Adoption of Business Intelligence Tools by Small and Medium-Scale Enterprises in North Central Province, Sri Lanka

Ms. HM Ranasinghe
Department of Information Systems
Rajarata University of Sri Lanka
Mihintale, Sri Lanka
rhansikadamalith@gmail.com

Mr. DMT Madushanka
Department of Information Systems
Rajarata University of Sri Lanka
Mihintale, Sri Lanka
thilina.dmt@gmail.com

Abstract— Business Intelligence (BI) is one of the decision support tools that offer the ability to gather, store, access and analyze huge amounts of data and support for making effective decisions. There is a rich body of literature relating to BI adoption and their related benefits over the Small and Medium Enterprises (SMEs) in developed countries. But the researcher’s pilot survey depicts that in developing countries, especially in Sri Lanka, even if larger companies adhere to the new technologies, it’s remaining very low to the SMEs. Therefore, those companies are still taking a long time to analyze data, interpret data and present data. The objective of this study was to address this research gap by examining the factors affecting BI adoption by SMEs in the North Central Province in Sri Lanka. North Central Province was selected due to ease of access to the sample for data collection. By initiating the deductive approach, a research model was developed using independent variables of relative advantages, complexity, organizational resource availability, competitive pressure and the dependent variable of BI adoption by SMEs. 150 SMEs considered the sample out of 7461 SMEs of the total population which the details obtained through the Divisional Secretariat Offices in Anuradhapura and Polonnaruwa. An administrative questionnaire was distributed to collect data adhering to the Stratified Sampling technique. The collected data were analyzed using SPSS version 21.0 and the results revealed that relative advantages, complexity, organizational resource availability and competitive pressure showed a high effect on BI adoption and the mean value is higher than 3.0. According to correlation analysis, three factors showed a significant and positive relationship with the dependent variable except for complexity with BI adoption. According to that three hypotheses were accepted and one was rejected. The research findings elaborate and statistically proved the reasons for minor adoption of new technologies including Business Intelligence by SMEs in North Central Province. Further, this study highlighted the actions that need to be taken by the Sri Lankan government and IT/IS vendors while providing direction for future researchers.

Keywords— Business intelligence, information systems, small and medium-sized enterprises.

I. INTRODUCTION

With the advancement of information technology (IT), increased competition, increased product versatility, and increased consumer demands, companies are now expected to work in very complex and competitive environments (Boonsiritomchai, Mcgrath, & Stephen, 2014). In order to survive and thrive in these market environments, businesses must make prompt, accurate, and appropriate decisions (Habjan & Popovic, 2007).

Business Intelligence Systems (BIS) aid in the identification of users and the resolution of issues, the detection of business risks and opportunities, the forecasting of market processes, the estimation of competitor operation, a clearer understanding of business needs, and the management of clients and supplier relationships (Boonsiritomchai, 2014).

II. THE PROBLEM OF THE STUDY

Due to the challenges of making successful and timely business decisions in highly competitive markets, many organizations around the world have turned to data-driven decision making using BI systems.

Zeng et al. (2006) define BI as "the method of purposefully gathering, updating, and disseminating information in order to minimize uncertainty in all strategic decision-making and in every strategic decision." Moreover, the IBM Tech Trends Report, which was based on a survey of over 4,000 IT professionals from 93 countries and 25 sectors, listed BI and business analytics as one of the four big innovations in organizations, alongside cloud computing, artificial intelligence, the internet of things, and data protection and analysis (Shamsul, 2016).

Despite the fact that SMEs are the primary drivers of national economic growth, there has been little research on their adoption and implementation of BI and other decision support systems in large enterprises (Chaveesuk, 2010). Regardless of the fact that there is a growing movement toward developing BI for SMEs, they have been slow to invest in BI systems (Boonsiritomchai, 2014).

Furthermore, a review of the current study shows that the majority of BI studies are focused on developed countries, especially Europe, the United States, and Australia. Furthermore, the use of BI in developing countries such as Southeast Asia has received little attention in the existing literature (Boonsiritomchai, 2014). According to Olszak & Ziemba (2012), there was limited research on factors influencing the usage of BI systems in SMEs, and there was also limited research on the adoption of BI systems by SMEs in developed countries, and there was inadequate information for forecasting and describing SME behaviors in IT adoption.

