted classifications of SMEs differ, not only from industry to industry but also from country to country (Atkins and Lowe, 1997), depending on the political and economic objectives defining them (Simpson et al., 2004). However, the most common criteria applied to classify the term SME, includes number of employees, invested capital, annual turnover and industry type (Ministry of Economic Development, 2011). According to the European Union, an SME is defined as a company with fewer than 250 employees and having either an annual turnover of less than 50 million euro or an annual balance sheet total of less than 43 million euro. In particular, a small business is one which
employs fewer than 50 persons and whose annual turnover or annual balance sheet total does not exceed 10 million euro (European Commission, 2003).

The European Commission (2008) claimed that more than 95 percent of enterprises fall within the SME group as the main driver of the world’s economy. As SMEs employ the majority of workers, they contribute to the economic growth of most countries, and are thus widely recognised as vital to economic development and expansion (Levy and Powell, 2005, Roy and Sander, 2004). As a result, the majority of governments support the growth of SMEs as a priority via the creation of various programs including technical support, training, regulatory provisions and policy interventions (Madrid-Guijarro et al., 2009, Esselaar et al., 2007, Chen, 2006). However, even though SMEs are often supported by governments, most SMEs underestimate the value of IT innovations by limiting them to administrative tasks rather than complex business operations (Festing, 2007). As a result, SMEs have lagged in the BI uptake despite being an important part of enterprise decision support for over two decades (Wirtschaft et al., 2010).

In an attempt to provide a conceptual framework to understand the adoption of BI among SMEs, the research questions that guide this study are: (1) what is the state of BI adoption in SMEs and (2) What are the enabling factors affecting the adoption of BI in SMEs. The remainder of this paper discusses the term ‘BI’, and discuss the adoption of BI in SMEs. The following section reviews the classification levels of BI to identify the current state of BI adoption among SMEs and develop a conceptual framework for this study. Then the theoretical background for developing this framework is presented, followed by potential factors that can affect the decisions for BI adoption. The paper concludes with a summary and suggestions for future research directions.

**LITERATURE REVIEW**

*What is Business Intelligence?*

Although BI is not a new area of information systems (Vitt et al., 2002), academic research in this field is at an early stage (Arnott and Pervan, 2005, Gibson et al., 2004, Negash, 2004) – with the term being defined in various ways according to context (Niu et al., 2009). The bulk of BI literature originates from the business world and IT industry (Gibson et al., 2004, Jagielska et al., 2003), with the various consulting companies and software vendors judging BI as compatible with their products, and promoting their particular connotations (Arnott and Pervan, 2005). For this reason, there is currently no commonly agreed definition of BI. For example, Negash (2004) 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”. Turban et al. (2007) defined BI as “an umbrella term that encompasses tools, architectures, databases, data warehouses, performance management, methodologies, and so forth, all of which are integrated into a unified software suite”. Elbashir et al. (2008) defined BI as “a specialised tool for data analysis, query and reporting that supports an organisational decision-making that potentially enhances the performance of a range of business processes”. Watson (2009) defined BI as “a broad category of applications, technologies, and processes for gathering, storing, accessing, and analysing data to help business users make better decisions”.
Although there is no commonly agreed upon definition of BI, existing definitions share two common characteristics. The first is the fundamental aspect of BI which includes collecting, storing, analysing and delivering information that is available both internally and externally, and the second is the aim of BI which is to support the strategic decision-making process of the firm. However, a problem arises when considering the existing definition of BI because it only discusses the process, software and technology components. English (2005) claims that the key component of BI is to understand what is occurring within the firm and what is the most suitable action to take in order to reach firm goals. Therefore, the human factor is also important because BI cannot be evaluated independent of interpreting its meaning but considered according to information gained from the practical knowledge of the users. Furthermore, an earlier study of BI in Finnish companies by Hannula and Pirttimaki (2003) found that more than 75 percent of responding business managers believed that human ability to use BI represented a major aspect of its usage. For this reason, the definition of BI in this paper adjusts Watson’s definition (2009) by including the aspect of human ability to use BI. Accordingly, BI in this paper is defined 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 analysing data in order to generate actionable and competitive information that can support its users to make better decisions.

