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INNOVATION TRAITS FOR BUSINESS INTELLIGENCE SUCCESSFUL DEPLOYMENT

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ABSTRACT

Business Intelligence (BI) is an innovative technology that facilitates analytics of big data. Deploying BI is a complex undertaking, expensive in nature, and time-consuming task as these software applications are high-risk/high-return projects. Improper implementation may lead to failure and in turn leave organizations into data rich and information poor. This study examines BI from the lens of innovation in which the traits of the innovation tool itself influence its successful deployment in organizations. Rooted from Diffusion of Innovation Theory (DOI), a model was developed and validated by decision makers and executives that involve in various levels of BI deployments in telecommunication industry. The primary data collected through quantitative method were analyzed via structural equation modelling technique. Findings of the study suggest that DOI offers valuable insights into characteristics of BI that influence its successful adoption. In line with the literature on DOI of other type of information systems success, BI characteristics namely relative advantage, complexity, compatibility, and observability are also found to be determinants in ensuring BI success. This study contributes significantly to the existing literature that will assist future BI researchers especially in terms of information system success. Practically, the model serves as guidelines for BI implementers to invest on the relevant skills and resources for fulfilling the requirements of BI successful deployment..

Keywords: *Business Intelligence, Innovation Traits, Diffusion Of Innovation (DOI), Successful Deployment, Quantitative Method*

1. INTRODUCTION

Big data can revolutionize organization's competitive advantage. To facilitate big data initiatives, a concept called Business Intelligence (BI) is considered the essential innovative tools for analyzing big data for organization's competitiveness [1]. A growing number of organizations from various industries are becoming BI-based and have made monumental investments for BI implementation. BI spending has increased compared with the IT budget overall [2]. BI now is not just nice to have; rather, it is a necessity for competing in the marketplace. BI applications includes forecasting product demand, determining selling price for products, market basket analysis, customer segmentation analysis, product recommendations, customer and product profitability analysis, campaign planning and management, supply chain integration, web analytics and fact-based decision making [3]. Telecommunication (Telco) industry in particular, also acknowledges the potential gain that can be realized from implementation of BI [4]. Identifying market trends, detecting fraud and predicting customer retention [5, 6] by BI analytics are attempted by Telcos to accelerate and improve decision making for positioning themselves in the volatile business environment.

However, current BI deployments are reported to be as complicated, expensive, and time-consuming tasks as these software applications are complex in nature and considered as high-risk/high-return projects. Advanced BI systems that support tactical and strategic decision making require (1) requirement modeling of massive historical data, (2) use of highly analytical applications to perform analytics functions and (3) visualization of data in the form of dashboard to be presented at various level of decision maker [7]. In order to perform these tasks, people with dedicated and special skills are needed. Incorporating advanced analytics in BI program such as data mining, predictive analytics and text mining may only works if people like data scientists, statisticians and predictive modelers are employed.

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Hence, with complex situations in hand, improper BI implementations may easily lead to failure, and in turn leave organizations into data rich and information poor. Without careful considerations, BI initiatives for creating innovation will not be successful. This is evident in Gartner report stated that fewer than 30% of BI projects meet the objectives of the business [8].

In general, the more complex using an innovation appears to be, the less likely that an individual will adopt it. Diffusion of Innovation (DOI) is a theory that helps to explain the adoption process of an innovation, which is a perquisite of successful implementation. A study on BI using DOI was done by [9] on the mapping of the diffusion stages of BI and analytic using systematic mapping approach. Another study investigates BI adoption in retail chain using qualitative method [9], analyzing BI life cycle from DOI perspective and found out that requirement analysis is critical in BI success implementation. Taking a different approach, this study develops a BI model grounded on DOI to examine how BI characteristic influence the success of BI deployment in Telco companies.

2. BUSINESS INTELLIGENCE

BI as a concept is not new as in the last 15 years, large literature on BI have emerged. BI has been a popular topic among researchers and scholars in the field of strategic management and information systems (IS). The IS field in particular is in unique position to capitalize on a general interests in BI. In particular, BI research spans both business and technology expertise. Such breadth and synergy are relatively rare on other research communities that impinge on BI.