Moreover, BI systems have been implemented in big, global, and foreign businesses, and as a result, research on critical success factors has been directed toward them, representing their circumstances and needs. Furthermore, there was a dearth of research on BI vital success factors in SMEs, despite the fact that they are increasingly using the BI method (Olszak & Ziemba, 2012). Furthermore, SMEs in developed countries have a poor understanding of the factors that influence technology adoption in decision support systems (Boonsiritomchai, 2014).
In the Sri Lankan context, the research discovered that it was a current necessity to connect the core banking system with the business intelligence system or to establish BI system components within the core banking system in order to generate more reliable, logical, and timely data in order to make effective strategic business decisions (Fernando, 2015). And also, Ranasinghe and Rajapakse (2016) found that all large-scale supermarket companies use and utilize BI and analytics on a considerable scale and also researchers examine four large-scale supermarkets and three of them are used BI and analytic tools and ERP system but one firm was still in the process of getting point of sales systems all outlets, from all details of stores throughout the country nothing is collected and put into a common system or linked.

Hence, the use of the BI systems by SMEs is remaining very low in Sri Lanka as a developing country and limited researches are conducted relevant to the BI system adoption SMEs in Sri Lanka. Therefore, this study investigates what are the factors affecting to the adoption of BI system in SME in North Central Province.

III. REVIEW OF THE LITERATURE

A. Information System

Information systems (IS) use a range of information technologies (IT) such as computers, hardware, software, databases, communication systems, the Internet, mobile devices, and more to perform specific tasks, communicate with, and notify various actors in various organizational or social contexts, as per Boell and Kecmanovic (2015). Two types of information systems have been identified: functional and structural perspectives. It defines an information system from a functional standpoint as a technologically applied medium for recording, storing, and disseminating linguistic expressions, as well as for inference support. It explains that an information system is made up of a group of individuals, processes, data, models, technology, and partially formalized language that form a cohesive framework that serves some organizational purpose or function (Checkland, 2012). Further, Information systems have been categorized into two parts, namely operational support systems (support business operations) and management support systems (support managerial decision making). Under the operational support systems, it has three types of information systems as Transaction processing systems (TPS), Process control systems and Enterprise collaboration systems. As well as under the management support systems, it has management information systems (MIS), decision support systems (DSS) and executive support systems (ESS). TPS, on the other hand, conducts and records the regular routine transactions required for the operation of the company. Industrial or physical processes are monitored and regulated by process control systems. Office automation systems, also known as enterprise communication systems, assist managers in controlling the flow of knowledge within organizations. MIS provides information to support business decision-making in the form of pre-defined reports and displays. DSS assists managers in making decisions that include modeling, formulation, calculation, comparison, selection of the best alternative, or scenario prediction. ESS offers essential information tailored to the information needs of executives from a range of internal and external sources, including MIS, DSS, and other sources (Al-Mamary et al., 2014).

B. Business Intelligence

Business intelligence, according to Negash (2015), is a data-driven Decision Support System (DSS) that combines data collection, storage, and knowledge management with analysis to provide feedback to the decision process. BI systems are aligned with systems such as Management Information Systems (MIS), Decision Support Systems (DSS), Executive Information Systems (EIS), management support systems, and business performance management, and they denote decision making, information processing and knowledge management, and human-computer interaction. The aim of BI, on the other hand, is to provide organizations with information that can be used to gain a competitive edge. They bring together the capabilities of several systems that previously worked separately. BI focuses on using sophisticated analytical methods to support different business functions.

Furthermore, Wieder & Ossimitz (2015) define BI as an analytical, technology-supported process that gathers and converts fragmented data from enterprises and markets into information or knowledge about an organization’s objectives, opportunities, and situations. They also emphasize that BI is not only about software and systems, but about the entire process of managing data to ultimately support business objectives, opportunities, and situations.

Business intelligence, according to Kopáková & krobáková (2006), is the collecting, managing, evaluating, and sharing of data in order to obtain knowledge that can be used to make informed decisions. Information is transformed into intelligence, intelligence is transformed into knowledge, and knowledge is transformed into market wisdom through business intelligence. Business intelligence systems combine advanced techniques like data warehousing, data mining, and decision support to turn data into powerful customer relationship management systems that can help build deeper, more productive partnerships, identify potential business opportunities, and even predict customer demands.

C. Business Intelligence in SMEs

The term Small and Medium Enterprise (SME) have been defined and classified in different ways in different industries as well as different countries. Each country has its own definition of a small business based on its political and economic goals, as well as different classification criteria. The most widely used metrics to describe the term SME are the number of workers, invested capital, fixed assets, and industry type (Boonsiriromachai, 2014).