**Business Intelligence in SMEs**

The advantages of implementing BI to support business operations are clear, and by utilising BI technology appropriately, a number of benefits can be anticipated (Ko and Abdullaev, 2007, Watson and Wixom, 2007, Ranjan, 2005). Many studies have reviewed the potential benefits of adopting BI in various types of business (Popovic et al., 2010, Sahay and Ranjan, 2008, Ko and Abdullaev, 2007, Ranjan, 2005, Anderson-Lehman et al., 2004, Eckerson, 2003). For instance, automobile manufacturers have increased returns on investment (ROI) using a financial BI solution by identifying repossessed vehicle loans more quickly. Electronics retailers have accrued substantial amounts of money by identifying smaller quantities of out-of-stock items using BI solutions (Eckerson, 2003). Similarly, BI has reduced inventory expenses through identifying more accurate information on supplier shipments (Sahay and Ranjan, 2008). More recently, Dumitrita (2011) found that BI can also help access more reliable and faster reports, improve decision making processes, increase the quality of client relationships, increase incomes and cut non-IT expenses.

Although a large number of studies have focused on the benefits of BI implementation, research focusing on SMEs is scarce. In one study Hill and Scott (2004) showed that some SMEs have the ability to access both historical and short-term order and production figures using BI applications, and in another study Wirtschaft et al. (2010) found that BI adoption benefited German SMEs by improving data and decision support, and cost savings. However, even though most SMEs realise that IT adoption will help them improve their businesses, many fail to take advantage (Bruque and Moyano, 2007), and BI is still far from being widely used (Voicu et al., 2009).

According to technology adoption research in SMEs, a number of researchers have found that the structural characteristics of SMEs are different from those in large enterprises, which explicitly affects their IT usage behaviours (Gutierrez et al., 2009, Struker and Gille, 2008, Buonanno et al., 2005). Man et al. (2002) point out that a small enterprise is not a small version of a large enterprise, but has dissimilarities in terms of structure, policy making procedures, and utilisation of resources.
Another study on SMEs by Deros et al. (2006) classifies these dissimilarities in terms of structures, systems and procedures, cultures and behaviours, human resources, and markets and customers. In accordance with these understandings, this paper does not directly apply the concepts used to conduct research into large organisations to the study of SMEs.

Lack of resources is one of the key characteristics many researchers address when studying SMEs (Bhaird and Lucey, 2010; Deros et al., 2006; Knight et al., 2004; Levy and Powell, 2003). These limited resources include finance, technology, knowledge and human resources. In particular, Bhaird and Lucey (2010) found that financial resources are personally funded by the owner in most SMEs. Due to their restricted financial budgets and low number of employees in SMEs, the majority of employees perform multiple tasks which do not specialise in any particular area (Kirchmer, 2011, Hudson et al., 2001). Moreover, the unskilled workforce with lack of technical specialisation results in SME managers being conservative when adopting IT innovations (Karkoviata, 2001). This may be the reason why many SMEs are reluctant to invest in new technologies and overly careful in assessing any investment strategies involving IT (Nguyen, 2009). For instance, Fuller-Love (2006) found that owner-managers in SMEs deal with IT adoption only when they perceive the promise of success, because they do not want to take risks. This is especially the case for BI, since BI maintenance and implementation costs are very high as is the failure rate of implementation when compared to other technologies (Lawton, 2006). Also, Hill and Scott (2004) conducted in-depth discussions with eleven SMEs located in Northern Ireland to find that BI technologies are not widely implemented in SMEs because they depend on personal contact networks as a fundamental way of doing business, and are unable to rationalise BI investments for financial benefits. Moreover, due to their limitations in both human and financial resources and scale and complexity of operations, SMEs require different BI approaches from those adopted by large firms (Barnard, 2010).

