FACTORS INFLUENCING BUSINESS INTELLIGENCE SYSTEMS IMPLEMENTATION SUCCESS IN THE ENTERPRISES

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Abstract

Reducing the risk of having a failure in Business Intelligence system (BIS) implementation and finding the critical affecting factors have become urgent tasks for the researchers who would like to bridge the knowledge gap in this study area. To help understand the factors influencing success of BIS implementation, this study took theory of TOE framework and empirically tested using data collected from 148 users of BIS. Analytical results suggested that technical characteristic (i.e., relative advantage), organizational characteristic (i.e., organizational size, Top management support, knowledge integrate) and environment characteristic (i.e., consultant ability and training) were significant in affecting user satisfaction. On the other hand, technical characteristic (i.e., compatibility) and environment characteristic (i.e., consultant ability) were significant in affecting overall system effectiveness. The implications of this study and future directions are discussed.

Keywords: Business intelligence, Critical success factors, Information systems success, Technology-Organizational-Environmental framework
1 INTRODUCTION

Properly applying BI (Business Intelligence) is the key issue to today's enterprises to form the variation and uniqueness for displaying advantages in a competitive global market. According to the latest forecast report published by Ovum, the size of big data software market will grow six fold by 2019, and also the big data analysis will become the core competence of many corporations. At that time, business will apply big data technology to reach the expectation in terms of gaining business value, and implement Business Intelligence System (BIS) to analyse big data to control the real time market information and increase decision quality. There has been a growing interest in Business Intelligence, for example, exploring the current application of BI (Shollo & Kautz 2010; Watson & Wixom 2007), investigating how a corporate adopting BI for decision making (Chen et al. 2012; Sauter 2014), and publishing comprehensive literature on this subject (Jourdan et al. 2008; Sangar et al. 2015). Nevertheless, this research found that, compared with the importance of BIS implementation, the knowledge regarding how to successfully establish BIS is still very limited among IS literature. Hence, in order to help this gap in our knowledge, this study investigates the key factors that enable successful implementation of BIS in business. To meet these goals, this research firstly explored the literature associated with BI, the success of IS, and the practice of BIS through literature review. Secondly, defined the characteristic of BIS and find the key factors of successfully implementing BIS. Thirdly, this study based on TOE (Technology-Organization-Environment) framework (Tornatzky & Fleischer 1990) to comprehensively investigate the critical factors affecting the BIS success from the context of technologic, organization, and environment (Angeles 2013; Olszak & Ziemba 2012; Sangar et al. 2015; Xue et al. 2011). Fourthly, this study proposed a theoretical research model of BIS implementation success by the estimate of user satisfaction and overall system effectiveness and inferring hypotheses. As would be expected, a most suitable model and success key factors can be examined through data collection, statistical analysis, and the verification of hypotheses.

2 THEORETICAL BACKGROUND

2.1 Business Intelligence Systems implementation

Different from the general information system, the most important characteristic of BIS is that it can provide real-time, fluent, and highly secure services (Sangar et al. 2015). BIS is defined as “collection of techniques and tools, aimed at providing businesses with the necessary support for decision making” (p.559) (Mikroyannidis & Theodoulidis 2010). In fact, today's data into multiply many times over, which means there is more competition. However, business executives, managers or professionals have to make better decisions in a shorter period of time, because time is money. Elbashir et al. (2008) pointed out that BIS provides the ability to analyse business information and improve management decision making of business activities. The results show that BIS achieve business value by enterprise
process performance and organizational performance. However, Hou (2012) believes that the value of BIS that meet end-user needs, and can enhance their job performance. Werner and Abramson (2003) argued that BIS is a strategic information system, IT can be used to organize the deployment, and thereby improve the decision making and competitive advantage. Organizations deploy business intelligence system without delay, in order to respond to today's information changing competitive environment. However, not all BIS can achieve the desired performance of the organization; one reason for failure is the lack of BIS to understand the critical success factors (Isik et al. 2011). Most BIS implementation success research is on the system and organization factors. For example, Isik et al. (2011) found that BI capabilities positively affect user satisfaction, user satisfaction as a surrogate for BI success. Popovic et al.'s (2012) study illustrated how effects of maturity and culture on analytical decision making affected BIS success. Isik et al. (2013) believe that the decision environment (such as decision type and information processing need) can strengthen the relationship between BI success and capabilities. Popovic et al. (2014) also argued that information-sharing values affected BIS success.