SMEs have variously perceived the aspect of business intelligence and the support of management decisions. Most SMEs are managed by their owners, and they use a less elaborated DSS to conduct performance analysis for their business activities. These DSS are often made from a combination of ICT resources available in the company infrastructure, resulting in a decrease in the quality of managerial decision support. Regardless of the sector they are in, the size of the company they operate, or the country of origin, all entrepreneurs have recognized the importance of implementing any ICT solution and using BI resources for decision making. For the adoption and selection of a decision support solution and BI tools, SMEs must consider certain factors such as ITC infrastructure, human and financial capital (Filofteia & Veronica, 2012).
However, one of the key skills required for SMEs to achieve competitive advantages has been described as knowledge building repositories, and data collection is a major contributor to the creation of knowledge in the enterprise. Larger companies have recognized the importance of data stored in databases and data centers and turned it into actionable processes to better understand their markets, consumers, and goods. However, since SMEs operate in volatile markets, the need to improve knowledge skills is even more important. As a result, managers have improved their ability to obtain reliable information quickly in order to take advantage of opportunities and respond to threats. As a result, the BI framework allows SMEs to incorporate data for analysis, monitoring, and accessing key performance indicators (KPIs) as well as marketing. Software-as-a-Service (SaaS) provides SMEs with tools to access technology that was historically only available to larger organizations through cloud-based solutions. As a result, SMEs will improve the efficiency of their information systems, gain access to new, efficient computing applications, and allocate funds to other areas of the business (English & Hoffmann, 2019).

D. The technology-organization-environment framework (TOE)

The technology-organization-environment (TOE) framework have been developed by Tornatzky and Fleischer in 1990 and it is a classic framework that provides a generic set of factors that explain and predict the likelihood of innovation or technology adoption. This framework is becoming a vital theoretical guideline for Information Technology (IT) adoption. And also, the adoption of complex IT innovation needed an advantageous technology portfolio, organizational structure and environmental strategy (Harfoushi, Akhorshaideh, Aqqad, & Janini, 2016). The framework provides three bits of enterprise contexts that affect the adoption or implementation of innovations. The contexts are technology development, organizational conditions and industry environment (L. Tornatzky & Fleischer, 1990). The technological context consists of both the internal and external technologies relevant to the firm. This describes current practices and equipment internal to the firm, as well as the set of available technologies external to the firm. In an organizational context, it refers to descriptive measures about the organization such as scope, size, and managerial structure. Environmental context is the arena in which a firm conducts its business and there have been its industry, competitors, and dealings with the government (Awa, Ukoha, Emecheta, Harcourt, & Harcourt, 2016).

The TOE framework provides a useful analytical framework that use to study the adoption and assimilation of various types of IT innovation. It was originally initiated and later adapted in IT adoption studies. The TOE framework has a solid theoretical basis, consistent empirical support, and the potential of application to IS innovation domains, via specific factors recognized within the three contexts may vary across various types of studies. The TOE framework consistent with DOI theory, pointed out individual characteristics, and internal and external characteristics of the organization, as forcing factors for institutional innovativeness. These two components have been recognize as technology and organizational context of the TOE framework, but the TOE framework consist of important component, namely, environmental context. The environment context offers both constraints and opportunities for technology innovation. The TOE framework makes the DOI theory better able to explain intra-organization innovation diffusion (Oliveira et al., 2011).

Many researchers have used the TOE framework to examine the adoption of different IS such as Open system (Chau & Tam, 1997); Electronic Data Interchange (EDI) (Kuan & Chau, 2001); Website (T. Oliveira & Martins, 2008); E-commerce (Liu & Arnett, 2000); Enterprise Resource Planning (ERP) (Pan & Jang, 2008); E-Business (Zhu & Kraemer, 2005); Knowledge Management System (KMS) (Lee et al., 2009).

![Fig. 1. Technology, Organization, Environment framework. Source : (L. Tornatzky & Fleischer, 1990)](image)

IV. METHODOLOGY

The research methodology includes the type of the study, research approach, population and sample, data collection and analysis.

Type of study: This research is to investigate the factors affecting to the adoption of business intelligence in SMEs in Anuradhapura in Sri Lanka. This is an explanatory research that tries to build up a relationship among the factors using the available literature. Based on nature, this is basic research.

Research Approach: An approach is a deductive approach where the known fact is applied to a narrow scope.

Research Strategy: The survey method is hoped to use as the strategy for this study it is widely used in deductive researches. Data will collect as single items at a time from a large pool of items.