**The level of BI adoption**

As the term BI can refer to both simple and complex technologies, the need for classifying BI levels is important. Organisations that adopt high levels of BI tend to have characteristics that are distinct from those with lower levels, and as a result have different enabling factors underpinning BI adoption (Olszak, 2013, Ong and Siew, 2013). However, as the number of studies on levels of BI adoption is limited (Sacu and Spruit, 2010), this section reviews the few existing studies that have categorised the levels of BI adoption. For example, when categorising BI levels in terms of technologies, (Gibson and Arnott (2003)) proposed five levels:

1) Personal decision support
2) Executive information systems
3) Data warehousing
4) Intelligence systems
5) Knowledge management.
However, McDonald (2004) preferred to define BI levels from the solutions perspective, stating that data structure positively impacts the efficiency of BI solutions. His framework comprised four levels:

1) BI infrastructure: refers to the process of collecting, integrating and transforming data in order to generate the report for supporting decision-making;

2) Business Performance Management (BPM): refers to the use of data from level 1) above to provide feedback based on Key Performance Indicators (KPI) to management;

3) Decision enablement: emphasises the use of data from a knowledge repository to generate automatic decisions; and

4) Business Activity Monitoring (BAM): refers to the process of monitoring changes or trends to assist users in taking the right action.

Other studies defined BI as not only a technology but also a process that transforms data into information and then knowledge, with the argument that BI involves other entities such as organisational function and human interaction, and applied the concept of a maturity model to explain the levels of BI adoption (Lahrmann et al., 2010, Najmi et al., 2010, Eckerson, 2007, English, 2005). As Klimko (2001) explained, Maturity models are characterised by sequentially ordered levels with specific requirements at each level. In the BI context, the most commonly used maturity model is the Information Evolution Model (IEM) proposed by SAS, the leading company in business analytics software and services (Davis et al., 2006). The purpose of this model is to study the enablers of BI usage and explain firms’ use of information to improve business, thus classifying BI adoption levels across four critical dimensions as follows:

1) Infrastructure: includes the implementation of technologies including hardware, software and networking tools, to create, handle, store, distribute and apply information;

2) Knowledge process: includes the role of information in corporate knowledge sharing, the role of information in decision-making, and the improvement of information accuracy and quality;

3) Human capital: includes capabilities, responsibilities, decision-making, training, enterprise goals and improvement of personnel skill-sets related to technological information; and

4) Culture: includes the moral, social and behavioural norms of corporate culture in relation to the information flow within an organisation.

However, as this IEM model (Davis et al., 2006) does not address the analytical application of BI, the present paper adds another dimension, ‘Application’ as derived from Sacu and Spruit (2010):

5) Application: includes analytic applications that organisations have implemented from basic software programs that generate reports to advanced programs that detect relationships in the data, provide predictive results, and generate an automated exception reporting when something unusual occurs.

Recognition of the relationships between these five dimensions makes the IEM model presented in this current study unique. Furthermore, in accordance with Davis et al. (2006), each dimension is given five levels of maturity in the following order:
1) **Operate**: This basic level of BI adoption is found in organisations that focus only on general information from day-to-day operations, without long-range plans;

2) **Consolidate**: This next level refers to organisations that consolidate information by integrating and storing information at the department level for supporting decision-making;

3) **Integrate**: Organisations at this level collect data in a central data warehouse to gain new knowledge from performing enterprise-wide analysis and bridge the borders of separated departments;

4) **Optimise**: At this level organisations use new technologies for deeper analysis in order to better understand the marketplace and their customers in comparison to their competitors, to better serve their customers; and

5) **Innovate**: Organisations at this highest level seek ways to reinvent and transform their value position for sustainable growth.