Most researchers and practitioners categorized BI applications into three types of (1) Strategic BI, (2) Tactical BI, and (3) Operational BI [10, 11, 12, 13]. The only real difference between these three types of BI application lies in the granularity of the data being analyzed and the frequency, at which it is being captured, analyzed, and reported as shown in Table-3.

The demand for BI is increasing as companies face the competitive challenges outlined above [14, 15]. This is evidenced when BI applications are in demand even at a time when demand for most IT products is soft [16]. For the first time in 2004, BI made the list of top 10 CIO priorities according to a Gartner survey [13]. Another survey of 225 Fortune 500 companies also reported an increasing use of BI programs [9]. In 2005, the BI market grew 11.5% to reach US$5.7 billion in worldwide license and maintenance revenue. Gartner group forecasting estimated that from 2002 to 2006, the percentage of BI deployments that provide instantaneous data currency grew from 11% to 29%. A report suggests that nearly 70% of the companies responding from all over the world are currently developing some type of BI applications [13].

Table 1 Types Of BI

Types of BI	Definition
Strategic	Developed to support long-term corporate goals and objectives and applications include aggregations, statistical analysis, multidimensional analysis, data mining, and exploration
Tactical	Developed for business analysts and experts whose daily jobs involve accessing and analyzing data and were targeted at making short-term business decisions
Operational	Used to manage and optimize daily business operations and evolved to meet the need to respond to specific events that happen in the operational world

A more recent report by Gartner [15] showed that BI software industry has grown 21.7% from over US$7.2 billion in 2007 to US$8.8 billion in 2008. It shows that executives now understand that timely, accurate knowledge can mean improved business performance [7, 9, 22]. Thus, many companies now are deploying BI tools and techniques which are designed to seek out, interpret and explain the information at hand [22].

2.1 BI Deployment

BI applications can be deployed either strategically across functional departments or tactically within functional departments [23]. Strategic BI has the potential of big rewards by giving senior managers a holistic view of the company. BI enables companies to identify trends and opportunities for growth as well as for monitoring key performance indicator (KPI). Tactical BI on the other hand, can be applied to the "pain" areas of their business. This type of BI can

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help companies with the knowledge and insights which will bring quick and quantifiable results.

BI-related technologies and strategies have been deployed in various industries. The first known BI application was the use of International BI for monitoring foreign currency instabilities way back in 1967 [10]. Organizations often employ BI to assess the business environment in various ways such as marketing research [11], competitor analysis [12], business process reengineering [13]; among others. Some examples of industries that have deployed BI are shown in Table 4.

Popular uses of BI are to help organizations understand their customers' buying patterns, to identify sales and profit growth opportunities, and to improve the overall decision-making. A study on current practices in data warehouse found out that information systems, marketing and sales, finance, and production are the major users of BI [14]. It has been reported that, based on a study from 2001 to 2006, enterprise that apply BI had achieved two to three times return of investment more than those who do not [15].

As BI continues to grow in volume and importance, the need of having BI successfully deployed in organizations escalates [16, 17, 18]. Since BI requires significant financial investment and management effort, it is necessary to measure the success of such initiatives, which provides a basis for organizations valuation, stimulates on management to focus on what is important, and justify in BI investments. The following questions are proposed [19] to be first answered by managers for BI to be successfully deployed in their organizations.

- What are the goals for using information and how are they prioritized?
- Who are the user of information in organizations and how do information changed among user groups?
- Does the organization culture allow the information to be used as a strategic asset?
- How does organization share the information with partners and customers?
- What are the corporate goals in implementing BI strategies?
- How are decisions made in organization? Does BI support and facilitate collaboration around data?
- How do the competitors use BI for information sharing with customers and partners?
- How will BI deployment add value to existing applications?
- What are the best practices for deploying BI?