Research Choice: The researcher expects to use the mono method for this study and that is a quantitative method.

Time Horizons: The time horizon for this study is cross-sectional as it gives many outcomes through a single period.

A. Techniques and Procedures

Research Population: The population comprises all small and medium-sized enterprises in The Anuradhapura district.

Research Sample: The researcher selected 150 small and medium enterprises (50 from small scale organizations and 100 from medium scale enterprises) in North Central Province as the sample size of this research. The sample is selected by a stratified sampling method.
B. Conceptual Framework

![Diagram](image)

Fig. 2. The relationship between independent and dependent variables.

**Source**: Developed by researcher

**Data Collection**: As this study is done by targeting small and medium scale enterprises, the researcher wishes to collect data through both primary and secondary data. As a primary data source researcher expects to gather data from questionnaires and observation. As a secondary data source researcher will use the website, journals, and paper articles.

**Data analysis**: Gathered data should be analyzed properly to reach the objective of the research. The researcher will use statistical analysis packages (SPSS Package). Descriptive statistics including frequencies, measures of central tendency (Mean, Median and Mode) and measures of dispersion (range, mean deviation, standard deviation) are used to analyze the gathered data from these questionnaires. Correlation analysis will use for data analysis under inferential statistics.

V. RESULTS AND DISCUSSIONS

A. Reliability Analysis

The purpose of this test was to examine the internal consistency of the construct that was used to assess key variables of the statistics and Cronbach’s Alpha test was used to measure the reliability of the construct. Table 1 shows the summary of the reliability statistics for the independent variables.

<table>
<thead>
<tr>
<th>Table 1: RELIABILITY ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Relative advantages</td>
</tr>
<tr>
<td>Complexity</td>
</tr>
<tr>
<td>Organizational resource availability</td>
</tr>
<tr>
<td>Competitive pressure</td>
</tr>
<tr>
<td>BI Adoption</td>
</tr>
</tbody>
</table>

**Source**: Survey Data

The reliability results of both dependent and independent variables are presented in Table 4.9. When considering those Cronbach’s Alpha values of all variables are ranged from 0.757 to 0.850, it fulfills the relevant accepted level of reliability. Generally, Cronbach’s Alpha value should be greater than its minimum value of 0.700 and considered those questions can be accepted. The reliability of the dependent variable was 0.771. The table shows that all the questions which were used to measure both independent and dependent variables were internally consistent.

B. Descriptive Analysis

Descriptive analysis was calculated to identify the basic nature of the research variables. The calculated Mean, Standard deviation and the skewness of all variables were shown in the following table.

<table>
<thead>
<tr>
<th>Table 2: DESCRIPTIVE ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Relative advantages</td>
</tr>
<tr>
<td>Complexity</td>
</tr>
<tr>
<td>Organizational Resource Availability</td>
</tr>
<tr>
<td>Competitive Pressure</td>
</tr>
<tr>
<td>Likelihood of BI Adoption</td>
</tr>
</tbody>
</table>

**Source**: Survey Data

According to 4.10 table, relative advantages toward the BI adoption of the selected respondents is relatively high (M=3.98, SD=0.65). But considering to the skewness, it is -1.062, which describes its negatively skewed. When considering the complexity, it is relatively high (M= 3.04, SD=0.69) but positively skewed (.068). The organizational resource availability toward the BI adoption by SMEs is also relatively high (M=3.60, SD=0.64). It also negatively skewed (-.153). Further, competitive pressure toward the BI adoption by SMEs is also relatively high and negatively skewed (M=3.77, SD= 0.62, Skewness= -0.679).

Respondent’s opinions regarding BI adoption is relatively high (M=3.81, SD=0.59) and it is negatively skewed (-.188). According to the above table mean values of all the variables are range from 3.04 to 3.98, standard deviation values are range from 0.59 to 0.69 and the highest mean value is 3.986 and the highest standard deviation value is 0.699.

C. Correlation analysis

The purpose of correlation analysis is to illustrate the correlation of each variable with other variables including the dependent variable. Therefore, correlation analysis is more valuable to the researcher to identify initially whether there is a relationship with each variable and a relationship between each dependent variable and independent variables. The following table described these things.