As shown above, this IEM maturity model can assist organisations to assess their use of current information resources and rank themselves on one of the five levels in order to decide their business direction. Therefore, to address the research question regarding the current state of BI adoption by SMEs, the levels of BI are categorised primarily using the IEM model. Also, due to SMEs in different levels possibly having different enabling factors to BI adoption, all five levels of BI from this IEM model are included in the conceptual framework (see Figure 1).

**Figure 1: The key enabling factors of BI adoption in SMEs**
CONCEPTUAL FRAMEWORK

Based on a multi-perspective framework, three adoption models, namely the Diffusion of Innovation theory (Rogers, 1995), Technology-Organisation-Environment model (Tornatzky and Fleischer, 1990), and Information Systems Adoption Model for Small Business (Thong, 1999), have been selected as the basic foundation for development of the conceptual model in this paper. Using these three models, possible enabling factors impacting innovation adoption are categorised into four characteristics including technological, organisational, environmental, and owner-managers. However, due to the limited number of studies related to BI in SMEs, the enabling factors in this paper have been developed based on prior research into technologies related to BI, in the context of both large enterprises and SMEs.

Technological characteristics

In this paper, the technological characteristics of BI are based on the Diffusion of Innovation theory as proposed by Rogers (1983). According to this theory, the attributes affecting technological innovation adoption are relative advantage, complexity, compatibility, trialability and observability. Chen (2003) also employed these attributes to examine electronic businesses and found that they influence technological innovation adoption. As BI is an innovation technology (Ramamurthy et al., 2008), in this paper the possible factors affecting BI adoption will build on the studies of Rogers (1995) and Chen (2003).

Relative advantage of technologies refers to the degree an innovation is perceived as being better than existing ideas or systems (Rogers, 1995). Prior research studies indicated that BI technology can offer several advantages to firms. For example, retail companies used Data Analysis tools in BI technology to determine which of their products are most profitable, and where to place them in their stores. The banking industry used BI to create better processes for checking credentials and generating credit reports of customers (Williams and Williams, 2003). Furthermore, using complicated BI tools, banks have been better able to detect money laundering (Khan et al., 2010). However, in spite of these benefits, Information Week (cited in Khan et al., 2010) conducted a study of 388 technology professionals in the United States in 2007 and revealed that more than 30 percent of their respondents claimed that BI vendors cannot explain the benefits of BI to the stakeholder. If the BI vendors have no ability to explain the benefits of BI, then the customers are unable to justify the adoption of BI applications. Furthermore, a study by O’Brien and Kok (2006) found that the full benefits of BI are not entirely understood by firms due to a lack of communication.

Complexity is the degree to which an innovation is perceived to be difficult to understand or use (Rogers, 1995). Many researchers have found that complexity is a barrier to innovation adoption (Chang et al., 2010; Alam et al., 2008; Sahay and Ranjan, 2008; Bradford and Florin, 2003). Ramamurthy et al. (2008) found that lower complexities in a technology resulted in higher positive effects on the adoption of Data warehousing solutions. Therefore, due to the high complexity of BI technology, employees resist its adoption and continue to use traditional spreadsheet technologies (The Economist Intelligence Unit, 2007). Voicu et al. (2009) confirmed that BI models are highly complicated because they integrate mathematical functions to predict trends in a firm’s performance to provide solutions in a variety of situations. Therefore, users with a weak IT and computing knowledge require a simple and stable solution that will meet their needs in the shortest
time.