Some challenging points in developing BI, which are often ignored that could lead to BI failures are also suggested [19]. Among the suggestions are the following issues: market and customer requirements are more important than internal requirements; dedicated business representation from every department; availability of skilled team members; unique BI development methodology; thorough project planning; data standardization and quality control; implementation of only required BI tools.

3. DIFFUSION OF INNOVATION (DOI) THEORY

Theory of Innovation Diffusion by Rogers [9], takes into account the perceptions about an innovation before adoption process takes place. Perceptions are important elements in the successful adoption process as it enhances people's awareness of the innovation.

This study adopts DOI theory as a theoretical basis firstly because it is a well-established theory and is widely used in information technology diffusion-related research [20, 21, 22]. The other reason of adopting this theory is that very limited research has been aimed at identifying sources of innovation and the integration of innovation perceptions from a knowledge-based perspective, particularly BI systems [23, 24].

Previous tudies have found the importance of the innovation characteristics in the adoption and diffusion of information systems. Agarwal and Prasad [25] stated that visibility or observability, compatibility and triability of the innovation characteristics were the significant forces of initial use of a system, while relative advantage and result demonstrability are relevant in predicting the intended continuous use of a system. Tornatzky and Klein [26] also found that factors of relative advantage, compatibility, and complexity constantly relate to adoption. Premkumar and Ramamurthy [27] concluded that relative advantage, technical compatibility, and cost influence the decision to adopt electronic data interchange.

In this study, BI is seen as an innovation for the executives in Malaysian telecommunication

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companies. Though BI has been utilized in various areas, the exploitation of it in Malaysia is still new. The empirical research discussing BI in telecommunication industry in Malaysia is also very scarce. Viewing BI as an innovation for the telecommunication industry, few questions arise

(1) whether the executives think BI brings relative advantage for them

(2) whether the executives feel the BI initiatives are compatible with existing systems and operations,

(3) whether it is quite complicated for the executives to try out and apply the relevant procedures, and

(4) whether the consequences of such endeavors can be visible, would have considerable effect on its successful deployment in telecommunication companies in Malaysia.

The theory gives the executives some perceptions on the new innovation, which is going to be deployed in their organizations. The opportunity to see the benefits be able to feel the complexity of BI and try it out and to see the results, would give them true perceptions of what BI systems are all about. Hence, it is considered appropriate in this research to employ the theory, which involves changes of thought, in the telecommunication industry in Malaysia.

4. CONCEPTUAL FRAMEWORK

This study examines BI from the lens of innovation theory in which characteristics of the innovation determine its successful deployment and continued use. The section below delineates the Diffusion of Innovation theory (DOI) and the related hypothesis as depicted in Figure-1.

In this study, the innovation is BI systems that are planned to be adopted by the firms. Diffusion theory, particularly by Rogers' work has provided an important set of theoretical constructs in influencing adoption and diffusion of information systems in organizations [10]. These constructs are known as 'perceived characteristics of an innovation', which include relative advantage, compatibility, complexity, trialability, and observability.

Viewing BI as an innovation for the telecommunication industry, few questions arise (1) whether the executives think BI brings relative advantage for them, (2) whether the executives feel the BI initiatives are compatible with existing systems and operations, (3) whether it is quite complicated for the executives to try out and apply the relevant procedures, and (4) whether the consequences of such endeavors can be visible, would have considerable effect on its successful deployment in telecommunication companies in Malaysia.