<table>
<thead>
<tr>
<th>Table 3: CORRELATION ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Relative Advantages</td>
</tr>
<tr>
<td>Complexity</td>
</tr>
<tr>
<td>Organizational Resource Availability</td>
</tr>
<tr>
<td>Competitive Pressure</td>
</tr>
</tbody>
</table>

**Source**: Survey Data

According to the above table there is a significant positive relationship between relative advantages and BI adoption by SMEs. The Pearson correlation value was 0.553, it is a significant relationship and this was accepted at the 0.05 significance level. Therefore, there is a strong positive relationship between relative advantages and BI adoption. There is a negative relationship between Complexity and BI adoption. The Pearson correlation value was -.122; it is a negative level and this was not accepted at the 0.05 significant level. Therefore, there is a negative relationship between
Complexity and BI adoption by SMEs. Pearson correlation for the relationship between organizational resource availability and BI adoption is 0.367 with low positive level and it is significant (p<0.05). It can be described as there is a low positive and significant relationship between organizational resource availability and BI adoption. The Pearson correlation value for the relationship between competitive pressure and BI adoption by SMEs is 0.528. It described a positive and significant (p<0.05) relationship.

VI. REGRESSION ANALYSIS

This section aims to explain how independent variables contribute to vitiate the dependent variable. In regression analysis, BI adoption by SMEs was entered as the dependent variable and relative advantages, complexity, organizational resource availability, and competitive pressure as predictors. The results are produced in the following tables.

TABLE IV. RESULT OF MODEL SUMMARY

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.670a</td>
<td>.449</td>
<td>.426</td>
<td>.45326</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Competitive Pressure, Complexity, Organizational Resource Availability, Relative Advantages

Source : Survey Data

According to the above table 4, the R-value shows the simple correlation and it was 0.670. The adjusted R square value indicates how much of total variation in the dependent variable can be explained by the independent variables. Further, the adjusted R square value is 0.426.

This means 43% of the factors affecting to BI adoption by SMEs was described by the independent variables taken under model 1 and the remaining 57% is described by other factors that are beyond in the study.

TABLE V. COEFFICIENT RESULTS

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>Relative</td>
<td>.330</td>
<td>.085</td>
<td>.363</td>
<td>3.894</td>
</tr>
<tr>
<td>Advantages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexity</td>
<td>-.190</td>
<td>.067</td>
<td>-.222</td>
<td>2.822</td>
</tr>
<tr>
<td>Organizational</td>
<td>.103</td>
<td>.086</td>
<td>.111</td>
<td>1.207</td>
</tr>
<tr>
<td>Resource</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive</td>
<td>.326</td>
<td>.083</td>
<td>.343</td>
<td>3.924</td>
</tr>
<tr>
<td>Pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: BI Adoption

Source : Survey Data

According to the above table 5, the regression coefficient of relative advantages of BI systems indicates that it has a positive impact on BI adoption by SMEs (β = 0.330, p<0.05). This result further supports the first hypothesis (H1) of the study. This means if higher the relative advantages of BI systems will cause to BI adoption by SMEs.

When considering the regression coefficient of the complexity of BI systems toward the BI adoption is -.190 and the significance value is 0.006. Those figures specify that there is a negative relationship between the complexity of BI systems and BI adoption (β = -0.190, p<0.05). This result revealed that there is a significant relationship and supported the second hypothesis (H2) of the study.

According to the regression coefficient of organizational resource availability, availability can be concluded as it has a moderate positive impact on BI adoption by SMEs, but it is not significant (β = 0.103, p>0.05). This result not much supported the third hypothesis of the study.

The regression coefficient regarding the competitive pressure indicates that it has a positive impact on BI adoption by SMEs (β = 0.326, p<0.05). This result further supports for the fourth hypothesis (H4) of the study that describes if competitive pressure is high, which will cause to BI adoption by SMEs.

VII. CONCLUSION

SMEs play a very important role in the economy of a Sri Lanka. The use of BI system improves the decision-making process of SMEs in a competitive and changing business environment. Most SMEs do not use Business Intelligence systems at a satisfactory level due to various reasons. Therefore, the study focuses to find out what are the factors affecting BI adoption in the North Central province in Sri Lanka. Relative advantages, complexity, organizational resource availability and competitive pressure were the identified factors for this study. The research model was developed using the above factors as independent variables and BI adoption was the dependent variable.

Based on the research findings, the researcher conveys that BI systems have more valuable advantages that support SMEs, if there is highly competitive pressure on SMEs or their competing rivals that use BI systems and getting benefits from BI systems, SMEs will adopt BI systems. And also, Insufficient organizational resources prevent SMEs from BI adoption.

REFERENCES