Compatibility is the degree to which an innovation is perceived to be consistent with existing values, past experiences, and needs of possible adopters (Rogers, 1995). Some researchers claim that BI systems are an expansion of Enterprise Resource Planning (ERP) systems, and provide higher performances in consolidating, transforming and analysing data (Hawking and Sellitto, 2010, Radding, 2000). Moreover, Voicu et al. (2009) regarded ERP systems as a minimal prerequisite for implementing BI tools. Any firms that have implemented an ERP system have to decide whether to employ their current ERP vendors, that can reduce compatibility related problems, or to use another BI vendor (Radding, 2000). Furthermore, the Business Intelligence Guide (2009) reported that 40 percent of BI project costs were related to the development of analytics and transformation of data between systems. If existing systems are not compatible with the BI technology, it will take a significant investment of time and resources to migrate and integrate data.

Trialability is the extent to which potential adopters have the opportunity to experiment with an innovation (Rogers, 1995). The higher the trialability, the more comfortable the potential adopters are with the technology and the more likely will be its adoption. Therefore, if BI providers give potential users opportunities to experience BI systems before adoption, doubts related to the unknown will be diminished. A number of empirical studies have confirmed that the perceived trialability of innovation had an impact on potential user adoption of diverse IT such as information retrieval systems (Venkatesh and Morris, 2000), Business-to-Business (B2B) e-marketplaces (White et al., 2007), and e-learning (Zhang et al., 2010). Based on a study of B2B adoption in healthcare industries, White et al. (2007) found that trialability was important in decisions for adoption, in which hospital professionals test new procedures before rolling out the B2B procedures more widely. Moreover, based on a survey of 102 SMEs located in the Northwest of England, Ramdani et al. (2009) found that trialability had an impact on the adoption of enterprise systems including ERP, Customer Relationship Management (CRM) and Supply Chain Management (SCM).

Observability is the degree to which potential adopters of an innovation can perceive the results of using that innovation from users who have already adopted it (Rogers, 1995). Lundblad (2003) claimed that the visible results of an innovation affect the perceptions of its value by both individuals and communities. Moreover, the visibility of results stimulated them to communicate about the innovation, as peers were found to frequently request information related to the evaluation of an innovation. Therefore, readily observable innovation effects normally lead to rapid adoption. In a study on e-commerce adoption by Alam et al. (2008), a survey conducted among 194 electronic manufacturing firms in Malaysia (in which 75 percent were SMEs), showed that observability is a significant factor in e-commerce adoption. Chiasson and Lovato (2001) also found that the observability of decision support system (DSS) benefits were a significant factor in DSS adoption. A recent study of BI adoption in telecommunications companies in Malaysia by Ahmad (2011) found that the perceived observability of BI had a positive effect on the success of its deployment in companies.

Organisational characteristics

Organisational characteristics are based on the Technology-Organisation-Environment (TOE) model proposed by Tornatzky and Fleischer (1990). Although Roger’s model of innovation contributed to
explaining the foundations of technological innovations, some studies have suggested that technological innovation alone is not sufficient to guarantee success in diffusion of technology (Surry and Ely, 1999, Pool, 1997). The ability of organisations to adopt and implement technological innovation is also a considerable issue affecting the adoption decision. In the organisational dimension, there are four possible enabling factors that many researchers have used as a predictor of whether an organisation should adopt innovation or not: organisational size, organisational age, absorptive capacity, and organisational resource availability.

A number of studies have investigated the adoption of IT in relation to the organisational size factor and found this factor has a strong influence on the innovation adoption (Jang et al., 2009, Ramamurthy et al., 2008, Lee and Xia, 2006). However, these results are mixed and inconsistent, with some arguing that small firms are more efficient in adopting innovation than larger firms (Yeaple, 1992), and others suggesting that large companies have more financial and human resources that meet the requirements for innovation (Scuilli, 1998). Lee and Xia (2006) conducted a study using a statistical meta-analysis methodology for merging the results of many individual analyses in the same area. They analysed 21 empirical studies and concluded that organisational size and technological innovation adoption have a positive relationship, but the direction and strength of that relationship depends on moderators including innovation type, organisation type, adoption stage, scope of size, and type of size measurement. In earlier versions of BI, due to its high complexity and cost, implementation normally required the financial resources and skilled workers (Sahay and Ranjan, 2008) which are in accord with the capabilities of larger companies. In agreement, O’Brien and Kok (2006) suggest that due to the cost and complexity of BI architecture, the suitable size for firms implementing BI should be more than 100 employees. Conversely, from the perspective of BI vendors, BI applications are now more diverse, flexible, cheap and less complex than in the past, offering targeted products that are specially tailored for a wide range of SMEs with financial and resources constraints (LogicXML, 2009).