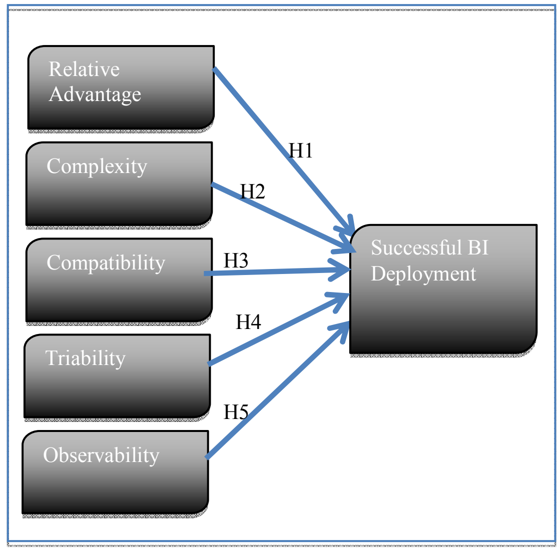

Figure 1 Conceptual Model Of Successful BI Deployment

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These constructs which belongs to BI systems in Telco organizations are hypothesized to influence the successful of BI deployment. As depicted in Figure-1, the hypotheses that are tested in the study are represented by arrows from five BI characteristics affecting its successful deployment. Sub-sections below detail out the construction of each hypothesis.

4.1 Relative Advantage and Successful BI Deployment

Relative advantage is defined as the degree an innovation is perceived as better in comparison with the one it replaces [4, 6, 7]. Firms have to perceive advantages of BI before adopting them due to high risk [8]. For example, Aubert and Hamel [9] in their study on adoption of smart cards in the medical sector found that relative advantage of the system

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for the medical professional is directly linked to the obligation for the client to use the card. BI can offer many benefits to organizations [14, 25, 26] that include: enabling effective decision support; ensuring data quality, accuracy, security, and availability; easing the setting and enforcing of standards; facilitating data sharing; and improving customer service [27, 28, 29, 30]. In a study on data warehouse benefits, it was found out that the most tangible benefits are time saving and more and better information [15]. The latter includes better decisions, improved business process, and support for the accomplishment of strategic business objectives. Specifically, BI offers many potential benefits for Telco namely; fraud detection, network optimization, long terms of retention service data and other competitive benefits [2].

In view of the advantages that BI, it can be inferred that perceived BI's relative advantage is likely to influence Telco's executives to use BI systems in their decision making tasks and this would lead to the successful BI deployment in their organizations:

Hypothesis 1 (H1): The higher the perceived relative advantage of using business intelligence systems, the more likely that business intelligence will be successfully deployed

4.2 Perceived Complexity And Successful BI Deployment

Perceived complexity is defined as the degree to which an innovation is viewed as being difficult to use [4]. Past researchers indicated that an innovation with substantial complexity requires more technical skills and needs greater implementation and operational efforts to increase its chances of adoption [10, 11]. Previous studies find complexity to be an important variable for various types of innovations [31, 32]. BI tools must be easy to use, but at the same time must provide significant power and flexibility [33]. This has been a classic problem since the inception of the computer. There has always been a tension between ease and sophistication. Findings such tool is not easy. BI has shortcomings that made it unattractive to many companies. Business users find BI applications both difficult and time consuming to use [7]. Since BI was considered complex, expensive, and time consuming, companies generally used it only on large-scale projects at the departmental level [15].

The complexity of BI system often made it expensive and usable only by technically savvy specialists. With a reputation for being hard to work with, BI requires the use of mathematician's skills in data and statistical analysis, or at least the help from IT staff [9]. BI tools have often restricted the accessing of corporate business information only to the experts. Business executives and managers frequently have to rely on these experts to answer their business questions, and to supply them with the information they need to make informed decisions. The user-interface, graphics, and what-if query capabilities have to be intuitive for BI systems to be deployed successfully in organizations. Findings from initial field study found that BI systems were hard to use and requires specialized skilled users to generate the reports from the systems. BI products and their interface were reported to be more complex than most IS applications and require too much technical sophistication for most employees to set up and use effectively. Most of the tools have rich functionality that is only appropriate for small percentage of executives in the company.

In the light of these BI complexities, people may be reluctant to adopt the technology. Therefore the following hypothesis is proposed:

Hypothesis 2 (H2): The lower the perceived complexity of using business intelligence the more likely that business intelligence will be successfully deployed.