2.2 Theory of TOE Framework

The TOE (Technology-Organization-Environment) framework was presented by Tornatzky and Fleischer in 1990 when they studied the procedure of technique innovation. This framework mainly states that when an enterprise decides to adopt or implement a new information technology, the process of making decisions would be influenced by technology, organization, and environment. Technology context includes the related technology inside and outside of the enterprise, such as equipment and processes. Organization context includes business characteristics and resources, such as firm size and degree of centralization, degree of formalization, managerial structure, human resources, amount of slack resources, and linkages among employees. Environment context is the whole industry structure, industry size, firm's competitions, macroeconomic context, and regulatory environment (Tornatzky & Fleischer 1990). Tornatzky and Fleischer explained that although these three contexts create some opportunities for the enterprises to adopt innovation technology, it also brings some limitations. Therefore, it is necessary to make a self-assessment before an enterprise decide to adopt the innovation technology, and have a clear picture about its demand and defect in order to adjust its operational structure and maximize it competitive advantage (Angeles 2013).

3 THEORETICAL MODEL DEVELOPMENT

Based on TOE Framework developed by Tornatzky and Fleischer (1990), and the associated literature, this study investigated several key factors affecting the success of BIS implementation. The research model is shown in figure 1.
3.1 Research Model

According prior studies, the measurement for BIS success include system use (Yeoh et al. 2008), information use (Popovic et al. 2014), information quality (Yeoh et al. 2008), system quality (Yeoh et al. 2008), user satisfaction (Davison 2001), BI satisfaction (Isik et al. 2011) and Organizational benefits (Isik et al. 2013). In this study, organization use satisfaction and overall system effectiveness as a surrogate for BIS success.

![Business Intelligence Systems Success Model](image)

### 3.2 Hypothesis Generation of Technical Characteristics

Technical characteristics is the main key factor to affect the IS implementation in a corporate as the adoption of IT can physically improve the operational performance. In the research of Tornatzky and Klein (1982) about innovation characteristics and innovation adoption-implementation, they pointed out that - relative advantage, compatibility, and complexity are the three characteristics that can significantly influence the adoption of IS in an enterprise. Many scholars indicated that if a technology innovation is found to be related to the degree of system, value, measure, procedure, and normal consistency, then this specific technology is more likely to be adopted for supporting the activities of a business (Gopalakrishnan & Bierly 2001; Jeyaraj et al. 2006; Rogers 1995). The main function of BIS is to provide real-time and valuable information to assist users or decision-makers to make accurate judgements so as to create a more competitive advantage for associated services in a business (Afolabi & Goria 2006). Thus, according to the literature above, this research proposed hypotheses H1 to H3.

**H1**: Relative advantage has a significantly positive effect on BIS implementation success.

**H2**: Compatibility has a significantly positive effect on BIS implementation success.

**H3**: Complexity has a significantly negative effect on BIS implementation success.
3.3 Hypothesis Generation of Organizational Characteristics

A good organizational climate is the cornerstone for the success of organizational transformation in the enterprises (Bock et al. 2005). A number of researchers asserted that the support and commitment of top executives is one of the critical factors for IS successful implementation in the business, as their supports enable the associated activities of software engineering to attain physic resource, including: the input of skilled manpower and capital funds, resource allocation, or minimizing the potential resistance caused by the internal structure adjustment (Chau & Tam 1997; Moss & Atre 2003; Sabherwal et al. 2006). Thong & Yap (1995) argued that because of the shortage of financial resource, manpower, and technique, a small size business will be much slower than the large size enterprise in the implementation of innovational technology. According to Diffusion of the Innovations Theory of Rogers (1995), the size of a business can significantly affect the success of innovational technology implementation. Since the establishment of BIS costs more, and have a longer payback period than the other information systems; especially, it requires to overcome some factors such as: integration of knowledge from different departments, data amendment, and operational objective adjustment (Bose & Sugumaran 2003; Cody et al. 2002; Herschel & Jones 2005; Lee & Xia 2006), therefore, it is considered that the implementation of BIS is highly related to the size of the organization and the degree of knowledge integration. The hypotheses of this research are proposed as below:

**H4 :** Top management support has a significantly positive effect on BIS implementation success.

**H5 :** Organization size has a significantly positive effect on BIS implementation success.

**H6 :** Knowledge integration has a significantly positive effect on BIS implementation success.

3.4 Hypothesis Generation of Environment Characteristics

The business activities are closely related to its external circumstance. The more uncertainty there is in the business circumstance, the more we need to develop IT in order to make profits and resolve potential problems for the business (Kuan & Chau 2001; Xue et al. 2011). Scholars concluded that social environment, task environment, and information are the factors affecting the activities of an organization. Based on this conception and having reviewed prior literatures, this research found some important factors that can significantly influence the success of BIS implementation, they are competitive pressure, consultant ability, and training. These factors are used as the base of the research mode (Sangar & Iahad 2013; Xue et al. 2011). Normally, the purpose of implementing a BIS is to cope with the intense rivalry between businesses, and to obtain the competitive advantage. However, during the period of implementing a new system, very often it can create some impact inside the organization. Therefore, in order to manage the prospective problems, the assistance from a professional and experienced consultant is necessary. In addition, some proper training can help the users to better understand the function of the system, and to be more familiar with the operational procedure (Sangar et al. 2015). Thus, this research assumed that:
**H7**: Competitive pressure has a significantly positive effect on BIS implementation success.

**H8**: Consultant ability has a significantly positive effect on BIS implementation success.

**H9**: Training has a significant positive effect on BIS implementation success.

### 4 RESEARCH METHOD

#### 4.1 Measurement Development

This study included eleven variables. The constructs were adapted from previous studies and modified to fit the context of BIS implementation. Besides, three scholars were also invited to conduct a pre-test. Finally, an elaborate questionnaire was revised as an instrument for the following data survey. All survey questions used a 5-point scale except the construct. Table 1 presents the constructs and sources of the questionnaire.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition and source</th>
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<tbody>
<tr>
<td>Relative advantage</td>
<td>The degree to which implementation of BIS to achieve competitive advantage. (Premkumar &amp; Roberts, 1999)</td>
</tr>
<tr>
<td>Complexity</td>
<td>The degree of difficulty associated with understanding and learning to use BIS. (Premkumar &amp; Roberts, 1999)</td>
</tr>
<tr>
<td>Compatibility</td>
<td>The degree to which enterprise business intelligence system implementation is perceived as being consistent with existing values, operating procedures and previous experiences. (Grover, 1993)</td>
</tr>
<tr>
<td>Top management support</td>
<td>The degree to which the company’s senior management supports BIS implementation. (Premkumar &amp; Roberts, 1999; Soliman et al., 2004)</td>
</tr>
<tr>
<td>Organization size</td>
<td>The size of the firm (i.e., the number of employees and capital) (Premkumar &amp; Robert, 1999)</td>
</tr>
<tr>
<td>Knowledge integrate</td>
<td>The ability of enterprises to integrate, transfer and application of knowledge resource. (Tanriverdi, 2005)</td>
</tr>
<tr>
<td>Competitive pressure</td>
<td>The degree of competition in the industrial environment. (Wu et al., 2003; Thong, 1995)</td>
</tr>
<tr>
<td>Consultant ability</td>
<td>The ability of consultant to provide professional management implementation and technical support of BIS. (Thong, 1994)</td>
</tr>
<tr>
<td>Training</td>
<td>The degree of BIS training provided to users. (Venkatesh &amp; Davis, 1996)</td>
</tr>
<tr>
<td>User satisfaction</td>
<td>The degree of user believes BIS meet their needs. (Raymond, 1990)</td>
</tr>
<tr>
<td>Overall system effectiveness</td>
<td>The degree to which BIS provides organizational effectiveness. Vandenbosch &amp; Huff (1997)</td>
</tr>
</tbody>
</table>

*Table 1. Constructs and sources*

#### 4.2 Data Collection

The research object is the users of a firm who has participated in the implementation of BIS. The objective of data collection is the top three hundred enterprises announced by CommonWealth Magazine 2015 (Taiwan's first political-economic magazine). Questionnaires were distributed by the approach of systematic sampling and were delivered by post or sent via network. In order to increase
the incentives for responding to the questionnaire, some strategies were adopted. Firstly, the researcher requested a name list provided by the domestic software companies to collect the information about the corporate that has established BIS. Secondly, a telephone inquiry was made to the CIO or whoever was in charge of the establishment of BIS within a business for obtaining permission before questionnaires were distributed. A total of 240 questionnaires were returned. Finally, 148 valid questionnaires were obtained.