Organisational age refers to the length of the firm’s time in business operation. This factor was also found to have an influence on organisations’ decisions to adopt an innovation. For example, in an earlier study Kimberly and Evanisko (1981) found that organisational age negatively related to the adoption of innovations, because newer organisations were using new technologies as an organisational strategy for defining a niche, while the older organisations were already firmly established. Rogers (1995) found that as newer organisations are born into an environment saturated with advanced communication and information technologies, they naturally rely on technologies to achieve competitive advantage. A later study by Daniel and Myers (2000) also found that the older the organisation, the more likely it will resist to engagement in an innovation process because it cannot easily change routines and is unable to adapt innovative activities that respond to externally generated major technical advances. In agreement, a study by Flanagin (2000) found that newer organisations are more prone to innovation adoption, particularly as they need to complement existing systems and goals.

Griffith et al. (2003) define the absorptive capacity of an organisation as the ability of its members in using existing or pre-existing knowledge. This ability helps organisations to increase recognition about the value of new and external information, and as a result, can be applied to increase the economic benefits of the company. Moreover, absorptive capacity can be used as a predictor of the organisation’s ability to adopt innovation or not (Lal, 2007). BI technologies require awareness and
understanding from its users. These requirements can provide the potential for development of IT within the firms context (O’Brien and Kok, 2006). O’Brien and Kok (2006) conducted a study on telecommunication firms in South Africa and found that many organisations were not utilising BI to the full potential due to the lack of knowledge, shortage of technical skills, and lack of training.

Organisational resource availability is another factor that many studies have identified as influencing innovation adoption (Adler-Milstein and Bates, 2010; Oliveira and Martins, 2010; Soares-Aguiar and Palma-dos-Reis, 2008). Managers will support the adoption of new technology when capital, equipment, human resources and organisational time to implement are available (Chong et al., 2009). Scupola (2003) found that resource unavailability prevented Taiwan’s SMEs from investing in ERP. In the BI context, implementation normally requires financial resources and skilled workers due to its complexity and high cost (Sahay and Ranjan, 2008).

Environmental characteristics

Environmental characteristics are based on the Technology-Organisation-Environment (TOE) model. Environmental factors are commonly and frequently used as a key determinant of innovation adoption (Damanpour and Schneider, 2006). It is necessary to examine the influence of environmental factors before adopting a technology because competitive pressure and the selection of vendors influence the success of innovation adoption.

Competitive pressure tends to stimulate firms to look for new approaches to raise their efficiency and increase productivity, that leads to firms achieving competitive advantage (Themistocleous et al., 2004). Waarts et al. (2002) found that competitors were the key drivers in innovation technology adoption. This is particularly so when competitive pressure significantly impacts on IT adoption (Premkumar et al., 1997, Iacovou et al., 1995, Premkumar and Ramamurthy, 1995, Mansfield et al., 1977). For example, in more recent research studies on SMEs, Alshawi et al. (2011) found that competitive pressure was an important influence on organisational adoption of CRM systems. Another study on data warehouse technology adoption by Hwang et al. (2004) found that environmental attributes including the degree of competitive pressure and vendors selection, were key factors in data warehouse adoption.