4.3 Perceived Compatibility And Successful BI Deployment

Compatibility is defined as the degree to which an innovation is perceived as consistent with the existing values, needs, and past experiences of the potential adopter. Rogers [4] suggested that an innovation, which does not align with existing social values and norms, is unlikely to be adopted, or, if it is adopted, the rate of adoption will be slow. The innovation also is judged based on its perceived consistency with "existing values, past experiences, and needs" of the individual or community. An innovation which does not align with existing social values and norms is unlikely to be adopted, or, if it is adopted, the rate of adoption will be slow. Conversely, the greater the perceived compatibility of an innovation, the higher the probability of adoption and the faster the rate of adoption [18].

A number of studies find compatibility to be associated positively with adoption 21, 22]. Compatibility with an individual's work style and skills was associated strongly with satisfaction and continued use of the BI systems in clinical data repository [23]. In an initial field study, participants expressed that BI systems should be relevant to their current working culture and should be compatible with all aspects of their work. BI has been viewed as

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a strategic tool that is compatible with the profile of the modern day executives.

Therefore, it is expected that the more the executives use BI, and the more he or she perceives BI as compatible with his or her lifestyle, the more likely that the executives will utilize BI. Following this, the next hypothesis is formulated:

Hypothesis 3 (H3): The higher the executives' perceived compatibility of using business intelligence, the more likely that business intelligence will be successfully deployed.

4.4 Perceived Triability And Successful BI Deployment

Rogers [4] argues that potential adopters who are allowed to experiment with an innovation will feel more comfortable with the innovation and are more likely to adopt it. Thus, if users are given the opportunity to try BI systems, certain fears of the unknown may be minimized. This is especially true when they find that mistakes could be rectified, thus providing a predictable situation. When individuals and communities can test and assess an innovation prior to adoption and implementation, the probability of adoption increases and the rate of adoption is faster. "An innovation that is trialable represents less uncertainty to the individual who is considering it for adoption, as it is possible to learn by doing" (Rogers, 2003, p. 16).

Inconsistent with the literature, an initial field study have not found any evidence to support that perceived triability of BI systems is a significant predictor of BI success. However, for the consistency with the literature, this study decided to maintain the factor. Therefore, the hypothesis of perceived BI's triability is proposed:

Hypothesis 4 (H4): The greater the perceived triability of business intelligence, the more likely that business intelligence will be successfully deployed.

4.5 Perceived Observability And Successful BI Deployment

Rogers' original conceptualization of the perceived innovation characteristics included perceived observability, which represents perceptions of the degree to which the results of using an innovation are visible [4]. If the observed effects are perceived to be small or non-existent, then the likelihood of adoption is reduced. The visibility of the results of an innovation also influences individual and community perceptions of its value. Visibility also encourages communication among individuals or within communities about the innovation as peers often ask for innovation-evaluation information. A more readily observable innovation is adopted faster [15]. However, perceived observability has received equivocal support in empirical studies. A potential explanation for this is offered by [12], who propose that observability is better conceptualized as two separate constructs – visibility and result demonstrability. Visibility refers to the degree to which the use of an innovation is apparent. In contrast, result demonstrability refers to the degree to which the outcomes of the use of an innovation are apparent [12]. A more readily observable innovation is adopted faster [13].

In the context of BI, when users are able to see the competitive gain through utilizing BI for improving customer service and retention, the higher probability they will adopt BI:

Hypothesis 5 (H5): The greater the perceived observability of business intelligence the more likely that business intelligence will be successfully deployed.

5. METHODOLOGY

The study employs a quantitative approach where the study population is business analyst and decision makers in four Telcos companies in Malaysia. Telco industry is chosen to be tested due to the competitive nature of the companies and utilizations of BI among them are fairly high. A nation-wide survey was performed using questionnaire as an instrument for data collection.

5.1 Measurement Of Constructs

All constructs and their representative items are based on established literature and from qualitative field study conducted earlier. All items are assessed using 6 point Likert-scale (Strongly Disagree to Strongly Agree). The following describes the breakdown of the constructs and representative items.