5 DATA ANALYSIS AND FINDINGS

A statistical software package - SPSS 21 for Windows was used in the analysis. The returned questionnaires were processed by data purification, reliability analysis, validity analysis, and assumptions in regression analysis before a multiple regression analysis was conducted to test each hypothesis in the research model. Reliability and validity were assessed for measurement model. The constructs were assessed for reliability using Cronbach’s alpha. The coefficients used for all constructs greater than 0.7 except those constructs (i.e., Relative advantage-0.689 and Knowledge integrate-0.662). Reliability was assessed by adopting a construct reliability used by Kerlinger (1999) that was greater than 0.60. The validity was tested using confirmatory factor analysis. All items loadings were greater than 0.60. In addition, each of variance inflation factor (VIF) value was not greater than 5, which indicates multicollinearity problems did not occur (Hair et al. 1992; Henseler & Fassott 2005). The explanatory power of each principal construct is greater than 0.45, including user satisfaction ($R^2=0.600$) and overall system effectiveness ($R^2=0.489$)

<table>
<thead>
<tr>
<th>The main effects</th>
<th>Standard Coefficient (The effect on user satisfaction)</th>
<th>Standard Coefficient (The effect on overall system effectiveness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative advantage</td>
<td>0.214**</td>
<td>0.110</td>
</tr>
<tr>
<td>Compatibility</td>
<td>-0.043</td>
<td>0.241*</td>
</tr>
<tr>
<td>Complexity</td>
<td>0.050</td>
<td>0.080</td>
</tr>
<tr>
<td>Organizational size</td>
<td>0.131*</td>
<td>0.052</td>
</tr>
<tr>
<td>Top management support</td>
<td>0.228***</td>
<td>0.112</td>
</tr>
<tr>
<td>Knowledge integrate</td>
<td>0.260***</td>
<td>-0.001</td>
</tr>
<tr>
<td>Competitive pressure</td>
<td>-0.013</td>
<td>0.170</td>
</tr>
<tr>
<td>Consultant ability</td>
<td>0.161*</td>
<td>0.216*</td>
</tr>
<tr>
<td>Training</td>
<td>0.157*</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Note: * $p<0.05$ ; ** $p<0.01$ ; *** $p<0.001$

Table 2. Results of Hypothesis Tests
6 CONCLUSIONS AND SUGGESTIONS

Besides having good operational effectiveness, as a successful IS it is more important to satisfy the user's requirement in the area of information systems while it is applied. Based on the framework of TOE, this study explored the factors affecting the success of BIS Implementation. The empirical study identified some important conclusions which can be referenced by business and academia for future research. In terms of technical aspect, relative advantage has significant effect on user satisfaction. This study found that the more a BIS can create profits, reduce operation costs, and provide real-time information for decision making for an enterprise, the more the users are satisfied with the expectation of using BIS. In addition, compatibility has a significantly positive effect on the overall performance. This indicates that among those enterprises with BIS, the one that has associated experiences in implementation, having stronger infrastructure supports, and having computer systems compatible to the BIS has better overall performance in the application of BIS. In terms of organizational aspect, the organizational size, the top management support, and knowledge integration are highly significantly related to user satisfaction. Many experts pointed out that in a world of global intense competition, massive resources and appropriate scale of the economy are necessary for the organizational development (Sabherwal et al. 2006; Thong & Yap 1995). Especially, when a business is too small or cannot receive support from top management, it will badly affect the implementation of modern technology. Besides, knowledge integration needs the cooperation and coordination between all department to reach the purpose of policy and process control. In terms of environmental aspect, this research found that consultant ability and training are also two important factors satisfying BIS users. Since BIS often involves much expertise such as business management, Statistics, and data mining, thus, the services of an experienced consultant is necessary during the period of implementation to minimize the possibility of having a failed project. Besides, spending a period of time training before understanding the function and being familiar with the operation can eventually make the use of this system more efficient (Xue et al. 2011; Sangar & Iahad 2013). In sum, good BI can create a brand new competitive advantage for the modern enterprises. Also, the implementation of BIS can increase the information integration and analysis ability, and therefore raise the profit for an enterprise, improve its service quality, and manage its risk. The findings of this study can be referenced for future research by academia in the field of BIS exploration, and also used as guidance by practitioners to better understand how to successfully implement BIS. In the first place, this study discussed influential factors of successfully implementing BIS only from the perspective of theory of TOE. Factors such as Environmental uncertainty and peer pressure and are not taken into account. Further research is therefore warranted in different theory. Secondly, this study has collected 148 users of BIS. A larger sample would improve the explanatory power of the model. Third, due to resource limitations, this study used cross-sectional data to predict BIS success evaluation factors. In future research, this study should be extended to strengthen the external validity of research results using longitudinal data.
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