Vendor selection is another environmental factor affecting the adoption of technology (Ghobakhloo et al., 2011, Lin and Hsu, 2007, Hwang et al., 2004, Chau and Hui, 2001). According to Seyal et al. (2004)’s study, the variable ‘vendor selection’ can be grouped and measured by quantifying the following items: the vendors’ reputation and successful experience possessed; vendors’ technical competence with the specific BI system proposed; and the professional competence of the consultant. In general, vendors are responsible for providing software, hardware, user training and technical support to customers in order to maintain their optimal performance (Moffett and McAdam, 2003). In the study by Hwang et al. (2004), the authors found a relationship between BI vendor selection and technology adoption. As BI is different from other enterprise information technologies, it requires a tailored solution to suit each particular firm and industry, and not just a total package (Hill and Scott, 2004).
**Owner-manager characteristics**

Owner-manager characteristics are fundamental to the Information Systems Adoption Model for Small Business proposed by Thong and Yap (1996). Ghobakhloo et al. (2011) claim that SMEs generally have simple and highly centralised structures, with authority mainly being given to the Chief Executive Officer (CEO), and, oftentimes, the owner and CEO are the same person. Thus, the owner-manager is the sole decision-maker having a direct effect on the decision-making processes ranging from daily functions to future investments (Nguyen, 2009; Bruque and Moyano, 2007; Jarvenpaa and Ives, 1991). A study by Thong (1999) proposed that owner-managers who have innovativeness and an IT background have increased potential for IT adoption success.

According to Zhu et al. (2003), *innovativeness* refers to a willingness to introduce newness and novelty through experimentation and creative process aimed at developing new products, services, and process. A study by Chang et al. (2010) found that that an owner-managers’ innovativeness is a significant determinant in ERP adoption for SMEs. Similarly, a survey of 325 manufacturing SMEs located in the central industrial sector of Iran found that the innovativeness of an owner-manager significantly impacted on their adoption of e-commerce (Ghobakhloo et al., 2011).

*Owner-managers’ IT background (or knowledge)* is another trait influencing the adoption of IT in SMEs (Ghobakhloo et al., 2011; Drew, 2003; Fink, 1998). According to Grover (1993), owner-managers’ IT background refers to experience and knowledge in information technology. This attribute involves the background of the managers, their experience and awareness in IT activities, their recognition of IT potential, as well as their ability to plan strategically. Thong and Yap (1995) claimed that owner-managers who have more IT knowledge will be more likely to be innovative.

Chao and Chandra (2012) conducted a survey with 217 small manufacturers and financial services organisations in the USA and found that the level of an owner’s IT knowledge is a key predictor of IT strategic alignment, as well as the adoption of IT. An interesting aspect of this finding is that although owner-managers’ IT knowledge can increase the chances of IT adoption in organisations, advanced IT applications including CRM and BI have received quite low rates of adoption among smaller firms due to the critical constraints of resources in such firms.

As shown in the research framework (Fig. 1), the above review of studies in the IT domain found thirteen potential enabling factors under four characteristics affecting innovation adoption. These four characteristics consist of Technological, Organisational, Environmental and Owner-managers. First, the Technological characteristics include five factors: Relative Advantage, Complexity, Compatibility, Trialability and Observability. Second, the four factors under Organisational characteristics include: Organisational size, Organisational age, Absorptive capacity and Organisational resource availability. Third, the two factors under Environmental characteristics include: Competitive pressure and Selection of vendors. Fourth, the two factors under Owner-manager characteristics include: Owner-managers’ innovativeness and Owner-managers’ IT knowledge. Furthermore, in order to allow for different enabling factors or characteristics that may impact SMEs’ decisions to adopt at each level of current BI, this framework also includes a classification of SME’s current BI adoption into five levels: Operate, Consolidate, Integrate, Optimise and Innovative, ranging from the lowest to highest, with Operate being the lowest.
CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