BI relative advantage is represented by 6 items taken from [14], while BI compatibility was assessed using 3 items [4, 15, 16, 14]. Meanwhile, BI complexity is measured using 4 items [4, 15, 4]. As for BI triability, 3 items were used to represent this construct [17, 18, 16, 19]. BI observability was represented by 2 items [20, 16, 17, 19]. Lastly, BI success is measured by 6 items [21, 22, 23].

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5.2 Sample Selection

The industry wide survey was conducted among all five telecommunications providers in Malaysia. The list of companies is provided by Malaysian Communications and Multimedia Commission. These companies are - 1 large government-linked company, 3 large locally owned private companies, and 1 multinational company. The respondents were the executives or higher level officers who were involved in decision-making activities and have certain level of BI utilization in their organizations. Based on the information from the companies' web sites, each company employed not more than 2000 executives and that gave the maximum population of the study of 10,000. It is recommended that for populations greater than or equal to 10,000, researcher should consider a sample size of between 200 and 1000 [40]. Therefore, the initial sample size was fixed at 1000. The low response rate among executives was also taken into consideration when selecting the number of sample size.

5.3 Data collection and analysis

A 3-stage data collection was done over the period of almost 6 months. During the first stage, survey was administered to a sample of 1,000 telecommunications executives through contact persons throughout the country including East Malaysia. To increase the response rate, the study administered follow up phone calls and reminders. Finally, 310 usable questionnaires were eventually obtained, which made the response rate of 31%. The final dataset exceeds the minimum sample size required (60), which supposed to be 10 times the largest number of items of constructs [26].

The data were then analyzed by partial least square-based structural equation modeling, which is discussed in detail in the following sections. Typically, there are two sequential stages of PLS procedure as follows [42]:

i. Stage 1 Assessment of the Measurement Model

This stage is concerned with the relationships between the observed variables and the constructs [44]. Items which represents the observed variables, measure the constructs. The analysis of the measurement model leads to the calculations of loadings that provide the researcher with an indication of the strength of the measures.

ii. Stage 2 Assessment of the Structural Model

This stage focuses on the relationships that exist between the paths in the model [44]. The PLS analysis calculates the estimated path coefficients for the different paths in the model. The results provide the researcher with an indication of the strength and direction of the theoretical relationship.

6. RESULTS

The results of the quantitative method of the study are presented accordingly followed by the discussion in the following section.

6.1 Demographic details

This section described the compositions of the respondents in terms of gender, academic attainment, tenure, work position and field of work. In terms of gender, a huge majority of respondents are male (71.9%). This is not a surprising fact as the respondents were executives from telecommunications companies were known to be dominated by male workers. Regarding education level, a large majority (83.9%) of the respondents had tertiary education. Some of them attained (56.8%) basic tertiary education and 27.1% had Master's or higher degree.

As for working experience, more than 50% of the respondents have been in their organizations for more than 10 years, with 32.3% of these executives have worked between 10 to 15 years. Some of them (27.1%) have served the organizations for more than 15 years. A small percentage (6.8%) is relatively new to the organizations, having served less than 2 years. Majority of the respondents (54%) were executives. Directors, managers and head of sections are also among the respondents in this study; 9.4% were Section Head, 15.2% were Department Managers, 12.6% were Section Managers, 5.8% were Directors and 2.6% were Senior Directors.

Respondents are diverted into various supporting field of work; Finance (5.5%), Marketing (9.7%), Commercial (0.6%), Customer Services (7.1%), Facilities and Maintenance (2.9%), Human Resource (5.2%), Production (1.3%), Information Technology (9.7%), Quality Control (2.3%), Purchasing (1.6%), Manufacturing Services (0.3%), Sales (4.5%) and Planning (4.8%).

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6.2 Validation Results of Measurement Model

Table 1 demonstrates all indicators significantly loaded on their respective constructs, hence demonstrating reliability.