The conceptual framework outlined in this paper aims to provide an understanding of the current adoption levels of BI in Thai SMEs and the enabling factors that may influence SMEs’ adoption of BI. Based on the framework of this study, SMEs should be classified into different levels of BI adoption before examining the factors that impact their decision on BI adoption. Rather than considering the BI adoption as a binary function, to adopt or not to adopt, the classification of organisations allows researchers to explore the enabling factors that impact each of the BI adoption levels and to gain an understanding of whether SMEs in the upper BI level have different impact factors from those in the lower levels. For this reason, different BI level groups of organisations will require different types of attention to help them prolong their use of BI technologies. According to the multiple-perspective framework that was used as the foundation for developing the conceptual framework in this paper, thirteen potential enabling factors under four characteristics that influence technological innovation adoption are found to drive the organisations’ decision to adopt technological innovation. These four characteristics are Technology, Organisation, Environment and Owner-managers. Because the BI adoption framework of this paper has been based on the literature in the area of IT, it is open and requires testing to determine its relevancy and validity in the practical environment. Furthermore, as the proposed model may not be complete, future studies may find additional factors that can potentially affect BI adoption. All enabling factors in the framework can provide testable hypotheses for future researchers to examine (see Table 1).

Table 1: Summary of testable hypotheses

<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Hypotheses</th>
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</thead>
<tbody>
<tr>
<td><strong>Technological Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Relative advantage</td>
<td>H1: Relative advantage has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Complexity</td>
<td>H2: Complexity has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Compatibility</td>
<td>H3: Compatibility has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Trialability</td>
<td>H4: Trialability has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Observability</td>
<td>H5: Observability has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td><strong>Organisational Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Organisational size</td>
<td>H6: Organisational size has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Organisational age</td>
<td>H7: Organisation age has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Absorptive capacity</td>
<td>H8: Absorptive capacity has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Organisational resource availability</td>
<td>H9: Organisational resource availability has an effect on the adoption of BI in SMEs.</td>
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</tbody>
</table>
Environmental Characteristics

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<tr>
<td>Competitive pressure</td>
<td>H10: Competitive pressure has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Vendor selection</td>
<td>H11: Vendor selection has an effect on the adoption of BI in SMEs.</td>
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</tbody>
</table>

Owner-managers Characteristics

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<tbody>
<tr>
<td>Owner-managers’ innovativeness</td>
<td>H12: Owner-managers’ innovativeness has an effect on the adoption of BI in SMEs.</td>
</tr>
<tr>
<td>Owner-managers’ IT knowledge</td>
<td>H13: Owner-managers’ IT knowledge has an effect on the adoption of BI in SMEs.</td>
</tr>
</tbody>
</table>

The contribution of the conceptual framework of this paper is to advance knowledge and provide a clearer understanding of the BI adoption rates and factors contributing to the process for BI adoption in SMEs. In utilising this framework, prospective outcomes are expected to form a basis for both government agencies and IT providers to determine the current levels of BI adoption in SMEs. By categorising SMEs into different groups, they can design policies and tailor the products that are most appropriate to their organisations, which will ultimately accelerate BI diffusion among other SMEs. The government and IT providers will be able to adjust their policies and allocate resources more efficiently in the areas (factors) that they determine to be overlooked and under-resourced, in order to introduce the more pertinent technologies into SMEs. Technology alone is not sufficient to guarantee the adoption of IT innovation by organisations, because other social, technical, organisational and individual factors may impact on the selection and adoption of technologies. The development of this new research framework is expected to guide future studies in the growing area of academic inquiry into IT adoption. This framework has the potential of being a research tool for examining enabling factors in the adoption of other technological innovations in the SME context. Further studies could also investigate the reasons for slow IT adoption in SMEs, and investigate ways to overcome inhibitors to IT adoption.

REFERENCE


Klimko, G. Knowledge management and maturity models: building common understanding. The Second European Conference on Knowledge Management, 2001 Bled, Slovenia. 269-278.


McDonald, K. Is SAP the right infrastructure for your enterprise analytics’. American SAP User Group Conference, 2004 Atlanta, GA.