Table 1 Items Loadings

Construct	Item	Ref	Loading
Relative Advantage (RA)	Accomplish task quickly	RA1	0.7676
	Improve quality of work	RA2	0.8511
	Easy to perform job	RA3	0.8455
	Enhance effectiveness	RA4	0.8467
	Increase productivity	RA5	0.7906
	Greater control	RA6	0.7789
Compatibility (CB)	Compatible	CB1	0.9082
	Fits well	CB2	0.9187
	No effect on working style	CB3	0.6380
Complexity (CX)	Time consuming	CX1	0.9286
	Too long to learn	CX2	0.8929
Triability (TR)	Opportunity to try	TR1	0.8964
	Enough time to experiment	TR2	0.8671
	Test run	TR3	0.8964
Observability (OB)	Visible	OB1	0.8899
	Encourage communication	OB2	0.9171
Sucessful BI Deployment (SD)	Use	SD1	0.7269
	Rely	SD2	0.7304
	Utilize	SD3	0.8312
	Accomplish tasks quickly	SD4	0.8253
	Satisfy	SD5	0.8158
	Effective and efficient	SD6	0.8117

Table 2 shows the composite reliability and the average variance extracted (AVE) for all constructs exceed the recommended threshold of 0.7 and 0.5 respectively [26].

Table 2 Composite Reliability And Average Variance Extracted

Construct	Ref	Composite Reliability	AVE
Relative Advantage	RA	0.922	0.663
Compatibility	CB	0.858	0.672
Complexity	CX	0.894	0.739
Triability	TR	0.899	0.816
Observability	OB	0.907	0.830
Successful Deployment	SD	0.909	0.626

Meanwhile **Table 3** demonstrates all the constructs satisfy the first requirements for discriminate validity; the loadings of items on their respective constructs were higher than cross-loadings of the items on the other constructs [27].

Table 3 Cross Loading Output

	RA	CB	TY	OB	CX	SD
RA1	0.768	0.536	.270	.458	.036	.486
RA2	.851	.591	.226	.451	.101	.506
RA3	.846	.581	.266	.382	.065	.529
RA4	.847	.642	.238	.457	.045	.568
RA5	.791	.586	.265	.385	-.063	.519
RA6	.779	.696	.247	.462	.006	.530
CB1	.693	0.888	.320	.487	.020	.517
CB2	.691	0.906	.289	.514	.038	.547
CB3	.393	0.638	.219	.164	.181	.237
TY1	.199	.178	.813	.248	.209	.212
TY2	.244	.273	.896	.360	.227	.233
TY3	.330	.383	.867	.465	.184	.307
OB1	.492	.485	.458	.890	.055	.437
OB2	.470	.453	.330	.917	.088	.500
CX1	.036	.079	.143	.059	.929	.060
CX2	.035	.039	.306	.091	.893	.049
SD1	.470	.398	.216	.406	.445	.727
SD2	.404	.389	.142	.335	.361	.730
SD3	.568	.547	.268	.405	.469	.831
SD4	.520	.383	.255	.457	.460	.825
SD5	.509	.484	.233	.406	.508	.816
SD6	.564	.460	.284	.448	.516	.812

The following Table 4 shows the square roots of AVE ranged are all greater than 0.9, satisfying the second requirements of discriminate validity [45].

Table 4 Square Roots Of Ave (Bolded Diagonal)

	RA	CB	TY	OB	CX	SD
RA	0.814					
CB	0.745	0.913				
TY	0.309	0.332	0.859			
OB	0.531	0.517	0.431	0.903		
CX	0.039	0.067	0.237	0.080	0.911	
SD	.644	.563	0. 299	0.520	0.060	0.79 1

In conclusion, all the constructs demonstrated appropriate validity. Next, the structural path or the hypotheses were tested.

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6.3 Results of Structural Model (Hypotheses testing)

Hypotheses testing was performed using bootstrapping technique considering n = 1000 resamples and examining the t-values and standardized structural coefficients. The results of the testing of the hypotheses are detailed in **Table 5**
.

Table 5 Results of Hypotheses Testing

Hypothesis	β	t-value	Support
H1: Relative Advantage -> Successful BI Deployment	0.411	6.274	Supported
H2: Complexity -> Successful BI Deployment	-0.062	0.837	Not Supported
H3: Compatibility -> Successful BI Deployment	0.217	1.966	Supported
H4: Triability -> Successful BI Deployment	0.046	0.895	Not Supported
H5: Observability -> Successful BI Deployment	0.206	3.648	Supported

It reveals that out of five hypotheses related to successful BI deployment, three were statistically significant. These are Perceived BI's Relative Advantage, Perceived BI's Compatibility, and Perceived BI's Observability.

7. DISCUSSIONS

This study provides support that the principals of innovation theory [4] and the number of studies [28, 7, 17] among many others that have highlighted the importance of perceived relative advantage in the successful deployment of an innovation. The significance of this construct is also consistent with the literature on BI that argues that firms have to perceive advantages of BI before adopting them, due to high-risk nature of BI systems [8].

This study proposed that if executives' perceptions of BI's complexity are low, then the higher the likelihood of BI systems to be successfully deployed (H2). In this study, the result did not support the influence of perceived BI's complexity on successful BI deployment. This finding may be due to the fact that the executives are very much aware of the complexities involving in BI system, which they might be ready to embrace the inherent complexities and challenges. However, future studies may validate this argument.

Additionally, this study contests that compatibility of BI systems with an individual's work style and skills was associated with successful deployment of BI systems (H3). The findings of this study supported the statistical significance of perceived compatibility of BI systems in increasing the success of BI deployment in organizations.

As to hypothesis H4, that any new systems should be experimented by the potential users so that they will feel comfortable with the systems and are more likely to use them.

However, the findings of this study did not support the significance of the influence of triability on BI success deployment. The lack of statistical support for this construct was not surprising, as this factor was not supported in the field study interviews. One potential explanation is there may be limited opportunity for the executives to experiment using BI system before the actual use. This is related to the nature of the Telco industry, which is fast paced, and demand for immediate solution. Another possible reason could be due to the support that these executives receive from their various technical BI teams. With strong technical support, the triability issue is minimal.

In this study, observability appears to be a significant factor related to successful BI deployment in Telco companies in Malaysia (H5). The degree to which the outcomes of BI are more visible to BI users leads to higher successful deployment of BI. The most visible outcomes from BI systems, which are apparent to them, are the information (auto generated reports) required for their decision-making tasks. Telco executives also perceive BI systems as an advantage particularly in encouraging and improving communications among staffs in their organizations [1, 2].

In summary, findings from this study suggest the fundamental dimension of BI system that needs to be assessed before a massive deployment of BI initiatives.

The findings of this study strongly support the appropriateness of using innovation attributes to predict the successful BI deployment in telecommunications companies. The suggested characteristics of BI namely relative advantage, compatibility and observability were shown to have significance impacts on the executives' toward BI use, which in turn affected BI successful deployment. The insignificant of complexity however may be interpreted with caution. The

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current construct despite having good reliability and validity may not tap the specific complexity related to BI. Future studies may incorporate these aspects in designing the complexity construct. The findings later can reaffirm the influence of complexity towards the success of BI deployment.

For the organizations, especially those telecommunications companies, planning to implement and deploy BI initiatives, this study presents a better understanding of the significant factors and variables that affect successful BI deployment in their organizations. Since perceived relative advantage and observability appears overwhelmingly important to BI users, management would find it worthwhile to expend organizational resources on making benefits of a system apparent through initiatives such as training programs, information sessions, and provisions of work that takes meaningful advantage of BI.

8. CONCLUSIONS

This study has important managerial implications particularly for telecommunications companies that are currently having BI systems as well as companies that are planning to deploy them. The model shows that it is important for these companies to pay attention perceptions of innovations' characteristics factors when examining BI systems that have consequences for the entire organizations. Telecommunications companies can predict whether BI systems will be successfully deployed. The factors and variables in the model will also be able to help organizations to diagnose the reasons for possibly unsuccessful deployment of BI. Thus necessary corrective actions can be undertaken to ensure its successful deployments.

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